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Effect of SARS-Cov-2 Vaccine Misinformation on Conspiracy Belief and Anxiety

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Abstract

Over the past two years, the SARS-CoV-2 pandemic has resulted in long-lasting damage, an increase in mood disorder diagnoses, and an increased spread of misinformation. It was this study's focus to determine whether exposure to misinformation about SARS-CoV-2 affected anxiety, conspiracy beliefs, and vaccine hesitancy. Participants completed a pre- and post-test State-Trait Anxiety Inventory for perceived anxiety measurement alongside the Perceived Stress Scale. Participants were also connected to biofeedback machines for physiological anxiety measurement. Participants completed the Conspiracy Mentality Scale, Conspiracy Belief Scale, Vaccine Conspiracy Belief Scale, and the Vaccine Hesitancy Scale for conspiracy belief measurement. It was hypothesized that exposure to misinformation would result in greater anxiety and greater conspiracy belief and vaccine hesitancy. Data suggests that exposure to misinformation resulted in greater perceived anxiety, and exposure to any SARS-CoV-2 information increased the physiological anxiety response. Results from the State Trait Anxiety Inventory and physiological anxiety suggest that any information regarding SARS-CoV-2 can be anxiety producing.

Introduction

Near the end of 2019, the SARS-CoV-2 virus (COVID-19) swept across the world and quickly reached global pandemic status in March 2020. Because COVID-19 is an airborne respiratory virus, social distancing mandates were placed into effect and "stay-at-home" lockdowns were enforced to mitigate spread and infection (*Coronavirus Disease 2019,* 2020). With everyone home, the news and social media became many people's source of information. The internet is known to be a place where one must be critical of what they encounter. However, during this time, news regarding the virus was spreading just as fast as the virus, causing many people to be overwhelmed. Eventually, misinformation about the virus began to spread as well, causing greater anxiety, stress, and fear. In fact, misinformation has built up and impacted society just as much as the virus, earning it the name "Infodemic" (Cinelli et al., 2020; Zarocostas, 2020). The Infodemic has created a greater sense of vaccine hesitancy, leading to a prolonged pandemic and multiple variant strains.

During the COVID-19 pandemic, there was a lot of information being spread regarding the virus and state of the world, often in such volume that it quickly overwhelmed the average person. Media consumption of COVID-19-related information was positively correlated with an increase in anxiety symptoms (Bendau et al. 2021). As people were sheltering at home, the only way to get information was through the media. News stations shared information as fast as it developed. On the internet, news websites updated information just as fast as television, but they also included the opinions and thoughts of everyone who wished to contribute. It is unknown how the torrent of information has affected people over time. Information, both true and false, was spread extensively throughout the first year of the pandemic. When someone scrolls through

the internet for hours on end, as was the case during the lockdown, eventually one falls victim to misinformation.

While the pandemic began with the original COVID-19 virus, it evolved into several variants over time. Each iteration has gathered momentum and spread quickly throughout unvaccinated populations, and sometimes infected the vaccinated population too. There are three major variants that have been circulating around the world: the Delta variant, the Lambda variant, and the Omicron variant (*Coronavirus Disease 2019*, 2021). Each has unique traits amd infection patterns that impacted the population. As COVID-19 has continued to spread and mutate, it has become increasingly apparent that it is here to stay. COVID-19 remains in a pandemic status due to the rate of infection, transmission, and death (Phillips, 2021; Samuel, 2021). However, if the population continues to be vaccinated and socially distance, it could achieve endemic status, much like influenza or the common cold (Phillips, 2021; Samuel, 2021). Only through the strengthening of social distancing, masking, and vaccination uptake can the spread of COVID-19 and its variants be stagnated.

Vaccine production for COVID-19 became a top priority for many governments during 2020. The United States even went as far as to put research into “Warp Speed,” and allow early use in people through emergency approval by the Food and Drug Administration (*Operation Warp Speed*, 2021). The collective work of scientists all over the world resulted in the creation of effective vaccines that offered protection against infection. Two major types of vaccines were created for use: a viral vector and one that is messenger ribonucleic acid (mRNA) based (Michel, Sauter, & Tanner, 2021). Viral vector vaccines use a modified virus that includes the spike protein of COVID-19 which allows the body’s immune system to acclimate to the virus directly without risk of infection (Michel, Sauter, & Tanner, 2021). mRNA vaccines provide the immune

system with the specific blueprint to create immune cells that can recognize the spike proteins on the COVID-19 virus (Michel, Sauter, & Tanner, 2021). mRNA vaccines are relatively new in use in the general population but are based on about 20 years of research (Schlake et al., 2012). At the beginning of the pandemic, it seemed like support for researchers and scientists was at an all-time high with between 57% and 67% of the U.S. population willing to receive a vaccine when released (Fisher et al., 2020; Malik et al., 2020; Ruiz & Bell, 2020). However, once the vaccine was developed and approved for emergency use, many people were hesitant to receive the vaccine, resulting in a slow climb to the minimum levels of herd immunity.

Although COVID-19 vaccines have been produced and administered across the world, the uptake of these vaccines has barely reached the necessary levels for herd immunity to offer greater support from infection. According to the Mayo Clinic COVID-19 vaccine tracker website, only 72.8% of eligible people have been fully vaccinated in the United States as of February 2022. To reach herd immunity, a range between 70% and 90% of the population needs to be vaccinated for effective control (*Coronavirus disease: Herd Immunity*, 2020). While the vaccination rates may be within the range of early support and low levels of herd immunity, it took a little over a year to reach that point. During this period of vaccine uptake, the mutations found within the variant strains of COVID-19 have necessitated the creation of booster vaccines. These boosters are used to restimulate one's immune system against the mutations found in the variant strains, as well as provide additional support against the original virus. According to the CDC website as of December 10th, 2021, 49.9 million U.S. citizens had received the booster, which makes up about 15.14% of the population. There is a large disparity between those who have received the full vaccine alone and those who are fully vaccinated with the booster shot in the United States. When compared to other countries, such as the United Kingdom, the disparity

is even more apparent. In the UK, around 85% of the population has been fully vaccinated, with 68% of the eligible population also receiving the booster (The Visual and Data Journalism Team, 2022). The hesitancy related to the vaccines and boosters has impacted how likely people were to receive the vaccinations, leading to more infections and deaths over time. This hesitancy may be attributed to two major things: anxiety and conspiracy theories. The uncertainty that surrounded COVID-19 near the beginning of the pandemic allowed conspiracy theories to form and influence individuals' beliefs and actions. As the pandemic continued, information regarding the virus was developed and some uncertainty went away. However, the vaccine hesitancy remained, resulting in variants of the COVID-19 virus, and prolonging the pandemic. Developing a more comprehensive understanding of the factors that contribute to vaccine hesitancy will help us resolve the COVID-19 pandemic and prevent future pandemics from arising.

During the pandemic, there was a drive to produce vaccines to protect the public against infection. However, around the world, and especially the United States, an environment of paranoia and irrationality was allowed to fester. Undeniably, there has been an increase in the creation and spread of information and misinformation. With all the uncertainty that COVID-19 has brought into the world, it is understandable that people would want to form some understanding or draw some conclusions. However, these conclusions are not always founded in fact, and can lead to serious consequences. There was already a great sense of fear and anxiety related to the virus and vaccines, but the spread of misinformation only heightens the problem. In fact, during the pandemic, there was a clear increase in the formation and diagnoses of mood disorders (DeAngelis, 2021; Fitzpatrick, Harris, & Drawve, 2020).

Misinformation can form around any topic or idea. During the COVID-19 pandemic, a major focus of the misinformation being shared was centered around the vaccines. The spread of

incorrect information about the vaccines suggests increased feelings of confusion and worry (Michel, Sauter, & Tanner, 2021). The lasting effect of the misinformation is worth study, because it can spread quickly and impact many people. The internet is a powerful tool as it can easily facilitate the spread of misinformation. As the pandemic continues the anxiety and vaccine hesitancy felt by the population has impacted our global health. The spread of misinformation can be just as dangerous as a virus. The study of misinformation is an important one as it could be a major source of anxiety, vaccine hesitancy, and conspiracy belief as time continues.

Anxiety

One of the largest problems facing our approach to COVID-19 is anxiety. Anxiety is a normal response to fearful times and uncertainty and is defined as the "anticipation of future threat [...] [and is] associated with muscle tension and vigilance in preparation for future danger and cautious or avoidant behaviors" (American Psychiatric Association, 2013). Anxiety is the activation of the sympathetic nervous system, which oversees the "fight or flight" response. If the "fight or flight" is activated for a long period of time, it can result in an anxiety disorder and/or chronic stress (*Anxiety Disorders*, n.d.). Stress and anxiety are similar and share some symptoms and triggers; but differ in other ways. The principal difference being that stress is usually caused by an external source impacting a person, and anxiety is a prolonged internal stressor (Daviu et al., 2019). Researchers can compare and contrast stress and anxiety responses to learn about the participant's external and internal stressors. The pandemic is a clear example of an external stressor. However, the impact of the pandemic may differ between individuals internally, leading it to be a source of anxiety. By studying both anxiety and stress, a better understanding of how individuals were differentially impacted may be formed, as not everyone is

affected the same way. When people are stressed and anxious, they are also more likely to experience fear. Fear is a reaction to a real threat, while anxiety is the fear related to the anticipation of a future threat (Daviu et al., 2019). The prospect of infection may lead to a greater sense of anxiety in some, while for others the ramifications on society may be more anxiety inducing. The COVID-19 pandemic offered an environment that fostered a great amount of stress, fear, and anxiety.

The pandemic and resulting lockdown were a huge source of stress and anxiety for the world. In 2020, there was a drastic increase in the reporting and diagnosis of emotional disorders (DeAngelis, 2021; Fitzpatrick, Harris, & Drawve, 2020). The fear, sadness, and anger that arose in some people began to impact their mental health and wellbeing so much that it affected their daily lives. During 2019, a monthly average of 7.4% to 8.6% of adults in the United States reported symptoms of anxiety and anxiety disorders (DeAngelis, 2021). However, during the year of 2020, that average jumped to 28.2% to 37.2% (DeAngelis, 2021). This was an unprecedented jump of about four times higher than the average reporting (DeAngelis, 2021; Fitzpatrick, Harris, & Drawve, 2020). Much of that anxiety and fear was related to the uncertainty regarding the virus and what to do moving forward. With the pandemic currently in its third year, much of the uncertainty has faded. However, the lasting impacts of the anxiety will undoubtedly play a role in the pandemic's future. Anxiety and fear are very tiring to maintain, as they are both mentally and physically draining.

Perceived anxiety is how the person feels and understands their emotions and worry. Perceived anxiety symptoms typically measure how intensely and how often a person feels anxiety, and are usually collected through self-reported surveys or questionnaires. The most common symptoms associated with anxiety are irritability, anger, insomnia, and difficulty

concentrating (*Anxiety Disorders, nd*). State and trait anxiety are common descriptors for anxiety and how it is experienced. State anxiety is how anxious a person is at the moment, while trait anxiety is how often the person feels anxious and how prone they are to experiencing anxiety (Bee et al., 2018; Grös et al., 2007). These anxiety types are generally measured separately and then compared (Bee et al., 2018; Grös et al., 2007). This allows researchers to see how individuals deal with anxiety at the moment and in their daily life. Alongside this, researchers sometimes compare the results of anxiety questionnaires to stress questionnaires. This is to help build an understanding of how stress can affect a person's anxiety, both in the short and long term. Of course, these scales can only tell researchers so much, as they rely on accurate and honest answers from participants. Additionally, if researchers ask participants to complete too many questionnaires, it can lead to response fatigue. Thankfully, there are other ways to measure anxiety that are resistant to inaccurate answers and response fatigue.

Physiological anxiety is a collection of physical symptoms that can arise from experiencing anxiety. These symptoms are related to the activation of the sympathetic nervous system and include an increased heart rate, blood pressure, sweat production, and shallow breathing (*Anxiety Disorders*, n.d.). In a "fight or flight" scenario, these responses can be the difference between life and death. However, when one experiences these symptoms chronically, it can lead to serious health problems. Physiological anxiety can appear on a spectrum, from very faint (such as feeling queasy) to very intense (a panic attack)(*Anxiety Disorders*, n.d.). These symptoms can be measured in two ways, self-reporting and using biofeedback machines (Davio et al., 2019; Gatti et al., 2018). The measurement of the physiological symptoms via biofeedback machines can be an efficient way to measure anxiety in a relatively noninvasive and quantitative way. Common biofeedback measurements are heart rate, temperature, breathing rate, and

galvanic skin response (*Biofeedback - Mayo Clinic*, 2021). These physical measures relate to how much anxiety the participant was feeling at the time of exposure. By comparing the body's responses to anxiety producing events as well as the results from anxiety questionnaires, researchers are able to get a better grasp of how a person feels in the moment of exposure. Oftentimes, research participants are exposed to pictures or videos in an attempt to see how they affect their anxiety or stress levels. The pandemic offers a unique look at a long-term societal stressor where practically all individuals were impacted in some way. By studying anxiety and stress while the pandemic is ongoing, researchers have an opportunity to see how major life-changing events may impact our society on both a personal and public level.

Misinformation and Disinformation

As the world around us has become more media-centric, misinformation and disinformation have become tied to our everyday lives. Misinformation is defined as "publishing wrong information without meaning to be wrong or having a political purpose in communicating false information" (Benklet et al., 2018 as cited in DeConinck et al., 2020). Misinformation spreads very rapidly and can be dangerous. Posting incorrect information happens at times, but it becomes a problem when it becomes widespread and impacts people's judgments and decisions. Misinformation can result in many things, from a bad decision to a life-threatening situation. In one example, there was misinformation spread about several medicines that were supposed to aid in preventing infection with COVID-19. These medicines were not intended for this use, and in a few cases not even for use in humans (Office of the Commissioner, 2021; HAN Archive, 2021). This led to hospitalizations and even some deaths (Office of the Commissioner, 2021; HAN Archive, 2021). Misinformation is constantly created and circulated on the internet, and has increased since the internet's creation. While misinformation can come from anywhere, social

media websites are near perfect breeding grounds for its formation and spread (Cinelli et al., 2020; Talwar et al., 2019). Thankfully, the problems caused by misinformation spread have gathered some attention in the past few years. Social media websites are combating misinformation by utilizing fact checking protocols and removing potentially harmful information. This is a great step forward, as in the past, there was practically no action taken to check the validity of information being posted on these websites.

Social media facilitates the sharing of thoughts, experiences, and friendships in a very streamlined way. However, the algorithms that promote these social interactions also allow the spread of misinformation. These algorithms are often complex and are used to monitor and gauge their members to show them content that matches their preferences, resulting in confirmation bias (Del Vicario et al., 2016; Talwar et al., 2019). Confirmation bias is the tendency to interact with and share information that is related to one's narrative and to ignore the rest (Del Vicario et al., 2016; Talwar et al., 2019). In addition, when a person is anxious and frightened, they are more likely to interpret information differently (Allen et al., 2014). Information that aligns with a person's confirmation bias is typically seen as trustworthy, and is not often fact-checked (Swami et al., 2011; Talwar et al., 2019). The internet is a place where anyone can voice their opinions and thoughts, and contains much information that has not been fact-checked. This often leads to confusion, speculation, and rumors. Social media can facilitate the creation of an "echo chamber," a place where there is a social homogeneity that drives the diffusion of information for a similarly minded, polarized group (Del Vicario et al., 2016). The climate of each social media app depends on the groups of people that often frequent their use (Cinelli et al., 2020). For example, Twitter users are more likely to be critical of the news they are shown on their feed when compared to GAB users (Cinelli et al., 2020). During the

pandemic, the confirmation bias and echo chambers that are formed on social media websites were centered on COVID-19 and strengthened many of the current opinions and biases that currently existed.

The impact of social media on the spread of misinformation is huge, but it also extends to disinformation. Disinformation, also referred to as conspiracy theories, is similar to misinformation with a key difference. Disinformation is "false information deliberately and often covertly spread in order to influence public opinion or obscure the truth" (Merriam-Webster, n.d.). Disinformation can be found related to any major world event, often touted as part of a government plot or conspiracy. Regarding the COVID-19 pandemic, disinformation is meant to scare people, often for political reasons. As mentioned earlier, many aspects of the pandemic have become politicized, from using masks to receiving the vaccines. In the absence of accurate information, belief in disinformation may be a rational attempt to make sense of a complex phenomenon (Swami et al., 2011). One example of this is related to the spread of COVID-19 and the belief that it originated from 5G cell phone towers. The conspiracy theory centers around the fact that many 5G towers were being constructed around the time of the initial spread of COVID-19, leading some to speculate that the two events were causal (Heilweil, 2020). This led to dozens of towers being attacked and burned with some workers being harassed and accosted (Chan, Dupuy, & Lajka, 2020). Of course, the spread of COVID-19 was not brought about by these towers, but due to the similar timing and fear of the situation, many people were convinced the two events may somehow be correlated. The COVID-19 pandemic has been a very complex series of events, leading many people to feel frightened and confused. Disinformation can be impacted by the individual's feelings of powerlessness (Swami et al., 2011). The lack of accurate

information and the size of the COVID-19 pandemic has led to a growth in the formation and spread of disinformation.

Previous belief in disinformation can impact how one views new theories. Research has noted that previous belief in one conspiracy theory makes someone more likely to believe other conspiracy theories (Swami et al., 2011). At the start of COVID-19, there was so much information on the internet that it became difficult for the average person to ensure that all of what they were being told was true. As time continued, the exposure and belief in conspiracy theories grew and impacted our society. Being introduced to misinformation only briefly can still impact a person's memory for a year after exposure (Zhu et al., 2011). There has been a clear increase in misinformation and disinformation belief over the last decade, which impacts people's judgment today. How misinformation and disinformation can impact an individual depends on how they choose to act on it. By examining how misinformation has impacted people's beliefs during the pandemic, researchers can build a better understanding of how misinformation impacts people's belief during periods of great uncertainty.

Vaccine Hesitancy

COVID-19 vaccine development was the major focus of the early days of the pandemic. At that time, many people were extremely supportive of vaccine development and were willing to accept a vaccine when it became available. However, as time continued, vaccination became politicized. Misinformation and disinformation were spread regarding the vaccines, leading many to become hesitant towards receiving the doses. The World Health Organization (WHO) includes vaccine hesitancy as one of the top ten threats to global health (MacDonald, 2015). To help understand how people develop this hesitancy, the "3 Cs" model was proposed by the WHO

EURO Vaccine Communications Working Group (MacDonald, 2015; Michel, Sauter, & Tanner, 2021). The three Cs are: Confidence, Convenience, and Complacency. By attacking these three factors, misinformation and disinformation can create vaccine hesitancy.

Confidence is the trust in the safety and effectiveness of the vaccine, in the health services that provide the vaccine, and the government that decided that the vaccines be developed (MacDonald, 2015). Misinformation and/or disinformation attempts to discredit this aspect of vaccines, because incorrect information will impact a person's understanding of the vaccine, leading to confusion and anxiety. Both mis- and disinformation created a sense of mistrust and anxiety toward the vaccine and the services that provide them (Bendau et al., 2021). Two major aspects of the vaccine have been the focus of these attacks: the potential side effects and the speed at which the vaccines were created (Geoghagan, O'Callaghan, & Offit, 2020). The exaggerated sense of danger related to the potential side effects is intended to make people worry about what would happen if they received the vaccine. One vaccine developed by the company Johnson and Johnson (J&J) could be administered in a single dose. Early in its use, several claims were made saying that the J&J shot had resulted in fatal blood clots in people (*Information about the J&J Vaccine*, 2021). While this did occur, the frequency of the event was blown out of proportion. Misinformation reported that these clots were common in people receiving the J&J shot, when in actuality it only occurs in 3.83 cases per million doses (*Information about the J&J Vaccine*, 2021). Fear is a strong tool for misinformation and disinformation, as it creates a "knee-jerk reaction" and leads to an incorrect preconceived notion toward the vaccines. After several years of the pandemic and bombardment of misinformation, it is unknown how confident people feel about the vaccine. Just because someone received the vaccine, it does not mean that they entirely trust it.

Alongside the fear of the dangerous side effects, the speed at which the vaccine was developed was called into question. Since the vaccine was developed quickly, many believe it must contains dangerous or unethical materials or be unsafe for use. Evidence supports that the vaccines work and are safe for use, but the spread of misinformation/disinformation has impacted inspired a lack of confidence. Many people have said that they are uncertain about receiving the vaccine due to their lack of knowledge about what is in the vaccines (Subbarao and Nature Editorial, 2020; Salnero et al., 2021). The Center of Disease Control website offers a list of the ingredients within the different vaccines and what each ingredient does for each vaccine. However, even though this information is available, this has not changed some people's mind. Confidence in the services that administer the vaccine and are important for the vaccination effort. Previous injustices against minorities and under-represented groups have caused their distrust of the medical field and the facilities giving vaccines (Subbarao and Nature Editorial, 2020). These groups are justified in their distrust, however, their hesitancy places them at risk of infection. Confidence in the vaccines themselves is extremely important moving forward (Chou & Budenz, 2020). Therefore, an important step moving forward, the bonds of trust must be built between these groups and the institutions. In doing so, it will not only benefit those who are still uncertain about the vaccine, but will also build trust in other aspects of healthcare for these groups. However, confidence is not built quickly, as actions will always be greater than words. Using misinformation or disinformation to attack the confidence in the vaccines causes long-lasting damage, especially when they attack the other aspects of the 3 "Cs".

Convenience is an important factor in vaccine distribution. To maximize the number of people vaccinated, there must be an abundance of the vaccine, and it must be readily available. Due to the limited number of vaccines available at the beginning of its distribution, vaccines

were allotted to those at the highest risk (Healy et al., 2020). This choice was justified, however it did draw the attention of those who wished to spread disinformation. One such conspiracy theory was that the rich and powerful were behind the spread of COVID-19 as a population control tactic, and those who received the vaccine were going to be the "sheep" to their "shepherd" (Lynas, 2020). The lack of convenience along with misinformation and disinformation factors in a greater sense of hesitancy towards receiving the vaccine. Since the beginning of the rollout, there has been an increase in the convenience of vaccines available in many developed countries, with almost all doctor offices and pharmacies offering to give vaccinations. However, developing countries, like South Africa, have had a much more limited supply of available vaccines (Peralta, 2021). South Africa began to manufacture the J&J vaccine, but had to destroy what they created due to contaminated ingredients from the United States (Peralta, 2021). Additionally, they had to create deals and pay extra to keep the viable doses they had made (Peralta, 2021). South Africa has asked for other countries to donate some of their immense stockpiles and received limited aid. The result of a limited supply is a greater unvaccinated population, increasing the chance of COVID-19 to spread and mutate. COVID-19 continues to mutate, infect, and spread, which fuels the anxiety and stress surrounding it.

Complacency is the last C of this model and plays a more passive role than the other two. The need for a person to receive a vaccine influences the likelihood of them taking it (Michel, Sauter, & Tanner, 2021). Similar to when a person tells another to complete a task, they are suddenly less interested in completing it. When the vaccine is necessary for people to take, the expected outcome is for everyone to be on-board and willing. However, this was clearly not the case when the vaccines were first released. Vaccine hesitancy due to complacency is also seen with other common vaccines, like the influenza vaccine (Ling, Kothe, & Mullan, 2019). With

COVID-19, choosing to not vaccinate is dangerous, as it leaves oneself open to infection, hospitalization, or even death. Complacency is the hardest hill to climb at this point in the pandemic. Since vaccination numbers are not at herd immunity levels, the chances of the virus mutating and the effectiveness of the vaccine decreasing grows. In order to get the most people to vaccinate, the 3 C's model must be followed and supported. They must be confident in the vaccine and the services that provide them, the vaccines must be convenient and readily available, and if they choose to remain complacent in their vaccination they may be able to do so (Chou & Budenz, 2020; MacDonald, 2015). However, this is extremely difficult to achieve while conspiracy theories and risk circulate. Studying misinformation is important due to its tendency to increase belief in conspiracy theories and inaccurate information. By studying COVID-19 misinformation specifically, a greater understanding of how it affects belief in conspiracy theories and vaccine hesitancy can be achieved. The impact of the pandemic on conspiracy theory belief provides a unique variable in how individuals interact with misinformation and how beliefs form and change.

Since the start of the pandemic in 2019, there has been an ever-growing number of infected individuals. The infection rate has fluctuated over time, ebbing and flowing with the season and current variant. Many individuals can recover to varying degrees from their infection. According to the CDC, there has been a total of 80.1 million cases of COVID-19 reported within the United States (Center for Disease Control, 2021). This number could be larger, as this is only reported cases. However, it is important to speculate how previous infection might impact a person's perception of this virus and the need for vaccines. For some, it led them to go against their previous hesitancy towards receiving the vaccine (Healy, 2021). The impact of the infections on them and their families cut through the misinformation and disinformation they had

encountered, and some went so far as to publicly speak out against the incorrect information. However, this group is not homogenous, as many were still against receiving the vaccine even as they are being treated for COVID-19 in the hospital (Healy, 2021). As the time has continued, the COVID-19 virus has seemingly disappeared into the background for many people, almost becoming an inconvenience. With 71% of the U.S. population vaccinated, the idea of infection may appear to be uncommon to most people. However, the vaccines only protect a person so much and as variants appear, the vaccines become less effective. The use of the booster vaccines then becomes more important. However, only about 45.5% of the U.S. population has received the booster. So, an important question to consider, is how does previous infection impact one's perception of the vaccine?

Current Study

In this study, a deeper look into how misinformation impacts vaccine hesitancy and anxiety was conducted. Anxiety was measured over time using two instances of the State Trait Anxiety Inventory and biofeedback machines using a within-subjects design. This was done to simulate anxiety responses after exposure to pandemic-related information. The information, either accurate information or misinformation, was presented using a between-subjects design. Both time and information presented were manipulated variables. Additionally, previous COVID-19 infection information was collected as a manipulated variable. The measured variables were anxiety, conspiracy belief, and vaccine hesitancy. It was expected that those exposed to the misinformation condition would have a stronger physiological anxiety response, more perceived anxiety, a greater conspiracy belief, and a greater hesitancy to vaccine uptake. For those who were previous infected with COVID-19, it was hypothesized that they would

score lower on conspiracy belief and vaccine hesitancy when compared to those who were not previously infected after exposure to the information condition.

Materials and Methods

This study was approved by the Institutional Review Board (IRB) for Human Subjects Research on October 21st, 2021. The IRB approval number was LHS2122038.

Participants

Demographics

The participants were college-age students at a university in central Virginia, averaging 19.98 (*SD* = 1.72) years of age. The total number of participants was 58. There was a total of 33 participants who identified as female, 19 who identified as male, 1 who identified as transgender male, and 6 who identified as non-conforming or nonbinary. Additionally, there were 9 who identified as Black or African American, 1 who identified as American Indian/Alaskan Native, 45 who identified as White, 5 who identified as Hispanic/Latino/Spanish Origin, and 3 who identified as Multiracial/Other. Political affiliation was also asked, and it was found that 11 participants were Republican, 23 were Democratic, 19 were Independent, and 5 identified as Other. Generalized media consumption was also a source of demographic data that was asked. It was found that 6 participants received their information from television, 23 from social media, 21 from internet/websites, and 9 from friends and family. Lastly, the participants were asked if they had ever been diagnosed with COVID-19, to which 15 said yes. For demographic information, see Table 1.

Recruitment

The students were recruited in two ways: email and class participation. An email was sent to all university students discussing the generalities of the current study. To limit potential

biasing of participants, the details regarding the vaccine misinformation condition were excluded in the email (Appendix A). In the email, participants were made aware of the biofeedback machines, SARS-CoV-2 contact tracing, and required face masking. The other method of participation recruiting was through class participation. In an introductory psychology class, class credit was awarded to students who took part in studies. A total of fourteen days were set aside in the class for study participation, in which experiments were conducted by the researcher. Outside of the class time, participants were able to set up a 30-minute appointment via email.

Physiological Data

Physiological anxiety was measured during the misinformation/accurate information section of the procedure. This was achieved by using machines that recorded biofeedback, specifically galvanic skin response (GSR) and heart beats per minute. The materials used in this experiment were from the IXTA-(iWorx Teaching Assistant) Biofeedback kits. The machine responsible for the recording of the information was the IX-TA-220 recorder, which translated the data received into the recording software, Labscribe. GSR was recorded using C-ISO-GSR electrodes that sat on the patient's index and ring fingers of their dominant hand. These electrodes were connected to the iWire-B3g biopotential module that translated the data into the recorder. To help facilitate the recording of the response, a paste made of 0.5% saline and a neutral base was used on the patient's fingers. Heart rate was measured using a PT-104 Pulse electrode, which sat on the pad of the patient's thumb or middle finger. The physiological data was separated into a midline and post-test interpretation. The patient would spend the first two minutes connected to the machine and not exposed to the information condition. This was to ensure a clear baseline for their GSR and heart rate for comparison purposes. The sections used

for analysis were the pre-test and post-condition areas, which sat at the halfway point and immediately after the condition had ended.

Perceived Anxiety

The State-Trait Anxiety Inventory measures the participant's anxiety in a given moment or in general (Spielberger, Gorsuch, & Lushene, 1970). Form Y-1 is focused on the anxiety levels of the participant at the moment they take the questionnaire. It uses a four-point Likert scale that is supposed to indicate how much the participant feels that statement applies to them. The scale ranges from 1, meaning "Not at all," to 4, meaning "Very much so". To quantify the participant's anxiety, the answers are totaled. An example statement is, "I am tense,". The participant would choose how much this applies to them. In some instances, the scales are reversed in meaning, typically for words/phrases not associated with anxiety. Such as "I feel calm". These are denoted with stars in Appendix D. The greater the score, the greater the participant's anxiety in the given moment. The minimum scoring possible is 20 and the highest being 80, with a general understanding of 40 suggesting clinically significant symptoms of anxiety (Julian, 2011). This difference in scores between the pre-test and post-test was analyzed in this study as a measure to see if the introduction of vaccine misinformation played a role in perceived anxiety.

Perceived Stress

The Perceived Stress Scale was developed to measure stress and how the participant perceives and understands their own stress (Cohen and Williamson, 1988). It is measured through 14 questions on a five-point Likert scale, focused on the last month of the participant's life. The Likert scale asks how likely the events of each question have occurred within the past month between "0" meaning never, to "4" meaning very often. There are seven positive stated questions that are reversed (0=4, 1=3, etc.) and are marked in Appendix E with an asterisk. After

reverse coding, the totals are summed together to result in a score that is an estimate of how much stress has been affecting the participant in the past month. The greater the score, the greater the amount of perceived stress on the participant.

Vaccine Hesitancy

The Adult Vaccine Hesitancy Scale (aVHS) is a modified 10-item scale used to assess how hesitant a person is in receiving vaccines. Akel et al. altered the original Vaccine Hesitancy scale to better fit all adults rather than just parents (2021). Additionally, they tested how the negatively worded questions impacted the results of the scale. Akel et al. were able to find both concurrent and content validity for their altered scale. This questionnaire uses a five-point Likert scale ranging from 1 to 5 Seven of the items were reverse-coded, so a higher number represented a higher level of hesitancy and are denoted using stars in Appendix F. After reverse-coding, the scores of each of the questions are added up, ranging from 10 to 50. If a participant scores above 25, they are understood to be vaccine hesitant.

Conspiracy Belief

Two scales were used to measure conspiracy theory belief. One is a scale for generalized conspiracy belief, and the other is specifically for vaccine conspiracy belief. The generalized conspiracy belief scale was developed by Bruder et al. to find a useful tool for researchers to measure conspiracy belief through a straightforward questionnaire (2013). This generalized scale is made up of five questions that attempt to focus on the conspiratorial views of the world (Appendix G). The participants read the statements and answer on an 11-point Likert scale how likely they are to believe the statements. For example, a score of 0 would mean 0% and a score of 10 would mean 100%. An example statement from the scale is, “I think that government

agencies closely monitor all citizens". To analyze the data, one would add up all the scores from each question. The greater the number, the greater the general conspiracy belief.

Another scale was used for specific vaccine conspiracy theory beliefs. Shapiro et al. combined questions from previous research and included questions regarding more common and frequently occurring conspiracy theories regarding vaccines (2016) (Appendix H). They created a seven-question scale that uses a seven-point Likert scale, where 1 means "Strongly Disagree" and 7 means "Strongly Agree". Participants indicate how much they agree or disagree with the statements. For example, "People are deceived about vaccine efficacy". To analyze the data, the answers for each statement are summed together and the greater the score, the greater the conspiracy theory belief related to vaccines. Together, both scales paint a picture of how the participant views and believes in conspiracy theories.

Procedure

Once an appointment had been created, participants were asked to arrive on time. The room that was used was sanitized alongside the equipment and computers. Masking and social distancing protocols were used to limit any potential spread of SARS-CoV-2. Participants were brought into the room and given an ID number based on their chronological order and information condition (i.e. 001F or 002M). To determine the information condition, the researcher used a coin flip program where Heads was the accurate information condition and Tails was the misinformation condition. Once given an ID number, the participant was asked to read and sign the informed consent waiver and SARS-CoV-2 Addendum. If completed, the participant was then asked to fill in the Pre-Test questionnaire (Appendix B). The Pre-Test questionnaire was composed of the demographic information and the preliminary Form Y-1 State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970). Once finished, the

researcher would move the computer aside and attach the biofeedback diodes. The biofeedback machines measured galvanic skin response (GSR) and heart beats per minute. To facilitate measuring the biofeedback, a paste of 0.5% saline in a neutral base was used to amplify the readings of the GSR electrodes and was placed on the fingers of the participant. The GSR electrodes were attached to the participant's index and ring fingers, and the pulse monitor was attached to the thumb or middle finger of their dominant hand. The participant was asked to keep their hands still during the recording period, which lasted for the duration of the vaccine information condition. Before the video began, a period of two minutes was set aside to act as a baseline comparison for the potential physiological anxiety information. The script and slides used for both vaccine information conditions are in Appendices C and D respectively. Once the video was completed, the researcher removed the electrodes from the participant's hand. Once removed, the participant was then asked to complete the Post-Test survey. This survey was composed of the following: Post Form Y-1 State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970), Perceived Stress Scale (Cohen and Williamson, 1988), Adult Vaccine Hesitancy Scale (Akel et al., 2021), Conspiracy Mentality Scale (Bruder et al. 2013), and the Vaccine Conspiracy Belief Scale (Shapiro et al., 2016). Once completed, the participant was then thanked for their participation and asked to leave. Afterwards, the room and equipment was sanitized and left to sit for several minutes to help mitigate the potential spread of SARS-CoV-2.

Results

Anxiety

In this study, the goal was to determine if exposure to information related to the COVID-19 vaccines impacted the participant's anxiety and conspiracy belief. It was hypothesized that exposure to misinformation would result in greater anxiety. A 2 (Time) x 2

(Information Condition) mixed-model ANOVA was conducted to measure how these variables impacted perceived anxiety. The ANOVA showed that the main effect for time was not significant, $F(1, 56) = .02$, $p = .89$. Therefore, there was no noticeable difference between the pre-exposure condition ($M = 35.33$, $SD = 12.09$) and the post-exposure condition ($M = 35.09$, $SD = 13.41$). A significant main effect for the information condition was calculated, $F(1, 56) = 4.26$, $p = .04$. Thus, the perceived anxiety was greater in the misinformation condition ($M = 38.47$, $SD = 14.79$) than in the accurate information condition ($M = 32.17$, $SD = 9.67$). Finally, the interaction effect between time and information was found to be non-significant, $F(1, 56) = 3.71$, $p = .06$. See Table 2 for the descriptive statistics. The hypothesis was partially supported because while time and the interaction did not impact perceived anxiety, the exposure to the information condition did play some role on the anxiety of the participants.

Physiological responses consistent with anxiety were also measured through biofeedback machines, specifically heart rate (HR) and Galvanic Skin Response (GSR). It was hypothesized that heart rate would increase after being exposed to misinformation. A 2 (Time) x 2 (Information Condition) mixed-model ANOVA revealed that the main effect for time was statistically significant, $F(1, 56) = 7.86$, $p = .01$. This shows that heart rates up to the midpoint of the exposure ($M = 57.64$, $SD = 30.41$) were statistically different when compared to heart rates after the midpoint ($M = 62.99$, $SD = 32.14$). Additionally, the ANOVA showed that the information condition did not significantly impact the HR, $F(1, 56) = .001$, $p = .97$. There was no noticeable difference in the HR when exposed to the accurate information condition ($M = 60.19$, $SD = 34.55$) when compared to the misinformation information condition ($M = 60.45$, $SD = 27.97$). Additionally, there was no significant interaction for time and HR, $F(1, 56) = .253$, $p = .62$. See Table 2 for descriptive statistics. The hypothesis was not supported as the effect of the

information condition played no significant role and heart rate differed significantly over time regardless of the condition.

Galvanic skin response was also used to measure physiological anxiety over time. It was hypothesized that the GSR scores would increase over time, and would have greater scores when the participant was exposed to the misinformation condition. A 2 (Time) x 2 (Information Condition) mixed-model ANOVA calculated that the main effect of time was not significant F (1, 56) = .280, p = .60. Therefore, there was no statistical difference in the GSR scores over time before the midpoint (M = 6.85, SD = 2.78) and after the midpoint (M = 6.86, SD = 2.79). Additionally, there was no significant effect of the information condition on GSR scores, F (1, 56) = .001, p = .61. So, the GSR scores did not differ between the accurate information condition (M = 7.04, SD = 2.86) and the misinformation condition (M = 6.66, SD = 2.74). Finally, there was no significant interaction between time and the information condition on the GSR scores, F (1, 56) = .253, p = .56. See Table 2 for descriptive statistics. The hypothesis was not supported.

To see a broader representation of the anxiety felt by the population, a look at the perceived stress of the participant was measured. An independent samples t-test was completed to see the impact of the information condition on the perceived stress of the participant. It was hypothesized that those exposed to the misinformation would score higher on the scale. Participants exposed to the misinformation condition (M = 31.14, SD = 8.30) had no significant difference in perceived stress when compared to those in the accurate information condition (M =28.23, SD = 8.25), t(56) = 1.34, p = .62. Therefore, there was no significant difference between the information condition and the perceived stress, which refuted the hypothesis. See Table 2 and Table 3 for descriptive statistics.

Conspiracy Belief

It was hypothesized that exposure to misinformation would result in a greater sense of conspiracy belief. Conspiracy belief was measured through the Adult Vaccine Hesitancy Scale (aVHS), Conspiracy Mentality Scale (CMS), and the Vaccine Conspiracy Belief Scale (VCBS). It was hypothesized that exposure to misinformation would result in a greater score on the Vaccine Hesitancy Scale. Those exposed to the misinformation condition ($N = 28$) had a mean of 22.79 ($SD = 7.43$) and those exposed to the accurate information condition ($N = 30$) had a mean of 19.00 ($SD = 8.15$). Using an alpha level of .05, the results show that there was no significant difference between the means, $t(56) = 1.34$, $p = .62$, which refutes the hypothesis. See Table 2 and Table 3 for descriptive statistics.

It was hypothesized that exposure to misinformation would result in a greater conspiracy belief on the Conspiracy Mentality scale. Those exposed to the misinformation condition ($N = 28$) had a mean of 33.36 ($SD = 8.77$), and those exposed to the accurate information condition ($N = 30$) had a mean of 29.43 ($SD = 11.05$). Using an alpha level of .05, the results show that there was no significant difference between the means, $t(56) = 1.49$, $p = .40$, which refutes the hypothesis. See Table 2 and Table 3 for descriptive statistics.

To see how vaccine related misinformation affected vaccine conspiracy theory belief, the participants were asked to complete the VCBS. It was hypothesized that exposure to misinformation would result in a greater score on the VCBS. Those exposed to the misinformation condition ($N = 28$) had a mean of 22.43 ($SD = 11.04$) and those exposed to the accurate information condition ($N = 30$) had a mean of 17.80 ($SD = 9.51$). Using an alpha level of .05, the results show that there was no significant difference between the means, $t(56) = 1.74$, $p = .38$, which refutes the hypothesis. See Table 2 and Table 3 for descriptive statistics.

Previous COVID-19 Infection

In this study, the goal was to see how exposure to information related to the COVID-19 vaccines impacted the participant's anxiety and conspiracy belief. It was hypothesized that exposure to misinformation would result in greater conspiracy belief, and that those who were previously infected with COVID-19 would have a lesser conspiracy belief. To measure this, a 2 (Previous Infection) x 2 (Information Condition) factorial ANOVA was conducted to measure how these variables impacted conspiracy belief via the Conspiracy Mentality scale. The ANOVA showed that the main effect for COVID-19 diagnosis was not significant, $F(1, 56) = 1.44$, $p = .24$. Therefore, there was no significant difference between the previous infected group ($M = 34.07$, $SD = 10.39$) and the non-infected Group ($M = 31.33$, $SD = 10.12$). The ANOVA showed that the main effect for the information condition was not significant, $F(1, 56) = .324$, $p = .57$. Therefore, there was no significant difference between the accurate information condition ($M = 29.43$, $SD = 11.05$) and the misinformation condition ($M = 33.46$, $SD = 8.77$). Finally, the interaction effect between previous infection and information was found to be non-significant, $F(1, 56) = 2.04$, $p = .16$. The hypothesis was not supported, as the data suggests that neither condition played a significant role in the participant's conspiracy mentality.

It was hypothesized that exposure to misinformation would result in greater vaccine conspiracy belief, and that those who were previously infected with COVID-19 would have a lesser vaccine conspiracy belief. To measure this, a 2 (Previous Infection) x 2 (Information Condition) factorial ANOVA was conducted to measure how these variables impacted conspiracy belief via the Vaccine Conspiracy Belief scale. The ANOVA showed that the main effect for COVID-19 diagnosis was not significant, $F(1, 56) = 0.05$, $p = .95$. Therefore, there was no significant difference between the previous infected group ($M = 20.27$, $SD = 7.7$) and the non-infected Group ($M = 19.95$, $SD = 11.33$). The ANOVA showed that the main effect for the

information condition was not significant, $F(1, 56) = .233$, $p = .63$. Therefore, there was no significant difference between the accurate information condition ($M = 17.8$, $SD = 9.5$) and the misinformation condition ($M = 22.43$, $SD = 11.04$). Finally, the interaction effect between previous infection and information was significant, $F(1, 56) = 4.76$, $p = .03$. See Figure 1 for data analysis. The hypothesis was partially supported, as the interaction between the variables played a role in the participant's vaccine conspiracy belief.

It was hypothesized that exposure to misinformation would result in greater vaccine hesitancy, and that those who were previously infected with COVID-19 would have a lesser vaccine hesitancy. To measure this, a 2 (Previous Infection) x 2 (Information Condition) factorial ANOVA was conducted to measure how these variables impacted conspiracy belief via the Asult Vaccine Hesitancy scale. The ANOVA showed that the main effect for COVID-19 diagnosis was not significant, $F(1, 56) = 0.076$ $p = .78$. Therefore, there was no significant difference between the previous infected group ($M = 21.4$, $SD = 5.05$) and the non-infected Group ($M = 20.63$, $SD = 8.81$). The ANOVA showed that the main effect for the information condition was not significant, $F(1, 56) = .613$, $p = .44$. Therefore, there was no significant difference between the accurate information condition ($M = 19.00$, $SD = 8.15$) and the misinformation condition ($M = 22.79$, $SD = 7.43$). Finally, the interaction effect between previous infection and information was found to be non-significant, $F(1, 56) = 2.98$, $p = .09$. The hypothesis was not supported, as the data suggests that neither condition played a significant role in the participant's vaccine hesitancy.

Discussion

In this study, it was hypothesized that exposure to vaccine misinformation would result in a greater perceived anxiety, greater physiological anxiety response, and a greater conspiracy

belief. It was believed that exposure would increase anxiety in the participant, as much of the misinformation and disinformation surrounding the COVID-19 vaccine misinformation impacts the confidence in the vaccines. By reducing the confidence in the vaccine, the misinformation theoretically led to greater anxiety as the participant began to worry. However, the results of this study show a mixed result from this.

Anxiety in the participants was measured through perceived anxiety and physiological anxiety responses. Perceived anxiety was used as a way to see how the participant thought they felt in the moments before and after exposure to the information. By having the participants report how they felt, a better idea of how they would feel after exposure to misinformation online could be gathered. The results of this study showed that exposure to vaccine misinformation led to a greater perceived anxiety within the participants. This is consistent with the thought that vaccine misinformation that targets the 3 Cs of vaccine hesitancy would result in a greater sense of worry and hesitancy toward the vaccine through the production of anxiety (MacDonald, 2015; Michel, Sauter, & Tanner, 2021). The STAI mean score of the misinformation condition was close to being clinically significant of an anxiety disorder. Meaning that after exposure to misinformation, some participants were scoring high enough to be considered for more anxiety testing and potentially diagnosis (Bee et al., 2018; Grös et al., 2007). Since this is perceived anxiety, the participant is reported how anxious they are feeling at the moment. Even though the pandemic has continued for several years, the impact of COVID-19 information still impacts the participant's anxiety. If generalized outside of this study, we would expect to see the same increase in anxiety in most people in the population. This trend of increasing anxiety has been noticed by other researchers. During 2020, there was an increase of reporting and diagnoses of anxiety, which supports the findings of this experiment (DeAngelis, 2021; Fitzpatrick, Harris, &

Drawve, 2020). However, by knowing that exposure to COVID-19 misinformation can cause an increase in perceived anxiety, a deeper look into misinformation's long-term impacts is recommended.

Perceived anxiety was only a part of what was evaluated, as the physiological responses were also measured for comparison. By using both, the participant's anxiety can be measured more efficiently and with a smaller margin of bias. The physiological results reported that after exposure to COVID-19 information, the heart rate of the participant increased. This trend did not take the information condition into account, instead exposure to any information regarding COVID-19 elicited the increase in heart rate. This suggests that the information itself increased the anxiety of the participant, at least physically. A person may undergo an anxiety response and not perceptually feel the anxiety. The long-lasting health impacts of unnoticed anxiety can result in serious issues, as anxiety can impact almost all parts of the body. Comparing the results of the perceived anxiety and physiological anxiety shows a unique outlook at how the participants interpret the COVID-19 vaccine information. After exposure to either information condition, the participants had an elevated heart rate, however those exposed to the misinformation condition were more likely to report feeling anxious. This trend does follow the general increase in anxiety and mood disorder diagnoses during the COVID-19 lockdown (DeAngelis, 2021; Fitzpatrick, Harris, & Drawve, 2020). Since the COVID-19 pandemic and lockdown has been a stressful series of events, the perceived stress of the participants was also measured to see if it played a role. The stress was measured and compared against the information condition to see if it was impacted by the information provided. However, the stress was not impacted by the information, showing that the anxiety response of the participants in the experiment was due to an internal stressor as opposed to an external one.

There was also the hypothesis that exposure to misinformation would increase conspiracy belief and vaccine hesitancy in the participants. However, this hypothesis was not supported as the conspiracy belief and vaccine hesitancy variables were not impacted by the exposure. There could be several explanations for why this could have occurred, but it was most likely due to a mixture of confounding factors. The hypothesis was formed based on the idea that misinformation surrounding COVID-19 vaccines would increase participant vaccine hesitancy by heightening the participant's anxiety regarding the vaccines. By attacking the three Cs of vaccine hesitancy, misinformation works to increase fear and anxiety towards the vaccines and thus increase hesitancy towards vaccine uptake (MacDonald, 2015; Michel, Sauter, & Tanner, 2021). However, the results did not support this hypothesis and instead showed that the vaccine misinformation had no impact on vaccine hesitancy. While the anxiety felt by the participants was found to be impacted, the hesitation towards the vaccines was unchanged. A potential confounding factor was that the participant group at the University were mandated to receive the COVID-19 vaccine to attend in person classes in the 2021-2022 academic year. Since the participants had already taken the vaccine and/or the vaccine booster months prior to the experiment, this most likely played a role in how they interpreted the misinformation condition, as they had first-hand exposure to how the vaccine affected them. It is hard to fear taking the vaccine if one has already received it and noted its effect on their body and immune system. Another potential reason is that the misinformation condition was too short of an exposure. Exposure to a single information session is unlikely to greatly impact one's preset notions towards an idea or belief. Many scientists and officials have been working to combat misinformation and have launched campaigns to highlight and disprove the misinformation surrounding the COVID-19 vaccines. The pieces of misinformation used in the experiment were

from more common conspiracy theories, so the participants may have been previously exposed to these pieces of misinformation and the information that disproves them. The role of the internet also could have played a major confounding role.

The internet became a very central part of life during the COVID-19 pandemic, especially during the lockdown. This is still the case for most of the participants, as about 76% of the participants received their news from online sources and/or social media. The internet is the greatest source of misinformation in the world, and it is not well policed when it comes to misinformation (Cinelli et al., 2020; Talwar et al., 2019). Some social media pages have been fighting misinformation through fact-checking. However, the websites are not able to search every post or website shared. Over the past two years, the participants were likely exposed to large amounts of information regarding COVID-19, a sizable portion of which was likely misinformation. Therefore, this previous exposure could have led to a desensitization effect, where the inaccurate information is easily brushed off and not considered deeply, so it does not impact the participant's belief system. As mentioned before, social media often shows users' information they are more willing to interact with (Del Vicario et al., 2016; Talwar et al., 2019). Therefore, people are more likely to interact with information and posts that already match their belief, leading to a confirmation bias (Del Vicario et al., 2016). So, if the participants were to be exposed to information that goes against their confirmation bias, they would be less likely to "interact" with the information; thus leading to a lessened effect on their current beliefs and therefore no increase in conspiracy belief or vaccine hesitancy.

In contrast to this, when previous COVID-19 infection was considered, there was an impact on participant vaccine conspiracy belief. It was expected that those who were previously infected would score lower on the conspiracy belief scales after exposure to the information

conditions. When analyzed, the data showed an interesting disparity. Those who previously had COVID-19 and were exposed to the accurate information condition scored higher on the Vaccine Conspiracy Belief scale when compared to those who were exposed to the misinformation condition (Figure 1). This went against the hypothesis that the exposure to misinformation would result in a greater conspiracy belief. Those who did not have COVID-19 scored as expected on the scale. There are a few possibilities for these unique findings, however it is only speculation at this point. It could be that population size of both groups played a role in the overall scoring, as there may have been greater outliers in the scores of those who were previously infected. Due to the limited size, if one or two participants scored markedly higher on the scale, it could have influenced the results. However, if this was not the case, the scores could show that those who were infected with the virus and were exposed to misinformation were more likely to disagree with the vaccine conspiracy statements due to their previous exposure to the virus, thus validating its existence and the necessity for the vaccine. On the other hand, those who were not infected and exposed to misinformation, were more likely to score higher, perhaps due to their full breadth of knowledge. A direct comparison of how individuals perceive the virus after infection would be unique, since there are indications that it has little influence with some people's thoughts and beliefs (Healy, 2021). This is certainly worth a more in-depth study to see how much of an impact previous infection may have towards the perception of the virus and the information surrounding it.

Limitations and Improvements

This study did have several limitations that could have impacted the results and measurements gathered. The sample size was relatively small at 58 participants, meaning that the results could have been impacted by a few outliers. Additionally, the participant group was

relatively homogenous. Many of the participants were young, Caucasian, vaccinated or masked, and college educated. This lack of diversity means that the results gathered here cannot be used to make generalizations about the larger population surrounding the University. There is a decent chance that if a greater number of participants were gathered with greater diversity, that the results could be different from what is reported here. There is a chance that the greater diversity would lead to a noticeable increase in conspiracy belief and vaccine hesitancy after exposure to misinformation. Gathering a group from more walks of life and beliefs may lead to this change due to the varying levels of applied critical thinking and confirmation bias. Additionally, it could be that there will be a greater anxiety response seen in individuals of different age ranges or vaccination status. Additionally, there may be a noticeable impact on vaccine hesitancy and conspiracy belief

Alongside this, there were some errors in the data collection. The scales were used and interpreted correctly, however there may have been other scales that could have been more effective for the purposes of this study. The use of the same anxiety scale for perceived anxiety measurement change may have influenced the answers of the participant, perhaps leading them to mark the same answers to the same questions. If possible, finding an anxiety questionnaire dedicated to measuring change in perceived anxiety will be immensely beneficial to researchers if this did play a role. Additionally, the biofeedback machines were useful tools for the purposes of measuring physiological anxiety, however they did have problems. For some participants, the biofeedback machines did not record their physiological data, which with the small sample size could have skewed the data significantly. To improve upon this, it may be worthwhile to consider more scales and measurements of biofeedback. Use of a more accurate machine may aid in the measurement of anxiety. Additionally, future researchers should inquire about alternative means

of measuring physiological anxiety, such as breathing rate. In doing so, future research may be more accurate in their interpretation.

Implications

The COVID-19 pandemic will be a period of time that will define a part of the 2020-2030 decade. It will have lasting effects on all those who have lived through it. The fear, anxiety, and stress felt by people have impacted on their physical and mental wellbeing. The pandemic offered a perfect breeding ground for misinformation and disinformation to form and spread and impact both critical thinking and non-critical thinking individuals. By studying the impact of misinformation during the pandemic, a realistic understanding of this point of history can be recorded and used to benefit others. While the results of this study were mixed, it does show that this aspect of our lives is worth studying, as even a small impact can snowball into something major. The results of this study cannot be generalized to other groups, and thus has a limited potential. This study attempted to measure the impact of misinformation on the participant's anxiety and conspiracy belief in a laboratory setting. Since it took place in a laboratory setting, the results could have been impacted by the environment. Therefore, I recommend exploring if exposing the participant to the information in a naturalistic setting, such as through a conversation with someone or through social media, would result in different conclusions. If this is done, the results may be more beneficial for academic use, as most individuals will be exposed to misinformation in a natural setting.

References

Akel, K.B, Masters N.B, Shih S.F, Lu Y, Wagner A.L. (2021). Modification of a vaccine hesitancy scale for use in adult vaccinations in the United States and China, *Human Vaccines Immunotheroeutics*, 17(8), 2639-2646. https://doi.org/10.1080/21645515.2021.1884476

Allen, D.K, Karanasios, S. & Norman, A. (2014). Information sharing and interoperability: The case of major incident management, *European Journal of Information Systems*, 23(4), 418-432.

American Psychiatric Association. (2013). Anxiety Disorders. In *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing. Arlington, VA.

Anxiety Disorders. (n.d.). National Institute of Mental Health (NIMH). https://www.nimh.nih.gov/health/topics/anxiety-disorders

Ball, P. & Nature Editorial. (2020, December 18). *The lightning-fast quest for COVID vaccines — And what it means for other diseases*. Nature. https://www.nature.com/articles/d41586-020-03626-1?error=cookies_not_supported&code=5c4fc7b5-c7f5-4473-9acb-7fd4d03e20e4. https://doi.org/10.1038/d41586-020-03626-1

Bee Seok, C., Abd Hamid, H., Mutang, J., & Ismail, R. (2018). Psychometric Properties of the State-Trait Anxiety Inventory (Form Y) among Malaysian University Students. Sustainability, 10(9), 3311. https://doi.org/10.3390/su10093311

Bendau, A., Petzold, M. B., Pyrkosch, L., Mascarell Maricic, L., Betzler, F., Rogoll, J., Große, J., Ströhle, A., & Plag, J. (2021). Associations between COVID-19 related media

consumption and symptoms of anxiety, depression and COVID-19 related fear in the general population in Germany. *European Archives of Psychiatry and Clinical Neuroscience, 271*(2), 283-291. https://doi.org/10.1007/s00406-020-01171-6

Bendau, A., Plag, J., Petzold, M. B., & Ströhle, A. (2021). COVID-19 vaccine hesitancy and related fears and anxiety. *International Immunopharmacology, 97*, 107724. https://doi.org/10.1016/j.intimp.2021.107724

Biofeedback - mayo clinic. (2021, March 18). *Mayo Clinic*. https://www.mayoclinic.org/tests-procedures/biofeedback/about/pac-20384664mk877

Bruder, M., Haffke, P., Neave, N., Nouripanah, N., & Imhoff, R. (2013). Measuring individual differences in generic beliefs in conspiracy theories across cultures : Conspiracy Mentality Questionnaire.*4*. https://doi.org/10.3389/fpsyg.2013.00225

Cavanaugh, A. M., Spicer, K. B., Thoroughman, D., Glick, C., & Winter, K. (2021). Reduced risk of reinfection with SARS-CoV-2 after COVID-19 vaccination — Kentucky, May–June 2021. *MMWR*, *70*(32), 1081–1083. https://doi.org/10.15585/mmwr.mm7032e1

Center for Disease Control. (2021, December 10). *COVID data tracker weekly review*. Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/past-reports/12102021.html

Chan, K., Dupuy, B., & Lajka, A. (2020, April 21). Conspiracy theorists burn 5G towers claiming a link to virus. *AP NEWS*. https://apnews.com/article/health-ap-top-news-wireless-technology-international-news-virus-outbreak-4ac3679b6f39e8bd2561c1c8eeafd855

Chou, W. S., & Budenz, A. (2020). Considering emotion in COVID-19 vaccine communication: addressing vaccine hesitancy and fostering vaccine confidence. *Health Communication, 35*(14), 1718-1722. https://doi.org/10.1080/10410236.2020.1838096

Cinelli, M., Quattrociocchi, W., Galeazzi, A., Valensise, C. M., Brugnoli, E., Schmidt, A. L., Zola, P., Zollo, F., & Scala, A. (2020). The COVID-19 social media infodemic. *Scientific Reports*, *10*(16589). https://doi.org/10.1038/s41598-020-73510-5

Cohen, S., & Williamson, G. M. (1988). Perceived Stress in a Probability Sample of the United States. *The Social Psychology of Health*.

Coronavirus Disease 2019 (COVID-19). (2021, December 1). Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-classifications.html

Coronavirus disease (COVID-19): Herd immunity, lockdowns and COVID-19. (2020, December 31). World Health Organization. https://www.who.int/news-room/questions-and-answers/item/herd-immunity-lockdowns-and-covid-19

Curators Of The University Of Missouri. (2020). *Does the COVID-19 vaccine affect fertility? Here's what the experts say*. University of Missouri Health Care. https://www.muhealth.org/our-stories/does-covid-19-vaccine-affect-fertility-heres-what-experts-say

Daviu, N., Bruchas, M. R., Moghaddam, B., Sandi, C., & Beyeler, A. (2019). Neurobiological links between stress and anxiety. *Neurobiology of Stress*, 11, 100191. https://doi.org/10.1016/j.ynstr.2019.100191

DeConinck, D., Frissen, T., Matthijs, K., d'Haenens, L., Lits, G., Champagne-Poirier, O., Carignan, M., David, M. D., Pignard-Cheynel, N., Salerno, S., & Généreux, M. (2021). Beliefs in conspiracy theories and misinformation about COVID-19: Comparative perspectives on the role of anxiety, depression and exposure to and trust in information sources. *Frontiers in Psychology, 12*. https://doi.org/10.3389/fpsyg.2021.646394

Del Vicario, M., Bessi, A., Zollo, F., Petroni, F., Scala, A., Caldarelli, G., Stanley, H. E., & Quattrociocchi, W. (2016). The spreading of misinformation online. *Proceedings of the National Academy of Sciences, 113*(3), 554-559. https://doi.org/10.1073/pnas.1517441113

Diagnostic and statistical manual of mental disorders. 3rd ed. Washington, D.C.: American Psychiatric Association, 1980;354

Fisher, K. A., Bloomstone, S. J., Walder, J., Crawford, S., Fouayzi, H., & Mazor, K. M. (2020). Attitudes toward a potential SARS-CoV-2 vaccine : A survey of U.S. adults. *Annals of Internal Medicine, 173*(12), 964-973. https://doi.org/10.7326/M20-3569

Fitzpatrick, K. M., Harris, C., & Drawve, G. (2020). Fear of COVID-19 and the mental health consequences in america. *Psychological Trauma, 12*(S1), S17-S21. https://doi.org/10.1037/tra0000924

Freiling, I., Krause, N. M., Scheufele, D. A., & Brossard, D. (2021). Believing and sharing misinformation, fact-checks, and accurate information on social media: The role of anxiety during COVID-19. *New Media & Society*, 1–22. https://doi.org/10.1177/14614448211011451

Frequently asked questions about COVID-19 vaccination. (2022, February 28). Centers for Disease Control and Prevention.

https://www.cdc.gov/coronavirus/2019-ncov/vaccines/faq.html#:%7E:text=Yes%2C%20you%20should%20be%20vaccinated,ve%20already%20had%20COVID%2D19.

Gatti, E., Calzolari, E., Maggioni, E., & Obrist, M. (2018). Emotional ratings and skin conductance response to visual, auditory and haptic stimuli. *Scientific Data, 5*(1), 180120. https://doi.org/10.1038/sdata.2018.120

Geoghegan, S., O'callaghan, K. P., & Offit, P. A. (2020). Vaccine Safety: Myths and misinformation. *Frontiers Media SA*. https://doi.org/10.3389/fmicb.2020.00372

Grös, D. F., Antony, M. M., Simms, L. J., & McCabe, R. E. (2007). Psychometric properties of the State-Trait Inventory for cognitive and somatic anxiety (STICSA). *Psychological Assessment, 19*(4), 369-381. https://doi.org/10.1037/1040-3590.19.4.369

HAN Archive - 00449 | Health Alert Network (HAN). (2021, August 26). Center for Disease Control and Prevention. https://emergency.cdc.gov/han/2021/han00449.asp

Healy, J., Harmon, A., Romero, S., Weiland, N., Gold, M., Rabin, R. C., Zraick, K., & Eligon, J. (2020). *U.S. starts vaccine rollout as high-risk health care workers go first*. The New York Times. https://www.nytimes.com/live/2020/12/14/world/covid-19-coronavirus

Healy, J. (2021, August 4). *Some covid vaccine hesitant now express regret*. The New York Times. https://www.nytimes.com/2021/07/30/us/covid-vaccine-hesitancy-regret.html

Heilweil, R. (2020, April 24). The conspiracy theory about 5G causing coronavirus, explained. *Vox*. https://www.vox.com/recode/2020/4/24/21231085/coronavirus-5g-conspiracy-theory-covid-facebook-youtube

Information about the J&J/Janssen COVID-19 Vaccine. (2021, December 28). Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/janssen.html

Lee, E. (2012). Review of the psychometric evidence of the perceived stress scale. *Asian Nursing Research, 6*(4), 121-127. https://doi.org/10.1016/j.anr.2012.08.004

Ling, M., Kothe, E. J., Mullan, B. A. (2018). Predicting intention to receive a seasonal influenza vaccinations using protection motivation theory. *Social Science & Medicine*, *223*(2019), 87-92. https://doi.org/10.1016/j.socscimed.2019.06.002

Lynas, M. (2020, October 12). COVID: Top 10 current conspiracy theories. *Alliance for Science*. https://allianceforscience.cornell.edu/blog/2020/04/covid-top-10-current-conspiracy-theories/

MacDonald, N. E. (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*(34), 4161-4164. https://doi.org/10.1016/j.vaccine.2015.04.036

Malik, A. A., McFadden, S. M., Elharake, J., & Omer, S. B. (2020). Determinants of COVID-19 vaccine acceptance in the US. *EClinicalMedicine, 26*, 100495. https://doi.org/https://doi.org/10.1016/j.eclinm.2020.100495

Merriam-Webster. (n.d.). Disinformation. In Merriam-Webster.com dictionary. Retrieved January 27, 2022, https://www.merriam-webster.com/dictionary/disinformation

Michel, J., Sauter, T. C., & Tanner, M. (2021). Vaccine hesitancy and its determinants – a way forward? *Journal of Global Health Economics and Policy*, *1*. https://doi.org/10.52872/001c.30018

Office of the Commissioner. (2021, December 10). Why you should not use ivermectin to treat or prevent COVID-19. *U.S. Food and Drug Administration*. https://www.fda.gov/consumers/consumer-updates/why-you-should-not-use-ivermectin-treat-or-prevent-covid-19

Operation Warp Speed: Accelerated COVID-19 vaccine development status and efforts to address manufacturing challenges. (2021, February 11). *U.S. GAO*. https://www.gao.gov/products/gao-21-319

Phillips, N. (2021). The coronavirus will become endemic. *Nature*, 590, 382-384.

Peralta, E. (2021, September 6). South Africa struggled to get COVID vaccines after richer countries stockpiled soses. *National Public Radio*. https://choice.npr.org/index.html?origin=https://www.npr.org/2021/09/06/1034631858/south-africa-struggled-to-get-covid-vaccines-after-richer-countries-stockpiled-d

Prooijen, J., Ligthart, J., Rosema, S., & Xu, Y. (2021). The entertainment value of conspiracy theories. *The British Journal of Psychology,* https://doi.org/10.1111/bjop.12522

Ruiz, J. B., & Bell, R. A. (2021). Predictors of intention to vaccinate against COVID-19: Results of a nationwide survey. *Vaccine, 39*(7), 1080-1086. https://doi.org/https://doi.org/10.1016/j.vaccine.2021.01.010

Salerno, L., Craxi, L., Amodio, E., Lo Coco, G. (2021). Factors affecting hesitancy to mRNA and viral vector COVID-19 vaccines among college students in italy. *Vaccines (Basel), 9*(8), 927. https://doi.org/10.3390/vaccines9080927

Samuel, S. (2021, October 22). When does COVID-19 go from “pandemic” to “endemic”? *Vox*. https://www.vox.com/2021/10/22/22737328/covid-19-pandemic-endemic

Schlake T, Thess A, Fotin-Mleczek M, Kallen K-J. (2012). Developing mRNA-vaccine technologies. *RNA Biology, 9*:11, 13-19-1330. https:doi.org/10.4161/rna.22269

Shapiro, G.K., Holding, A., Perez, S., Amsel, R., Rosberger, Z. (2016). Validation of the vaccine conspiracy beliefs scale. *Papillomavirus Research 2*, 167-172. https://doi.org/10.1016/j.pvr.2016.09.001

Sriskandarajah, I. (2021, June 5). *Where did the covid microchip vaccine conspiracy theory come from?* The Verge. https://www.theverge.com/22516823/covid-vaccine-microchip-conspiracy-theory-explained-reddit

Stewart, C., & Kuroski, J. (2018, March 1). *FDA mistakes: 7 drugs that shouldn’t have been approved*. All That’s Interesting. https://allthatsinteresting.com/fda-mistakes

Subbarao, K. & Nature Editorial. (2020). COVID-19 vaccines: time to talk about the uncertainties. *Nature*. https://www.nature.com/articles/d41586-020-02944-8?error=cookies_not_supported&code=913ae2ac-3835-4be4-9b0a-a1e583f6ddcc

Swami, V., Coles, R., Stieger, S., Pietschnig, J., Furnham, A., Rehim, S., et al. (2011). Conspiracist ideation in Britain and Austria: evidence of a monological belief system and associations between individual psychological differences and real-world and fictitious conspiracy theories. *Br. J. Psychol. 102*, 443–463.

Talwar, S., Dhir, A., Kaur, P., Zafar, N., & Alrasheedy, M. (2019). Why do people share fake news? Associations between the dark side of social media use and fake news sharing behavior. *Journal of Retailing and Consumer Services*, *51*, 72–82. https://doi.org/10.1016/j.jretconser.2019.05.026

The Visual and Data Journalism Team from British Broadcasting Corporation. (2022, March 4). *COVID vaccine: How many people are vaccinated in the UK?* BBC News. https://www.bbc.com/news/health-55274833

U.S. COVID-19 vaccine tracker: See your state's progress. (n.d.). Mayo Clinic. https://www.mayoclinic.org/coronavirus-covid-19/vaccine-tracker

Zarocostas, J. (2020). How to fight an infodemic. *The Lancet*, *395*(10225), 676. https://doi.org/10.1016/s0140-6736(20)30461-x

Zhu, B., Chen, C., Loftus, E. F., He, Q., Chen, C., Lei, X., Lin, C., & Dong, Q. (2011). Brief exposure to misinformation can lead to long-term false memories. *Applied Cognitive Psychology*, *26*(2), 301–307. https://doi.org/10.1002/acp.1825

Tables and Figures

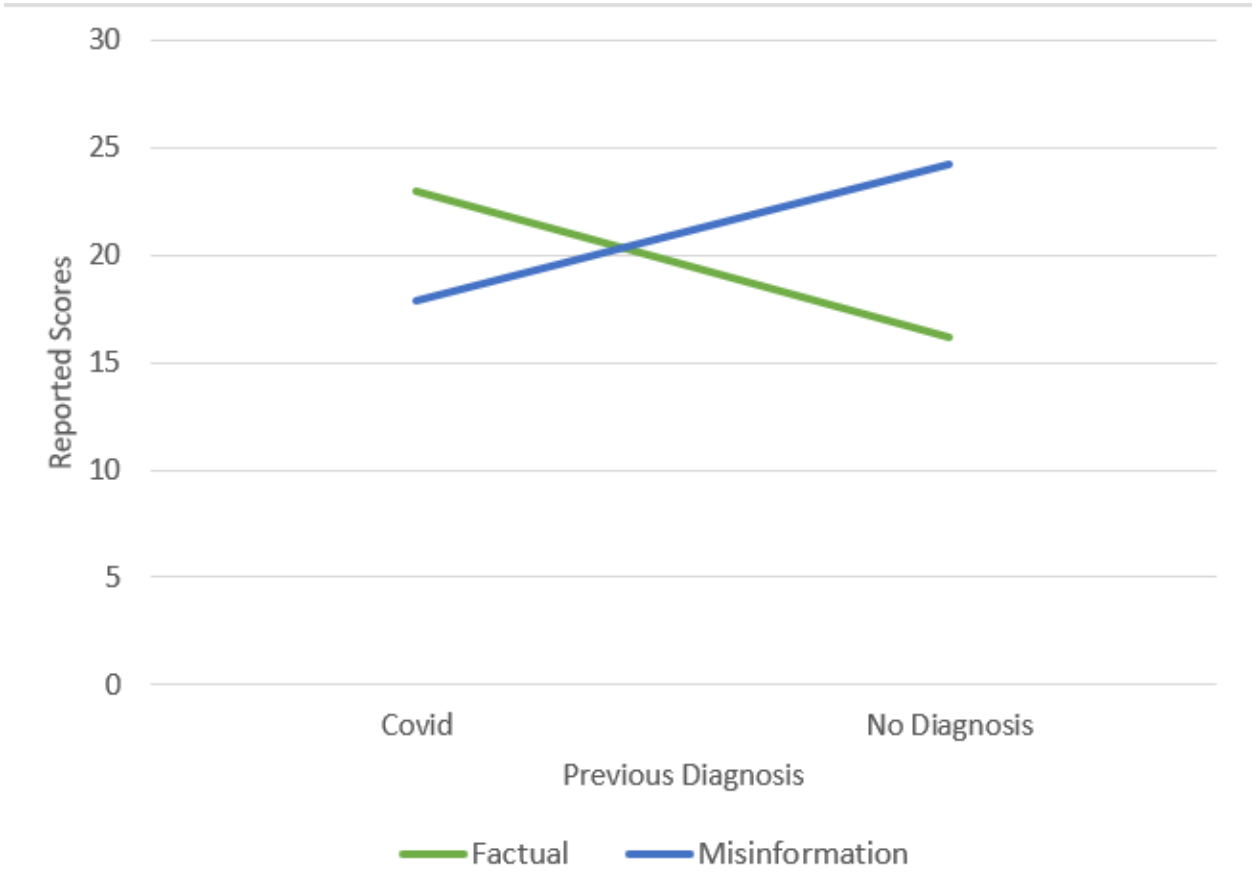

Figure 1: Vaccine Conspiracy Belief in Previous COVID-19 Infected Participants. This graph shows the comparison of the vaccine conspiracy belief of the participants based on previous infection and the information condition presented. The green line shows the participants exposed to the accurate information condition. The blue line shows the participants exposed to the misinformation condition. Those with previous infection scored higher in the conspiracy belief when exposed to accurate information. Those without a previous infection and that were exposed to the misinformation condition scored the highest out of the four groups.

Table 1.

Demographics

Variable	Total (*N*)	Mean (*SD*)	% of Total Sample
Gender	58		100%
Male	19		32.75%
Female	33		56.89%
Transgender	1		1.72%
Non-Conforming	6		10.34%
Age	58	19.98 (*1.72*)	
Race	58		100%
Caucasian	45		77.59%
Black/African-American	9		15.52%
American Indian/Alaskan Native	1		1.72%
Multiracial/Other	3		5.17%
Hispanic/Spanish Origin	5		8.62%
Political Affiliation	58		100%
Democratic	23		39.66%
Republican	11		18.87%
Independent	19		32.76%
Other	5		8.62%
Media Consumption	58		100%
Television	6		10.34%
Social Media	23		39.66%
Internet	21		36.20%
Friends/Family	9		15.52%
Previous COVID-19 Infection	58		100%
Yes	15		25.86%
No	43		74.14%

Table 1: Demographics Table. Describes the demographic informaiton of the participants and the percentage of each group.

	Misinformation		Accurate Information		
	Mean	StDev	Mean	StDev	p-Value
Perceived Anxiety	38.47	14.79	32.17	9.67	0.04
Physiological Response:					
Heart Rate	60.45	27.97	60.19	34.55	0.97
GSR	6.66	2.74	7.04	2.86	0.61
Perceived Stress	31.14	8.3	28.23	8.25	0.62
Conspiracy Belief:					
aVHS	22.79	7.43	19	8.15	0.62
CMS	33.36	8.77	29.43	11.05	0.4
VCBS	22.43	11.04	17.8	9.51	0.38

Table 2: Descriptive statistics between information conditions. The data of this table shows the mean scores from each of the dependent variables from the experiment (excluding previous COVID-19 infection).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Vaccine Conspiracy	58	7.00	46.00	20.0345	10.44781
Conspiracy Mentality	58	2.00	50.00	31.3276	10.12447
Vaccine Hesitancy	58	10.00	48.00	20.8276	7.97174
Perceived Stress	58	10.00	52.00	29.6379	8.33235
Pre-Anxiety	58	20.00	80.00	35.3276	12.08796
Post-Anxiety	58	19.00	76.00	35.0862	13.40631

Table 3: The descriptive statistics of the scales. The scores were added from both groups to develop an understanding of the entire sample. The minimum column describes the lowest score recorded for each scale, and the maximum score is the highest score recorded from the sample. The mean column describes the averaged scores of all subjects.

Appendix A - Recruitment Email

“Hello! My name is Alex Yeager and I am a Senior Biomedical and Psychological Science major. I am writing this email to ask you if you would be willing to participate in my study! The title of the study is “Physical and Psychological Responses to Information Regarding SARS-CoV-2 Vaccines”. This study will be done in person so appointments will need to be made. You will be asked to answer some questions via Google forms and you will be connected to biofeedback equipment using diodes on your fingers. This equipment will monitor your heart rate and galvanic skin response. If you have a heart condition that affects your heart rate you are not eligible to participate in this study. You must be 18 or older to participate. You must wear a mask at all times during the data collection process. If you are interested in participating, please reach out to me using the email address “yeagerw877@lynchburg.edu” to schedule a 30 minute appointment. You can also use the same email address to reach out if you have any questions! Thank you for reading my email and I hope to see you soon!”

- William Yeager

Appendix B - Script for Information Slides

“Hi there, I am going to be presenting to you some myths about the COVID-19 vaccines and debunking them. Let’s get started!

One of the most common worries/myths regarding the COVID-19 vaccines is that they were developed too quickly and are therefore unsafe.

So, to break this down a little, there are two types of COVID-19 vaccines: Viral Vector and mRNA. mRNA vaccines utilize messenger RNA that tell the immune system how to develop white blood cells that can recognize the spike proteins on the COVID virus (Michel, Sauter, & Tanner, 2021). Once they can recognize that it is a virus, the cells can then attack and kill the virus very efficiently. mRNA vaccines are relatively new in practice, but have about 10 to 15 years worth of research behind them (Schlake et al., 2012). They are developed by a genetically engineered bacteriophage infecting a bacterium (Michel, Sauter, & Tanner, 2021). The bacterium then begins to develop the mRNA within the virus, which is then utilized to develop the vaccine. Viral Vector vaccines are a more common type of vaccine. They use a weakened, but usually dead, form of the virus. Once injected, the body interacts with the dead cells, realizes that it's a virus, and begins to develop an immunity to the virus.

Now, I bring your attention to the graph on the right, which shows how much time was needed to develop vaccines used today. The orange dot determines the starting year and the blue dot shows the end year. The covid vaccine has the smallest range on the entire graph, but there is a reason for this. Firstly, Corona viruses are not uncommon, in fact they are typically the viruses that cause the Common Cold. So the genus of virus is not entirely unknown. Additionally, breakthroughs and developments happen very quickly when everyone across the world is working together in an effort to create the vaccines.

While developed quickly, all the vaccines went through the proper tests and were allowed for use in people. They began as an emergency procedure, but are now counted as FDA approved and have been approved by similar institutions across the world.

Another common myth seen today is that the vaccines are affecting expecting mothers and causing miscarriages. However the reasoning behind this does not make much scientific sense. The spike protein that the vaccines target is called Syncytin-1 (Curators Of The University Of Missouri, 2020). The body builds antibodies to attach to and destroy this protein rendering the virus inert and unable to spread. Within an expecting mother, there is a protein within the placenta that shares a piece of the genetic code with Syncytin-1. Conspiracy Theorists and those who spread misinformation will say that because the two proteins are similar, the body will begin to attack the protein within the placenta as well. However, this is not the case. Dr. Hsu is a reproductive endocrinologist and he deals with patients all the time that worry about this topic.

He has a direct quote that he uses with his patients, “This would be like mistaking an elephant for an alley cat because they’re both gray” (Curators Of The University Of Missouri, 2020).

Myth 3: You dont need to get the vaccine if you have had a previous infection. One of the biggest things about our immune system is that once we are able to overcome an infection, we should have some level of resistance or immunity to said infection. This does apply to COVID, however, this does not make one exempt from receiving a vaccine. While there is some protection, researchers have been unable to find how long this protection lasts (Cavanaugh et al., 2021). It could be a month, three months, 6 months, or even a year, but all we do know is that it isn’t permanent. Receiving the vaccine is also not a permanent fix, but it has been proven to effectively grant resistance/immunity to the virus without the same danger of getting sick and/or dying. While social distancing and masking helps limit the spread of the disease, the greatest tool at our disposal is the use of the vaccine. And for those still on the fence, a study by Cavanaugh et al. in 2021 found that those who were infected in the past and are still unvaccinated have twice the risk of being infected as those who are unvaccinated and have never been infected.

Finally, the grandest of all the vaccine myths, the theory that there are trackers or microchips within the vaccine. Now, this theory can be traced back through the internet back to Bill Gates. Bill was on Reddit at the start of the pandemic doing an “Ask me Anything” (Sriskandarajah, 2021). In one of his responses, he wrote about how he believed that one day we will be using digital passports, which will hold all of our important documents and medical records, including vaccinations. He expressed at the time that he did not want to use chips within the body to do this. However, this post was seen by a Swedish Biohacker group, who actively use technology in their body to augment their day to day life (Sriskandarajah, 2021). They posted on their blog about Bill’s post and began to talk about how these chips will be extremely helpful and began to form an argumentative statement towards it. Now, in this post, they did not mention vaccinations at all. This post was seen by a right-wing pastor who was scrolling through the internet and he was appalled by what they were saying. He essentially miscommunicated the ideas of the Swedish blog post and most importantly to the story, added the word “vaccines” (Sriskandarajah, 2021). He posted a youtube video sprouting misinformation regarding the COVID-19 vaccinations using these microchips to track people and their medical information, going against what Bill Gates had said originally. So, this theory was only formed through the paranoia and mistrust in the government and large corporations.

Logistically though, let’s look a little deeper into the microchips argument. Computer chips are hard to make. They require a lot of small pieces that need to fit together perfectly, otherwise they wont work. Now, as we build these chips smaller and smaller, they require more powerful parts, they have less room to fit and work, and require intense skill to build correctly. All of this put together results in an exorbitant cost to build. For every vaccine made, they would have needed to place a tracker within it. There must have been billions of doses made if every member of the

world was intended to take 2 shots. The cost of materials and creation of the chips would be so immense that it would not be beneficial to anyone to do this.

Thank you so much for listening to my presentation about the COVID-19 vaccines."

Appendix C- Script for Misinformation Slides

“Hi there, I am going to present to you the truth about the COVID-19 Vaccines. Over the past year, we have heard a lot of conflicting things about vaccines, which I will try to clear up here.

The COVID-19 vaccines were developed extremely quickly (Ball, 2020). In the United States, the vaccine development was placed into “Warp Speed”. Vaccines typically take years to develop and many tests before they are approved in human subjects. The COVID-19 vaccines were the fastest vaccines ever developed and the side effects related to their use are not fully known.

Ever since being injected in people, there have been thousands of reports of dangerous side effects. Some of the more known effects are myocarditis (inflammation of the heart), pericarditis (inflammation of the tissue around the heart), and blood clots that can result in death. These side effects are extremely critical, needing immediate care. The dangerous effects of these vaccines are downplayed by the media as they are trying to get more and more people to get the vaccine. If there are dangerous side effects, why would they choose not to talk about them directly and continue to push them?

Some may say that ‘But the vaccines were FDA approved! They must be safe!”. I would like to argue that being FDA approved does not amount to much. Medicine and drugs in the past have been FDA approved only to be pulled off the market years later. For example: DES or Diethylstilbestrol was a synthetic form of estrogen that was approved by the FDA (Stewart & Kuroski, 2018). DES was meant to help expecting mothers maintain their pregnancy and help prevent miscarriages, premature labor, and other complications. However, years later, they found that the use of DES resulted in higher chances of developing cervix and vagina cancer and higher chances of cancer developing in their children. Daughters born from those using DES had about 40 times the risk of developing Clear Cell Adenocarcinoma, 2 times the risk of developing Pancreatic cancer, and a higher risk of developing breast, cervical, and vaginal cancers. This drug was on the market for 30 years and impacted who knows how many children.

Another example is Quaaludes also known as Methaqualone (Stewart & Kuroski, 2018). Quaaludes were once a sleep aid used by many people and were legal for about 20 years. In the United States, Quaaludes were used to treat insomnia and anxiety, acting as a potent sedative to help people relax. The FDA approved the use of this drug for people to use. However, it was quickly abused by the general population and led to a perfect storm of prescribed medication abuse. Doctors were pushing and prescribing the drug as often as they could and were essentially handing them out like candy.
I bring up this case to talk about how even though a drug being FDA approved may seem safe,

the unknowable effects of long-term side effects may cause more damage than good over time, especially when doctors are pushing for their use like crazy.

Another way the covid-19 vaccines could impact our population is through expecting mothers. The new mRNA vaccines that were used for the covid-19 vaccines work by telling your body how to recognize the protein “Syncytin-1” which is the spike protein of the covid virus (Curators Of The University Of Missouri, 2020). However, the makeup of this protein shares a common build to a protein used by a mother’s body when forming the placenta. If the vaccine were to be injected into an expecting mother, it is feasible that the body will begin to attack that protein as well. Leading to a potential miscarriage if the placenta was formed improperly.

Let's say you have already been infected with COVID-19, what does that mean for you and your immunity? Those who have overcome COVID have a natural immunity built up in your body. This immunity lasts for a long time, and helps defend your body against reinfection. COVID is no different from any other infection. The use of the vaccine has been described as a preventative measure, but why prevent being infected if you have already been infected with the disease? It seems suspicious to push the vaccines for everyone regardless if they had a resistance or immunity to the disease already.

The main reason governments everywhere have been pushing the vaccines so hard is due to the installment of microchips. Now, before you jump to the conclusion that it’s impossible, please consider: the US government already watches everything its citizens do via the Patriot Act, which was installed in 2001 and renewed in 2011 and 2019. The Patriot act allows the government to monitor internet and phone use for all users within its borders. This allows the government to basically access all of your social media accounts and your phone records, what is to stop them from also monitoring your physical body? Cell phones already have GPS trackers in them. If they could place a chip into your body that does the same thing, they can limit errors that can occur. Additionally, Bill Gates, the CEO of Microsoft, went on Reddit during an “Ask Me Anything” chat (Sriskandarajah, 2021). During this chat, he mentioned that he thinks it is a good idea to start implementing digital passports that hold all medical and important information. These passports could exist as microchips within the body and are actually being used today by Swedish Biohackers (Sriskandarajah, 2021).
Over the past year, a large deficit in materials for computer chips has been created. Why?
A solid conclusion that could be drawn from this is that through the Patriot Act, the government has forcibly implemented a Digital Passport chip into the members of its population. This chip allows the government to collect biometric data and global positioning.
Now before you argue that the chips would be too small, there have actually been chips developed that are so small that they are impacted by Quantum Physics.

Thank you for listening to this presentation about some of the facts regarding COVID-19 Vaccines.”

Appendix D - State-Trait Anxiety Inventory

"A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to indicate how you feel right now, that is, at this moment. Please use a scale of 1 (Not At All) to 4 (Very Much So). There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best". Those marked with an asterisk are reverse-coded.

1 - Not at all; 2 - Somewhat; 3 - Moderately So; 4 - Very Much So

- I am calm*
- I feel secure*
- I am tense
- I feel strained
- I feel at ease*
- I feel upset
- I am presently worrying over possible misfortunes
- I feel satisfied*
- I feel frightened
- I feel comfortable*
- I feel self-confident*
- I feel nervous
- I am jittery
- I feel indecisive
- I am relaxed*
- I feel content*
- I am worried
- I feel confused
- I feel steady*
- I feel pleasant*

Appendix E - Perceived Stress Scale

"This scale asks you about your feelings and thoughts during the last month. For each statement, please indicate how often you felt or thought a certain way using a 5 point Likert scale. Although some questions are similar, there are differences between them and you should treat each one as a separate question. Do not try to count up the number of instances, rather, make a reasonable estimate." The questions that are reverse-coded are marked with an asterisk.

0 - Never; 1 - Almost Never; 2 - Sometimes; 3 - Fairly Often; 4 - Very Often

- In the last month, how often have you been upset because of something that happened unexpectedly?
- In the last month, how often have you felt that you were unable to control the important things in your life?
- In the last month, how often have you felt nervous and "stressed"?
- In the last month, how often have you dealt successfully with day to day problems and annoyances?*
- In the last month, how often have you felt that you were effectively coping with important changes that were occuring in your life?*
- In the last month, how often have you felt confident about your ability to handle your personal problems?*
- In the last month, how often have you felt that things were going your way?*
- In the last month, how often have you found that you could not cope with all the things you had to do?
- In the last month, how often have you been able to control irritations in your life?*
- In the past month, how often have you felt that you were on top of things?*
- In the last month, how often have you been angered because of things that happened that were outside of your control?
- In the last month, how often have you found yourself thinking about things that you have to accomplish?
- In the last month, how often have you been able to control the way you spend your time?*
- In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Appendix F - Adult Vaccine Hesitancy Scale

"Please indicate on how much you agree or disagree with the following statements below using a 5 point likert scale, where 1 means 'Strongly Disagree' and 5 means 'Strongly Agree'." Those marked with an asterisk are reverse-coded.

1 - Strongly Disagree; 2 - Disagree; 3 - Neutral; 4 - Agree; 5 - Strongly Agree

- Vaccines are important for my health*
- Vaccines are effective*
- Being vaccinated is important for the health of others in my community*
- All routine vaccinations recommended by the CDC are beneficial*
- New vaccines carry more risks than old vaccines
- The information I receive about vaccines from the CDC is reliable and trustworthy*
- Getting vaccines is a good way to protect me from disease*
- Generally, I do what my doctor or healthcare provider recommends about vaccines for me*
- I am concerned about serious adverse effects of vaccines
- I do not need vaccines for diseases that are not common anymore

Appendix G - Conspiracy Mentality Scale

"Please indicate how likely you are think each statement is true using an 11 point likert scale"

0- 0%; 1- 10%; 2- 20%; 3- 30%; 4- 40%; 5- 50%; 6- 60%; 7- 70%; 8- 80%; 9- 90%; 10- 100%

- I think that many very important things happen in the world, which the public is never informed about
- I think that politicians usually do not tell us the true motives for their decisions
- I think that government agencies closely monitor all citizens
- I think that events which superficially seem to lack a connection are often the result of secret activities
- I think that there are secret organizations that greatly influence political decisions

Appendix H - Vaccine Conspiracy Belief Scale

"Please indicate how much you agree or disagree with the following statements regarding vaccines using a 7 point Likert scale."

1-Strongly Disagree; 2-Disagree; 3-Somewhat disagree; 4-Neutral; 5-Somewhat Agree; 6-Agree; 7-Strongly Agree

- Vaccine safety data is often fabricated
- Immunizing children is harmful and this fact is covered up
- Pharmaceutical company cover up the dangers of vaccines
- People are deceased about vaccine efficacy
- Vaccine efficacy data is often fabricated
- People are deceived about vaccine safety
- The government is trying to cover up the link between vaccines and autism