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Investigating the relationship between reliance on emotion versus reason and fake news acceptance in the COVID-19 context

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Abstract

A randomized control trial was done through an online survey with 170 participants, where a manipulation method was conducted on them, dividing the participants across two groups: emotion and reason group. This research examines the effect of reliance on emotion versus reason on susceptibility to fake news in the COVID-19 context. This study also investigates the influence of news valence (i.e., positive or negative valence) and COVID-19 itself on susceptibility to fake news. No different effect was found for reliance on emotion and reason on fake news acceptance. However, it was found that negative news valence increases on average fake news being perceived as accurate. Furthermore, it was found that people who are more concerned about the coronavirus rate on average less news as being accurate.

Keywords: COVID-19, Fake News, Emotion and Reason, News Valence

word count: 126

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In this section that was granted to me and where I am allowed to say "I think" (i.e., what I think), I would like to share my deepest gratitude to the persons who had a big impact on me to follow the paths I have followed and that also helped me achieve it. The persons that encouraged me all the time and gave support to pursue adventures in the scientific field and throughout this world are my mom and dad, Vivien Hertogh and Jairo Okret. I would also like to thank my thesis supervisor Dr. Marine Hainguerlot for all her support along this research. I would lastly acknowledge this work to my family, friends, and all the people that help this world to be more just and equal place. I desire that fake news is abolished and stops being used as a machine to influence people's decisions.

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1. Introduction

It could be said that 2020 was an atypical year so far and that probably it will be remembered for a long time, because the entire globe suffered a pandemic caused by the COVID-19 (coronavirus). The pandemic reached global scales at least never seen before since the last century, when the world was very different than it is now. Nowadays, the pandemic occurred in a world where globalization, tourism, and digitalization have reached levels never seen before. The pandemic caused enormous impacts on the world economy and social life. Many countries entered different degrees of lockdowns. The stock market crashed, a large number of businesses shut down and unemployment levels raised. Also in some countries, political instability has deteriorated during the pandemic, while corruption rates also increased. Furthermore, this was also a year where the magnitudes of polarization intensified. This can be seen, for instance, when you look at the 2020 USA elections. An election more vibrant and atypical from the ones experienced before, where even the electoral process was put into question by some people.

Nowadays it is very common that people obtain news information not only in traditional forms such as newspapers, radio, or television but also via social media platforms (Kennedy & Prat, 2019). Gottfried & Shearer (2016), found that 62 percent of the US adult population get news via such platforms. Also, in 2019 we have globally obtained impressive levels of online interaction, wherein one minute 41.6 million messages are sent via the internet and where the major social media platform, Facebook, has achieved impressive 2.4 billion active users (Clement, 2019). In the last few years we have experienced more and more an already existent type of incorrect information dissemination, similar to disinformation or misinformation, but now mainly through social media, known as fake news.

During these uncertain times, where regions suffered from lockdowns, people's well-being was affected. Because of the disease, social distance turned into a reality, loneliness and depression level have raised. Also, many people got afraid. So people's emotion is largely affected due to the coronavirus. Furthermore, fake news regarding the COVID-19 emerged with the pandemic spread. Misinformation related to the coronavirus was largely shared on social media (Frenkel, Alba, & Zhong, 2020; Russonello, 2020). Since we are talking about a worldwide pandemic, more than ever the information that is delivered to people should be accurate and fake news could have a big impact on people's life. People could overestimate, as well as underestimate

the coronavirus crisis and the health department's measures. Also, they can be misled by false claims, putting in some cases their own lives in danger (e.g., a claim that states that infecting people with disinfectant could help against the disease). Furthermore, fake news susceptibility increases when people rely on emotion compared to when they rely on reason (Martel et al., 2020). Also, fake news is overall more negative than real news (Paschen, 2019), and negative valence news spread more than positive valence news (Heath, 1996). So, understanding how fake news works during the COVID-19 and how this is affected by reliance on emotion and reason, as well as the effects of the type of valence the news has is very important.

Not yet a study was conducted combining fake news, with the coronavirus, emotion, and news valence. So this study pursues to bring all these different topics together and interact with them. The objective of this paper is to investigate the impact of reliance on emotion and reliance on reason with fake news susceptibility in the COVID-19 context. It is also interested, in verifying if positive news valence has a different effect than negative news valence on fake news susceptibility. Lastly, it also attempts to examine if there was an impact of the coronavirus on news perceived accuracy, by looking if people's worries levels due to the COVID-19 affect news susceptibility. To do so this paper follows parts of Martel et al. (2020) and Pennycook et al. (2020a), with also my contributions.

In the next section, the literature review necessary to give the theoretical background of this research is discussed. It consists of previous literature findings that are relevant for this study, as well as to give support to the raised hypotheses. Afterward, the methodology will be described, which illustrates how the framework of data collection and its analysis is structured. Next to that, the results from the planned analysis will be presented. This aims to test the hypothesis that was constructed along with this research, as well as give support to its findings. Subsequently, the implications of the findings and limitations of this study are discussed. Also, some thoughts for future research are sketched. Finally, the conclusions are presented, which summarize the key elements and discoveries examined throughout this paper.

2. Literature Review

In this section, literature will be examined to give the needed scientific background to support this research, along with a theoretical presentation of what is going to be investigated. To have a better understanding of the literature relevant to this work, this section will be divided into

the main theoretical aspects, as well as a COVID-19 'crisis' description. The important literature that will be discussed is mainly related to fake news in general, reliance on emotion versus reliance on reason, and positive versus negative news valence.

2.1 Fake News in General

To have a better comprehension of what is fake news, nothing better to start by defining its meaning. It is similar to disinformation or misinformation and consists of information that is intentionally produced in a way to perceive people that it comes from a legitimate media source (Lazer et al., 2018) and intends to reach specific groups (Gelfert, 2018). However, according to Allcott & Gentzkow (2017), this type of news contains false information, which could be used to mislead whoever accesses it. They also suggest that with the rise of social media, every person would be able to create and easily spread this false news. Moreover, studies show that false news spreads faster than true news in social media (Vosoughi, Roy & Aral, 2018) and is likely to be accepted as containing accurate information (Silverman & Singer-Vine, 2016).

A lot of research has examined the reasons that contribute to fake news dissemination and some specific characteristics that contribute to its acceptance as being truthful. De keersmaecker & Roets (2017) support that people with a low level of cognitive ability adjust their attitudes (i.e., how they review something again after receiving additional information) in a lower strength compared to people with a higher level. They also discover that when being presented with false information and afterward receiving feedback that it was false, those with lower levels of cognitive ability still stay connected to biased beliefs and remain influenced by the false information. Furthermore, Bronstein et al. (2019), found that people who are considered to be dogmatic, religious-fundamentalist, or who support delusion-like ideas have a higher chance of believing in false news. Moreover, fake news acceptance may be related to a tendency of not thinking in an open-minded way (Pennycook & Rand, 2019). Bronstein et al. (2019), suggest two approaches to minimize the impact of fake news beliefs: actively open-minded thinking and analytic thinking.

2.2 Reliance on emotion vs reliance on reason

Theory suggests mainly two different approaches for belief in misinformation: motivated cognition and classical reasoning (Martel, Pennycook, & Rand, 2020). On the one hand, motivated cognition supports that people's analytical side and not their emotional side has an impact for misinformation to be perceived as truthful (Kahan, 2017). So, they use reasoning to

preserve their identity (i.e., who they are and what they believe), and not necessarily what is a fact (Kahan, 2013). This last author also suggests that misinformation that endorses and does not threaten a person's believes increases the chances of perceiving that information as truthful. On the other hand, classical reasoning argues that reason helps assist people to differentiate what is true news from false news, while emotion probably engages people to be deceived by false information (Pennycook & Rand, 2019). Furthermore, Martel et al. (2020), discovered that feeling intense emotions results in an increase of perceiving fake news has been accurate but does not increase the levels of belief in real news. They have also demonstrated that reliance on emotions raises fake news acceptance as being real, having both a correlational and causal effect. Moreover, Vosoughi et al. (2018), argue that differences between false and true news dissemination could be explained by the novelty degrees and emotional reaction that the readers perceived by such news. However, they don't make any empirical analysis of emotional relations. Additionally, Cotter (2008), found that higher levels of emotion increase rates of information sharing. It was also found that emotions such as anxiety can boost and increase news acceptance (Valentino, Hutchings, Banks, & Davis, 2008).

2.3 The COVID-19 Pandemic

In the first months of 2020, the world has witnessed a global pandemic. It was caused by a virus called SARS-CoV-2, which can lead to a disease named COVID-19, popularly known as the coronavirus disease (Gorbalenya et al., 2020). In the first weeks of the pandemic, it was expected that the world would go through an economic crisis and that many people will die or lose their jobs (Jones, Brown & Palumbo, 2020; De Jesus, 2020). However, until now it is not possible to know the exact magnitude and consequences of this unfortunate event. But it is forecasted that the GDP grows -4.5% this year, with a monetary GDP loss of 76 billion USD (Statista Research Department, 2020). What is a fact so far is that more than 1 million people around the world died due to the COVID-19 (Roser et al., 2020) and that the health care systems suffered from overloaded hospitals (Horowitz, 2020; Sirna et al., 2020). Also, the stock market dropped down brutally (Merril & Dey, 2020), country borders were closed, and have imposed lockdowns of different degrees (Thiessen, 2020).

During the coronavirus period, fake news about it emerged and spread into social media (Frenkel, Alba, & Zhong, 2020). According to the Ofcom[1] (2020), almost half of the United

[1] United Kingdom Office of Communications

Kingdom adults that have access to the internet got in touch to COVID-19 false claims. Therefore, many measures have been implemented to combat it. The World Health Organization created a myth buster website, to educate people and stop them from believing in COVID-19 related false information. Also, social media platforms, such as Facebook and Twitter, have supported such an initiative and deleted specific posts from users that contained coronavirus related misinformation (BBC, 2020).

Human well-being is affected by infectious diseases (Duncan, Schaller & Park, 2009). According to the United States Centers for Disease Control and Prevention, the COVID-19 crisis can cause strong emotions in people, potentially causing them stress, due to fear and anxiety that the disease can appear. Fear is an emotion that can be expressed by a lot of characteristics such as anxiety, concerns, apprehension, and jitter (Freitas-Magalhães, 2007). As already mentioned, we still don't know for sure what the consequences of this pandemic will be. The feeling of not having enough information causes anxiety in people since they experience fear of what is unknown (Dastagir, 2020). For the COVID-19, in particular, this refers to the unknown of what will or can happen to them. This uncertainty also brings us fear (Slovic, Fischoff & Lichtenstein, 1979). And when people have to deal with the uncertainty of a threat that has the potential of occurring to them, they also suffer from anxiety (Grupe & Nitschke, 2013). Furthermore, when we sense that we are not in control of something, we get more afraid (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978).

2.4 Positive and Negative Valence

Among many things news can also be divided according to its valence (i.e., positive (good) valence news and negative (bad) valence news). However, there is still no consensus in the literature about the effect of valence to news (i.e., information or message) expansion. On the one hand, some studies support that negative information is spread more easily or that people's willingness to share this information increases as compared to positive information (Heath, 1996; Fessler, Pisor, & Navarrete, 2014; Bebbington, MacLeod, Ellison & Fay, 2017; Boyer, 2018). On the other hand, some studies report that positive information is more viral than negative information (Berger and Milkman, 2012). Bringing valence to the fake news context, fake news is overall more emotional than real news, more precisely as it relates to negative emotions (Horne & Adali, 2017; Horne et al., 2018). Fake news is higher in emotions such as anger and disgust and is also less happy than real news (Paschen, 2019). The last of these authors also found that fake news is in general more negative as compared to real news.

If it is taken into account that the majority of fake news is negative as compared to positive news, and also that people are more willing to pass this type of information (i.e., negative valence news), then it could be that people probably accept more negative valence news, in comparison to positive valence news, as containing accurate information. Since it is expected that if they transmit the information, they probably pursue it to be accurate. Because intentionally spreading fake news probably has the purpose to mislead people, and it is expected that not the majority of the people has the desire to mislead deliberatively. So this paper pursues further verification of these premises. Now that the theoretical background was established, which will give support to this research findings, the research question along with the raised hypotheses of this study are formulated.

2.5 Defining the Hypotheses

Up until now, not a lot of research has focused on emotions when looking at fake news acceptance. Also, the literature does not have a consensus regarding the effect of news valence. Furthermore, due to the coronavirus, it is possible that people are experiencing higher levels of fear and uncertainty and that these might have an effect on fake news susceptibility. So, the purpose of this research is to further investigate the relation of reliance on emotion compared to reliance on reason with fake news susceptibility. Also to verify the impact of news valence, as well as the COVID-19 situation itself when people judge a headline accuracy. Thus, it is important to have a deeper understanding of these topics in the fake news environment and this study aims to contribute by incorporating all these subjects and testing their effects. Therefore the following research question was elaborated "To what extent does reliance on emotion versus reliance on reason affect fake news acceptance as being truthful?". Also, the following sub-questions were developed "What is the effect of a positive or negative headline valence to fake news susceptibility?" and "Is there an impact of people's afraidness levels for the COVID-19 on how they perceived headlines veracity? ". To answer this the following hypothesis will be tested, where H_1 and H_2 are based on previous literature and H_3 is based on my reasoning:

- H_1: When people rely on emotion rather than on reason they will rate fake news as being more accurate.

- H_2: When people are confronted with negative valence news, they will rate fake news as being more accurate, compared to when confronted with positive valence news.

- H_3: People who are worried the most about the COVID-19 rate headline news on average as being more accurate.

Having established the research question and the hypotheses the methodology of this study is presented.

3. Methods

To address the research question and test the raised hypotheses, an experimental approach will be taken. This targets the collection of proper data that afterward will be analyzed for a suitable investigation of H_1, H_2, and H_3 while making further conclusions. In this section, the methodology of this research project will be elucidated. Firstly, the experimental design will be explained. Secondly, the sample construction will be described. Thirdly, the material and procedures that were used will be illustrated. Lastly, the planned analysis will be presented, focusing on the experiment validity, as well as the hypotheses evaluation.

3.1 Experimental Design

The experiment consists of a between-subject design, where a randomized controlled trial (RCT) will be adopted, and the experimental data will be collected through a survey using Qualtrics (https://www.qualtrics.com) as a tool. The purpose is to verify what are the differences in fake news acceptance when people are specifically told to rely on emotions compared to when they are told to rely on reason. It also pursues to find out if headlines valence and the COVID-19 have an impact on headline news judgment. So, more objectively it intends to look if there is a cause-effect or correlation of the different topics mentioned above on people perceiving fake news, or news in general, as being accurate. This will be done by replicating part of Martel, Pennycook & Rand (2020) and Pennycook, Bear, Collins & Rand (2020a), but now as it relates entirely to the COVID-19 context. This research also aims to verify if people judge news accuracy that contains negative valence information differently than when judging the accuracy of news containing a positive valence message. The data will be mainly in ordinal scale and will measure how accurate people are when having to judge a news headline containing true or false information, as well as if the valence information (i.e., positive or negative) has any relation or effect. Also, data regarding people's perceived vulnerability to

diseases is collected, as well as people's worries levels related to the COVID-19. This is done to verify what is the effect of the coronavirus context, using among other things the perceived vulnerability to disease scale, on people's perception about news accuracy. Lastly, some demographic data will be gathered.

3.2 Sample Construction

In this study, all of the participants were contacted via the internet, through platforms such as Survey Tandem, Facebook, and WhatsApp. The majority were contacted via WhatsApp contacts and groups, and with the support of acquaintances of mine, to help spread it. The survey was accessible over five days (from the 1st to the 5th of June 2020) in Qualtrics. The only eligibility constraint to participate in the experiment was the participant having a good comprehension of the English language.

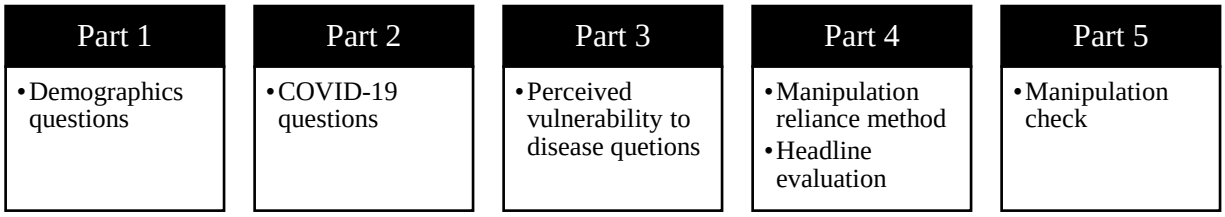
In total, 250 responses were recorded from 228 distinguished participants (i.e., there was considered one unique IP Address per participant). However, only 192 participants completed the entire survey. Thus we have 54 responses of participants that stopped in the middle or didn't finish everything. And 4 responses of participants that didn't pass the eligibility criteria. All of these 58 responses were discarded from the sample. Moreover, the survey was built in a way that forced participants to answer a question before moving forward to the next one. However, even so, some answers regarding age were left blank. If the age information was not available they were removed from the sample, because one of the assumptions in the sample construction is to consider only participants that answered the survey completely (i.e., all the mandatory questions). Also, some participants answered more than one nationality for the nationality question or did not answer this question. Therefore, the data set was constructed considering only data of participants that answered all the questions of the survey properly (e.g. exclude response without the baseline information for a variable or that answered incorrectly). Hereby 22 participants were discarded from the sample because they didn't fulfill the criteria established above. Of these 22 participants, 15 didn't fill in their age while 7 of them filled in more than one nationality. Finally, the total number of participants that will be analyzed in this research is 170 (these correspond to 170 distinguished IP addresses).

3.3. Materials and Procedure

To encourage participants to answer the survey and consequently pursue access to a bigger sample, a reward was given to some of them who answered the survey completely. So six

participants were randomly selected, via a random draw using excel, and won a 5 euros reward, that was transferred to them. To apply for this draw, participants needed to answer all the questions and give their email address at the end of the survey. The survey was expected to take between five and 20 minutes to be answered and consists of five parts, which will be described in detail, for a better comprehension of its framework, as well as to understand what was the data collected with the participant's answers. Figure 1 shows a diagram of the different parts of the survey and, Figure D1 in the appendix shows the diagram in more detail.

Figure 1: *Survey diagram*



3.3.1 Baseline Characteristics

The first part consists of demographic questions such as gender, age, education level, and nationality. They can be used as control variables and could also help to check if randomization was done successfully. Also, both the second and third part of the survey will generate data that can be used as control variables. The second part consists of some specific questions related to COVID-19, taken from Pennycook, McPhetres, Zhang, Lu & Rand (2020b). Hereby it is intended to verify how concerned people are with dealing with the COVID-19 (measured from 0 to 100, where the highest is the most concerned), as well as see to what extent people search for news as it relates to the disease. Where participants were asked to evaluate by a 5-point Likert-scale (1=Never, 5=Very often) how often they proactively checked news regarding the coronavirus. The third part of the survey consists of the "Perceived Vulnerability to Disease" scale test (Duncan, Schaller & Park, 2009), where the participant should answer fifteen questions using a 7-point Likert scale (with endpoints labeled ''strongly disagree" and ''strongly agree"). The questions can be found in Table D2 in the appendix D and are related to people's perceived infectability and germ aversion, and will be a good scale to measure participant's fear levels as it relates to infectious diseases such as COVID-19. Also, some of the questions are reverse-scored, which could help to check if participants are consistent when answering the survey (e.g., they could answer questions without even reading the questions). In addition, to verify if the fifteen questions from the Perceived Vulnerability to Disease are indeed related to each other, the Cronbach's alpha, which is a measure of internal consistency

between items in a scale, is calculated for these questions. The degree of reliability is 0.773, which is larger than the rule of thumb of 0.7, justifying the combination of the fifteen questions (Taber, 2018). Furthermore, the germ aversion questions reported a reliability degree of 0.694, while those related to perceived infectability had an 0.812 degree of reliability.

3.3.2 Manipulation Process and Headlines Evaluation

At the beginning of the fourth part of the survey, the manipulation process took place. Participants were randomly assigned into two treatment groups, which will be called the reason and the emotion group. This randomization process will avoid any selection bias. Moreover, the only difference between the groups is when it relates to the fourth and fifth parts of the survey. Through a reliance induction method, participants should interpret, using reliance on emotions or reliance on reason, when judging if a given news headline presents truthful or false information. The reliance induction method was presented for both treatment groups. This same methodology by experimentally manipulating reliance on emotion and reliance on reason, when having to judge headlines accuracy, was previously used by Martel, Pennycook & Rand (2020) but then with political news headlines. They created it based on Levine, Barasch, Rand, Berman & Small (2018) induction prompt. This reliance induction method consists of given the following instructions to each of the specific groups:

Emotion group: "Many people believe that emotion leads to good decision-making. When we use feelings, rather than logic, we make emotionally satisfying decisions. Please assess the news headlines by relying on emotion, rather than reason."

Reason group: "Many people believe that reason leads to good decision-making. When we use logic, rather than feelings, we make rationally satisfying decisions. Please assess the news headlines by relying on reason, rather than emotion."

Afterward, for both groups, twenty news headlines related to the COVID-19, which can all be found in Appendix C, were given for the participants to have their accuracy interpreted. The headlines were all presented in the format of a Facebook post, thus with a written headline, with a picture on top and a source in the middle (see Figure 2). Furthermore, ten headlines present true information and ten headlines present false statements. Overall, the same headlines used by Pennycook, McPhetres, Zhang, Lu & Rand (2020b) will be used. In their study, the headlines containing truthful information were selected from reliable media sources (e.g., The Guardian, CNN), whereas the false information headlines were selected using websites that

check facts (e.g., snopes.com and factcheck.org). Also, some additional headlines were created by me, applying the same method described above.

Half of the true information headlines contain positive valence headlines, while the other half contains negative valence headlines (i.e., from the 10 true news headlines 5 will have a positive connotation message and 5 of them a negative connotation message). The same division applies to the false information headlines. Positive valence headlines should indicate headlines that address a positive emotion (e.g., scientists discover the vaccine that will cure the COVID-19), while negative headline valence indicates headlines that address negative emotions (e.g., the second COVID-19 wave should cause much more deaths than the first wave).

Prior to the survey kick-off, two independent reviewers were asked to independently classify if they perceived the headlines as being of positive or negative valence. This was done to verify whether the news "framing" was in perfect agreement (e.g., with percent agreement) between the two reviewers (i.e., that headlines are properly divided into negative and positive valence news so that there can be controlled in further analysis by news valence). From the 20 news headlines presented to the reviewers, they have first agreed to 18 of them, which were also in accordance to the valence expected for these (i.e., the valence given by the reviewers (positive or negative), were in agreement with the valence predicted). However, for two of them, the reviewers were in disagreement. So both of the headlines were excluded and two new ones were sent to the same participants to be reviewed. For both of them, their answers matched precisely and were in perfect agreement with my given valence. This way the 20 news headlines that will be used on this survey were selected.

Figure 2: *Example of a real and negative headline*

The headlines will appear in a randomized order to the participants. Most importantly, for each of the headlines participants will be asked “To the best of your knowledge, how accurate is the claim in the above headline?”. Participants could answer using a 6-point Likert scale (1 = Definitely false, 2 = Probably false, 3 = Possibly false, 4 = Possibly true, 5 = Probably true, 6 = Definitely true).

3.3.3 Manipulation Check

The fifth and last part of the survey consists of some control questions to verify if the participants indeed followed the reliance induction method. Also to check to what extent they consider this instruction when answering the questions. Therefore participants were asked questions such as: “Previously to the part where you should judge the headline accuracy, you were asked to answer using your.” 1 = Emotion, 2 = Reason, and “To which extent you used emotion/reason when judging the accuracy of the news headlines?”. Likert-scale: 1 = None at all, 2 = A little, 3 = A moderate amount, 4 = A lot, 5 = A great deal. With participants, self-reported answers to these questions it can be verified if participants were consistent with their given instructions and give an idea of the level in which participants used the instructions when evaluating the headlines accuracy.

3.4 Planned Analysis

To analyze the experimental data, collected through the randomized controlled trial, some statistical test will be performed. The purpose of this analysis is to address the presented research question, along with the established hypotheses. Also, it aims to check the validity of this study used methods, to support the potential findings, as well as to present descriptive statistics of the collected data. Therefore the investigation will consist in general of the following four analyses: a) descriptive statistics; b) randomization check; c) manipulation check; d) hypotheses testing. Below can be found more details about each of the four analyses that will be carried out.

3.4.1 Randomization Check

The randomization check will test whether variables at baseline differ across groups. This is done since a randomized control trial will be used and it needs to be verified if randomization was done successfully throughout the experiment. To make sure that there are no differences for some variables across treatments, only variables collected at baseline will be compared

between the two different groups. These variables include the demographics, and COVID-19 related questions, as well as the Perceived Vulnerability to Disease scale and the total time participants spent to answer the survey. So, for each variable, given the type of variable (e.g., scale type), a specific test will be used. Also, both parametric and non-parametric techniques could be done depending on the assumptions that the variables hold. According to McCrum-Gardner (2008), the following assumptions should hold in order to use a parametric test to compare two groups means: the observations are independent, the observations should be normally distributed, and variables should be measured in an interval scale. The author also defends that parametric tests are more powerful and flexible if compared to non-parametric tests.

As already mentioned, depending on the variable nature, a specific test per variable will be accomplished to perform the randomization check. If the parametric test assumptions hold for a specific variable, the Student's t-test will be used. This test looks at the means and determines if there is any significant difference between the means across the 2 groups. If the parametric assumptions do not hold and the variable is in a ratio, interval, or ordinal scale, and following the assumption of the randomized controlled trial (i.e., in the RCT method the two samples are independent), the Mann-Whitney U test will be used, since the experiment is a between-subject experiment. This test looks at the population medians (i.e., medians of the groups are equal to each other or not) and does it by testing if groups differ based on ranks of data. Nevertheless, if it is a binary variable, so on a nominal scale, a Chi-squared test will be completed. With this test, the distribution of the dummy variable will be compared across the two groups. The hypothesis tested with these tests is shown in Table 1.

Table 1: *Null and Alternative hypothesis from the experimental statistical tests*

Type of test	The null hypothesis (H_0)	The alternative hypothesis (H_1)
Student's t	The means of the two groups are equal.	The means of the two groups are not equal.
Mann-Whitney U	The median in the two groups is equal.	The median in the two groups is not equal.
Chi-square	There is no difference between the two groups distributions.	There is a difference between the two groups distributions.

Notes. These are used in both the randomization and manipulation check

3.4.2 Manipulation Check

To find out if the experimental manipulation has influenced participants with their given answers, regarding the accuracy judgments of the presented headlines, a manipulation check will be executed. This aims to check if participants who were in the reason group reported using their reason and their counterparts from the emotion group reported using their emotion. For this the variable consistent will be formed, which is going to be established by the survey question "Previously to the part where you should judge the headline accuracy, you were asked to answer using your.", with the possible answer being emotion or reason. If the participant who was allocated to the emotion group answered that he was instructed to answer using his reason, he was evaluated as being inconsistent (variable *Consistent*, 0= not consistent, 1= consistent), since he reported not having received his actual given instructions. Since the variable *Consistent* is a binary variable, the comparison is done between the proportions. So, it will compare the proportion of consistency between the two groups. This is done to make sure that the participants understood the given manipulation instruction and is tested using a two-group proportion test. With this test, the proportion of the variable *Consistent* will be compared across both groups, emotion, and reason. The null hypothesis of this test is that the consistency proportion in the emotion group is equal to the consistency proportion in the reason, while the alternative hypothesis states that the consistency proportion is not equal between groups. Also, there will be analyzed the extent of emotion self-reported used by the emotion group and the extent of reason used by the reason group. However, this will not be compared across groups.

3.4.3 Hypotheses Testing

In this part of the planned analysis section, the process to test the raised hypotheses will be enlightened. The first hypothesis H_1 aims to validate the effect of the experimental manipulation on the perceived headlines accuracy, overall. The second hypothesis H_2 attempts to investigate if there is a different effect of positive news headlines valence and negative news headlines valence on the perceived headlines accuracy. The third and last hypothesis H_3 pursues to confirm if people who are more worried due to the COVID-19 rate news headlines overall as being more accurate. The measurement of how worried people are about the COVID-19 is accomplished by the perceived vulnerability to disease scale, as well as the direct coronavirus related questions. Ahead the type of statistical test used will be detailed. Also, the dependent variable, along with the independent variables, control variables, and interaction terms are described.

3.4.3.1 Dependent and Independent Variables

The data will be examined considering the level of the participants perceived headlines accuracy ratings (i.e., on the 6-point Likert scale a 1, 2, or 3 was rescaled to an 0, whereas a 4, 5, or 6 was rescaled to a 1, so 1 means that the participant perceived the news headlines as being accurate and 0 means he has perceived the news headlines as not being accurate) and the data set is settled in a long format. So in all the regressions, the dependent variable will be the "perceived" news accuracy i.e., participants' belief about whether or not the news is accurate (their self-report) not "actual" accuracy. Therefore, the dependent variable will be a binary variable, which is the same as used by Pennycook et al. (2020a). Furthermore, this research will have more than one independent variable. The explanatory variables will consist of the variables *Treatment* (0 = Reason, 1 = Emotion), *Fake* (0 = Real News, 1 = Fake News) and *Negative* (0= Positive, 1= Negative), along with interaction terms between these variables. Also, there will be controlled for the participant's perceived vulnerability to disease levels (i.e., with an variable indicating the participant average score in the perceived vulnerability to disease scale) and variables directly related to the COVID-19.

3.4.3.2 Statistical Model

Because the dependent variable will be a binary variable the statistical model chosen is a logistic regression (logit). This model is ideal to verify if there is a relationship between the explanatory variable(s) and the binary dependent variable. Moreover, the logistic model that will be used in this study has standard errors clustered on two dimensions (clusters at the participant and cluster at the headlines level). One of the advantages of using clustered standard errors is that it assists robustness to heteroskedasticity (Cameron & Miller, 2015). Also when the clusters are done by two dimensions, it tends to produce less biased standard errors and is a useful robustness check (Petersen, 2009). The methodology to account for multiple dimensions at the same time is followed in this research and can be verified in Cameron, Gelbach & Miller (2008), Petersen (2009), Thompson (2011) and Cameron et al. (2011). The last of these authors claim that when using this method it is possible to make correlations across standard errors by two dimensions. So in this study case, the standard errors will be both clustered at the same time at the participant level and headline level. Furthermore, the logistic regression does not allow to directly interpret the coefficient magnitude of a variable. It only

allows for interpreting the coefficient sign and its significance. Therefore, to be able to interpret the coefficient of the logit model the odds ratio and the average marginal effect will be calculated.

3.4.3.3 Regressions

To test the first-established hypothesis (H_1), primarily two regressions will be built and tested. The first regression considers the variable treatment as the explanatory variable and will also control for the dummy fake (0 = Real News, 1 = Fake News). While in the second regression an interaction term between the variable treatment and the variable fake is added. So the variables of interest to test H_1 will be both the variable treatment, as well as the interaction term between treatment and fake. Following the literature, it is expected that the variable *Treatment* has a positive coefficient sign and the variable *Fake* has a negative coefficient sign. This occurs since it is expected that reliance on emotion increases the probability of perceiving the headline as accurate. While the headline being fake decreases the probability of perceiving the headline news as being accurate. Even though it is expected that Fake has a negative sign and Treatment a positive sign, it is expected that the interaction term *Treatment*Fake* has a negative coefficient sign. The interaction term is the difference of log-odds that compares emotion versus reason for fake headlines and emotion versus reason for real headlines. And it is expected that the negative effect of the headline been fake is larger than the positive effect of relying on emotion. Therefore, the sign of the interaction term *Treatment*Fake* to be negative.

Next to that, to test the second hypothesis (H_2), a regression will be built, similar to the second model aimed to test H_1, but then also controlling for the type of news valence, by adding the dummy variable *Negative* (0 = Positive news valence, 1 = Negative news valence). And by including some interaction terms with this newly added control variable. More specifically, the interaction term between treatment and negative and between fake and negative, as well as the interaction term between the three variables treatment, fake and negative. Hypothesis H_2 aims to verify if the valence of the news headlines has an effect on the perceived headline accuracy. The variables of interest to test this hypothesis is the interaction term between Fake and Negative. Furthermore, this research is also curious to verify the effect of the headline containing negative valence on the news susceptibility. It is expected that the variable *Negative* has a positive coefficient sign, i.e., that a headline containing negative valence news increases

the probability of perceiving the headline as accurate. Also, it is expected that the interaction term created between the variables *Treatment* and *Negative* has a positive sign.

Moreover, to test the third and last hypotheses (H_3) two regressions will be assembled. Firstly a regression will be built where the control variable *PVD Score* is added to the last conferred model. This aims to verify if the perceived vulnerability to disease scale affects the perceived headline accuracy. A higher *PVD Score* indicates that the participant has a higher perceived vulnerability to disease. Secondly, the last regression will be built where the variables *COVID-19 Concern* and *COVID-19 News* are included in the model. This intends to verify if the self-reported measures of people's concern regarding the COVID-19 and how often they proactively check coronavirus-related news have a relation to how they perceive headline veracity. To examine H3 there should be looked to the effect of the variables *PVD Score*, *COVID-19 Concern* and, *COVID-19 News*. Unfortunately, there was not found previous literature using the *PVD Score* and the COVID-19 related measures on the fake news context. Nevertheless, this study has hypothesized that the perceived vulnerability to disease and people's concern regarding a disease, as well as the intensity they check the news regarding this disease has a positive effect on the perceived headline accuracy, i.e., the variables *PVD Score*, *COVID-19 Concern*, and *COVID-19 News* having a positive sign in the logit regression. So if people are more worried they will be more affected to pursue news to be accurate.

Additionally, if the randomization check confirms that randomization was successful, it will not be necessary to control for other things in the regression e.g., demographics, since there would be evidence that such variables are already equally balanced across the two treatment groups. However, if a difference is found for some variables between the two groups, these variables need to be added to the regression to control for this. Table A1 in the appendix A describes the main variables used in this study along with their description.

3.4.3.4 Correlations and Collinearity

It is possible to divide the variable *PVC Score*, indicating the participant's level of perceived vulnerability to disease, into two variables. Where one of the variables indicates the degree of perceived vulnerability to infectability and the other variable the degree of perceived vulnerability to germ aversion. To verify if splitting the variable *PVC Score* into the above-mentioned variables is ideal, it needs to be looked at to which extent both variables are correlated. Because if they are highly correlated, there could be collinearity issues (e.g., weaken

the significance, or have an impact on the sign and magnitude of a variable). Thus if the correlation is high, it would be better not to split the variable perceived vulnerability to disease into the two subgroups. Since the perceived vulnerability to disease scale is on an ordinal scale, the Spearman Correlation test is done to verify the level of correlation. In addition it could also be interesting to add the variables consistent as a control variable, to control that the participants were consistent in the use of their given treatment. However, since it is just a self-report, it does not necessarily mean that what the participants reported they were doing actually is what they did. So our regressions will not be controlled by the participant's self-reported consistency in using their given treatment.

Furthermore, it is also important to verify how the independent variables are correlated with each other. And also their collinearity degrees. To do so a correlation matrix between the variables is generated, as well as a collinearity diagnostic with the variance inflation factor (VIF) and condition number of these variables. This aims to detect signs of multicollinearity

4. Results

In this section, the results are presented. First, the data description and the descriptive statistics from our sample are shown. Secondly, the randomization check results, following with the manipulation check are presented. Finally, the regressions results that aim to test the raised hypotheses will be reported. The statistical tests along with the regressions generated some tables and figures, which are all presented in this section or in the appendix.

4.1 Data and Sample Description

The final sample of 170 answers is composed of participants from 19 distinguished nationalities, where 106 participants are male and 64 female. And the sample mean age was 35.03 years, while the SD_{age} = 15.42 years, the Min_{age} = 17, and the Max_{age} = 80. Also, the nationality that appears the most is Brazilian with 97 participants, followed by Dutch with 46 participants. Both of these nationalities account for 88.82% of the participants. In addition, although the treatment allocation was done randomly, using the randomization check on Qualtrics, the proportion of participants between treatments was not the same. The emotion group consists of 81 participants, while the reason group of 89 participants. It is only expected

that on average half of the people should be allocated in each group. However, it doesn't mean that the distribution is fifty percent each (i.e., this is expected only for big numbers) and this will not be an issue for the analysis

Table 2 presents descriptive statistics for the categorical variables *Gender*, *Brazilian*, *Education*, and *COVID-19 News*. The variable *COVID-19 News* is a categorical variable indicating how often the participant checks the news for coronavirus related news. The table shows the proportion for each variable, distinguishing between the emotion and reason group, as well as them combined, for each of the categorical variables mentioned above.

Table 2: *Descriptive statistics for the binary and categorical variables*

Variables		Emotion		Reason		Total	
		No.	%	No.	%	No.	%
Gender	Male	45	55.60	61	68.54	106	62.35
	Female	36	44.40	28	31.46	64	37.65
Brazilian	Yes	49	60.49	48	53.93	97	57.06
	No	32	39.51	41	46.07	73	42.94
Education	High School	9	11.11	11	12.36	20	11.76
	Bachelor	46	56.79	40	44.94	86	50.59
	Master	23	28.40	36	40.45	59	34.71
	PhD	3	3.70	2	2.25	5	2.94
COVID-19 News	Never	1	1.23	2	2.25	3	1.76
	Rarely	11	13.58	8	8.99	19	11.18
	Sometimes	18	22.22	32	35.96	50	29.41
	Often	30	37.04	30	33.71	60	35.29
	Very often	21	25.93	17	19.1	38	22.35

Notes. $N_{emotion}$= 81 and N_{reason}= 89.

When looking at the participants' highest attained level of education, 11.76% of them only completed High School, 50.59% received a Bachelor's degree, while 34.71% a Master's degree, and 2.94% a PhD. Therefore, it could be said that the participants are in general well educated and none of them has no schooling degree. Also, the majority of the participants reported having proactively checked COVID-19 related news often or very often while only 3 participants stated never proactively checked COVID-19 news. When asked how concerned the participants are about the COVID-19 (measured from 0 to 100, but divided by 10 in the analysis), on average they were 6.57 concerned with a 2.45 standard deviation. Also, only 1 participant was not concerned at all (i.e., gave a rating of 0) and 11 participants were extremely

concerned (i.e., gave a rating of 10). Furthermore, table 3 presents descriptive statistics for the rest of the variables collected at baseline.

Table 3: *Descriptive statistics for the continuous variables*

Variables	Emotion		Reason		Total	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Duration	23.796	67.813	48.346	146.585	36.648	116.26
Age	34.716	14.511	35.315	16.286	35.029	15.422
COVID-19 Concern	6.954	2.278	6.217	2.561	6.568	2.451
PVD Score	4.189	0.787	4.124	0.845	4.155	0.815
PVD GermAversion	4.705	0.97	4.496	1.041	4.595	1.01
PVD Infectability	3.6	1.02	3.7	1.053	3.652	1.035

Notes. $N_{emotion}$= 81 and N_{reason}= 89.

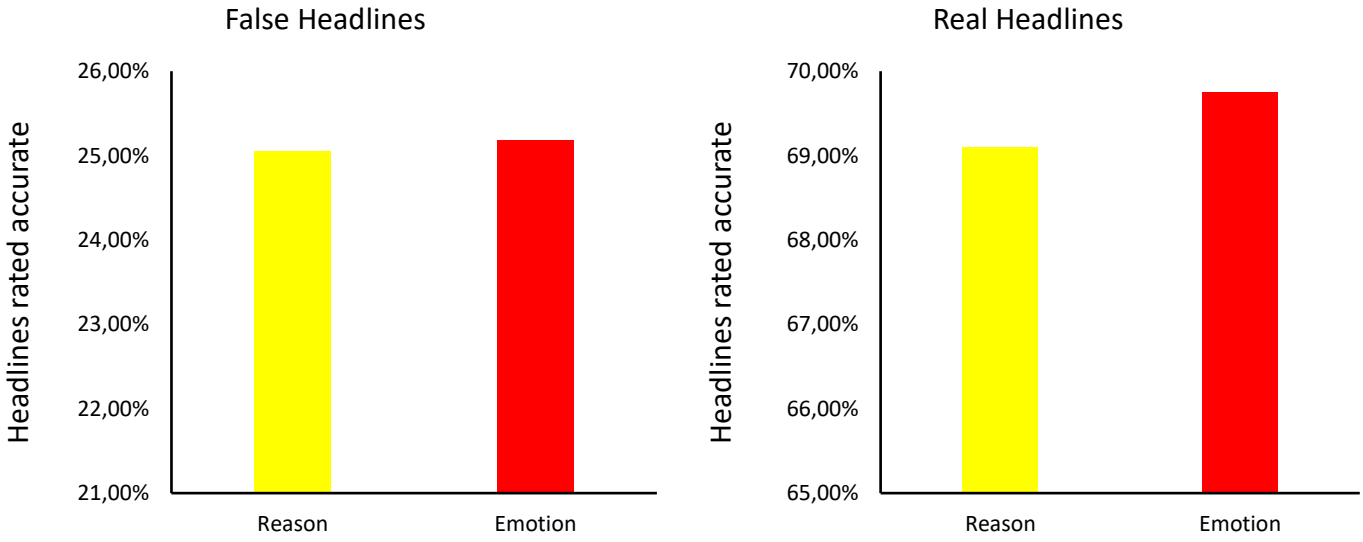
As previously mentioned, it was expected that answering the survey would take between five and 20 minutes. Yet our sample took on average 36.65 minutes to answer the survey, with an $SD_{duration}$ = 116.26 minutes, the $Min_{duration}$ = 4.23, and the $Max_{duration}$ = 1130.78. This number is also considering participants who could be possible outliers, meaning that they could have answered the survey in parts or even made use of the internet to search for the answers to a question. There are cases in our sample where participants took several hours to answer the entire survey, and even in some cases more than a day. Since it was expected that the survey took between five and 20 minutes to be answered, when removing participants who took more than 20 minutes to finish the survey (36 in total), the average duration to answer the survey drops to 10.57 minutes, with a 3.45 standard deviation.

On the Perceived Vulnerability to Disease scale, the participants reported an average score of 4.16. This scale is measured from 1 to 7, where a higher score indicates a higher perceived vulnerability to disease. Also, as already mentioned, from the 15 questions that composed the PVD scale, 7 are germ aversion related, and the other 8 are of perceived infectability. The average reported score for germ aversion was 4.60 with an $SD_{germ\ aversion}$ = 1.01 and the perceived infectability score was on average 3.65 with an $SD_{infectability}$ = 1.04. The question that received the highest average score asked if participants got bothered when people sneeze without covering their mouth (5.764) and the one that received the lowest score asked participants to interpret the following statement “I am more likely than the people around me to catch an infectious disease” (2.629).

As mentioned in the planned analysis, to verify if the PVC Score will be divided into the two sub-variables, the Spearman correlation test is used. The test results show that the Spearman correlation coefficient between the variables perceived infectability and perceived germ aversion is 0.273, indicating that there is a positive but not very strong correlation between both variables. The p-value ($p < .001$) indicates that there is a statistically significant correlation between both variables at an 0.05 significance level since the null hypothesis that the variables are independent is rejected. So this is evidence that the variable PVC Score could be split in two. However, since most of the literature does not do it, this research will also not split them.

Furthermore, Figure 3 shows the percentage of headlines rated as being accurate for each treatment and per headline veracity type. In other words, it reports the percentage of real and false headlines that were perceived as being true, for the reason and the emotion group. It can be observed that 25.06% of the false headlines were rated as being accurate by the participants in the reason group. For the same false headlines, 25.19% of them were judged as being accurate by the emotion group. Furthermore, 69.10% of the real headlines were perceived as being accurate by the participant's reason group. While the participants in the emotion group rated 69.75% of the same real headlines as containing accurate information. So for both headline veracity types, the difference of correct rated headlines between the two treatment groups is less than 1 percentage point (i.e, for the false headlines the difference is 0.13 percentage points, while the difference for the real is 0.65 percentage points).

Figure 3: *Percentage of headlines that participants rated as accurate*



Notes. Percentage of headlines that participants rated as accurate (i.e. Accurate = participants gave a 4 or more on the 6-point Likert scale) for each headline type (real or false) and per treatment group (reason or emotion).

The correlation matrix is reported in Table A3 (appendix A). It only considers variables that were used in the hypothesis testing, since these are the variables of interest used to test these research hypotheses. From the pairwise correlation, 25% of the correlations presented a statistically significant correlation. However, the variables did not present in general a strong relation, except for the variables from the perceived vulnerability to disease scale that present a positive and strong relationship.

4.2 Randomization Check

To use the parametric test, the test assumptions mentioned previously should be satisfied. The first assumption that the variables are independent is satisfied since the method used consists of an RCT, which satisfies these conditions. The second assumption, where the variables should be in interval or ratio scale is only satisfied for the variables Duration, Age, and COVID-19 Concern. Therefore, the rest of the variables can already not be considered for a parametric test, so discarded for the analysis of the next assumption. The third assumption states that the variables should be normally distributed. To test if these variables are normally distributed the Shapiro-Wilk test is used. The null hypothesis of this test is that the population of the variable is normally distributed. Table A2 (appendix A) presents these test results. All the three variables *Duration*, *Age*, and *COVID-19 Concern* present a p-value lower than the 5% significance level. Thus the null hypothesis that these variables are normally distributed is rejected, giving evidence that they are not normally distributed.

Since the normality assumption does not hold, only non-parametric tests will be used. Thus, for the variables *Duration*, *Age*, and *COVID-19 Concern* a Mann-Whitney U test will be performed to check for randomization. The hypothesis tested hereby is if the two medians across groups are equal for a given variable. Furthermore, the variables *Education*, *COVID-19 News*, and *PVD Score* are all on an ordinal scale. So for these variables also a Mann-Whitney U test will be done. Lastly, the variables *Male* and *Brazilian* are in nominal scale and also are dummies. Thus, a Chi-square test will be done and the proportion distribution across groups will be reviewed.

The Mann-Whitney U test was conducted on the 170 participants to determine if there is any difference between the medians for the variables *Education*, *COVID-19 News*, *PVD Score*, *Duration*, *Age*, and *COVID-19 Concern*, across the treatment groups. As already mentioned for the randomization check of the variable duration, participants who took more than 20 minutes to answer the experimental survey, were excluded from this specific analysis (i.e., as

it regards only for the Mann-Whitey U test for the variable duration). These participants were kept for the rest of the analysis, since taking a long time does not necessarily mean they cheated or that they didn't answer the best way (i.e., with their best intentions). It could be that they just went to do something else and answered the survey at another moment. In Table 4 the test results for these variables are reported. The results did not indicate any significant difference ($p>0.05$) between medians for all these variables across the two groups. Therefore this gives evidence not to reject the null hypothesis that the medians for the variables in the emotion and reason group are equal.

Table 4: *Mann-Whitney U test results*

Variable	z-value	p-value
Duration	-0.84	0.4007
Age	0.075	0.9402
Education	0.954	0.3402
PVD Score	-0.443	0.6575
COVID-19 Concern	-1.852	0.064
COVID-19 News	-1.078	0.2811

Table 5 presents the results of the Pearson's Chi-squared test conducted over the binary variables *Gender* and *Brazilian*. It exhibits that the relationship of both variables Gender and Brazilian between the treatment groups is not significant at a 5% significance level. Therefore, the null hypothesis that there is no difference between the two treatment groups distribution, cannot be rejected, since there is not enough evidence for this. The percentage distribution for these variables across the groups can be verified in Table 2. The results from the randomization check indicate overall that randomization was successful between treatment groups.

Table 5: *Pearson's Chi-squared test results*

Variable	Degrees of freedom	χ^2	p-value
Gender	1	3.045	0.081
Brazilian	1	0.745	0.388

4.3 Manipulation Check

The first step in the manipulation check is to conduct the two-group proportion test between the variable *Consistent* and the emotion and reason groups. The objective of this is to verify if there is any difference in proportion between participants that reported correctly when asked what their given treatment was (i.e., when in the reason group, reported having been instructed to use reason, the opposite for the emotion group) across both treatment groups (emotion or reason). The test presents a z-value of 6.9871 with an p-value < 0.05 at an 95% confidence interval. Therefore the null hypothesis stating that the proportion of consistency between groups is equal can be rejected. Also, there can be conclude based on the test of proportion that there is evidence that participant's in the emotion group are less likely to be consistent. This can be verified based on the estimate of the difference of consistency proportion between the two groups (proportion of consistency in the reason group minus the proportion of consistency in the emotion group), which presents a positive value (i.e., the proportion of participants being consistent is higher among the reason group).

Table 6: *Proportion of "consistency" across the treatment groups*

	Consistent	Not consistent
Emotion	48.15%	51.85%
Reason	97.75%	2.25%

Notes. Values in percentages

Table 6 presents the proportion of participants that were consistent or not with their given treatment, across both treatment groups. It shows that the majority of the participants in the emotion group were not consistent with the treatment that was given to them in the manipulation process. On the other hand, 97.75% of the participants allocated to the reason group reported being given the treatment that actually (i.e., correctly) was given. There can also be analyzed to which extent did the individuals used their given treatment (i.e., measured with a 5-point Likert scale to which extent participants in the emotion group used emotion and to which extent participants in the reason group used reason). However, since it was not the same question in the survey for the two groups, a comparison between the extent of treatment use cannot be done (i.e., a proportion test cannot be examined). Table 7 reports these results and demonstrates a big difference in levels of the use of their treatment between the two treatment groups. The results show that the majority of the participants of the reason group made use of reason a lot or a great deal. While in the emotion group the minority of the

participants reported having used emotion a lot or a great deal. These results demonstrate a considerable difference between the use of the given treatment across the treatment groups.

Table 7: *Extent use of the given treatment across the treatment groups*

	None at all	A little	A moderate amount	A lot	A great deal
Emotion	12	18	39	10	2
Reason	0	0	20	40	29

Notes. $N_{emotion}$= 81 and N_{reason}= 89.

The results from the manipulation check suggest that the manipulation inductive method employed was not able to ensure that the manipulation was effective for all groups.

4.4 Hypotheses Testing

Table 8 presents the results from the logistic regression that aims to test the three hypotheses. For all the presented models in this table, the dependent variable is perceived headlines accuracy which is a binary variable indicating if the participant perceived the news headline as being accurate or not (0= perceived as not accurate, 1= perceived as accurate). Models 1 and 2 are used to test H1. Model 3 is used to test H2, while Models 4 and 5 are used to test H3. The variables of interest to test the raised hypothesis are the variables: *Treatment*, *Treatment*Fake*, *Fake*Negative*, *PVD-Score*, *COVID-19 Concern* and, *COVID-19 News*. And on Table 8 the coefficient can only be interpreted by his sign and significance level. Furthermore, all the models have in total 3400 observations. This occurs since the regression is tested over 170 participants and the 20 headlines since the data set is in long format. Also, the standard errors are clustered over the 170 participants and the 20 headlines at the same time.

Table 8: *Binary logistic regression predicting the perceived headline accuracy (0 = not accurate, 1 = accurate). Treatment = 1 for the emotion and 0 for reason. Fake = 1 for fake headlines and 0 for real headlines. Negative = 1 for negative valence headlines and 0 for positive valence headlines.*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Treatment	0.020	0.031	0.041	0.043	0.094
	(0.094)	(0.099)	(0.128)	(0.128)	(0.132)
Fake	-1.912***	-1.900***	-2.530***	-2.530***	-2.549***
	(0.363)	(0.368)	(0.502)	(0.503)	(0.507)
Negative			-0.370	-0.370	-0.372
			(0.517)	(0.517)	(0.520)
Treatment*Fake		-0.024	0.011	0.011	0.014
		(0.080)	(0.132)	(0.132)	(0.133)
Treatment*Negative			-0.018	-0.018	-0.018
			(0.150)	(0.150)	(0.152)
Fake*Negative			1.166*	1.166*	1.174*
			(0.695)	(0.695)	(0.701)
Treatment*Fake*Negative			-0.057	-0.057	-0.058
			(0.113)	(0.113)	(0.115)
PVD Score				-0.042	0.045
				(0.066)	(0.070)
COVID-19 Concern					-0.008***
					(0.002)
COVID-19 News					-0.002
					(0.065)
Constant	0.810***	0.805***	0.996***	1.169**	1.308**
	(0.273)	(0.270)	(0.330)	(0.458)	(0.455)
Observations	3,400	3,400	3,400	3,400	3,400
Wald chi2	619.53	619.55	637.61	638.92	645.74
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.1474	0.1474	0.1597	0.1599	0.1642

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Model 1 in Table 8, shows that there is a positive but not statistically significant relationship between the variable treatment and the perceived headline accuracy at a 5% significant level (p-value > 0.1). The control variable fake (p-value < 0.01), presents a negative and significant relationship with the dependent. This means that a fake headline decreases the probability of rating the headline as accurate, keeping all things fixed. In model 2, the interaction term between variable treatment and fake is included to verify what is the effect of a fake headline for participants in the emotion group on the dependent variable. The interaction term presents a negative sign, but no significant relation was found for this interaction on the perceived headline accuracy (p-value > 0.1). Thus no evidence was found in Models 1 and 2 to support H_1.

In model 3, the control variable negative is added, along with the interaction term between the variables treatment and negative, as well as the interaction term between fake and negative. Also, the interaction term between the three variables treatment, fake and negative is included in the model. Model 3 is used to test H_2, which aims to verify if a positive headline has a different effect on the dependent variable than a negative headline. The results show that the variable negative has a negative but not statistically significant effect on the dependent variable (p-value > 0.1). Furthermore, the interaction term between treatment and negative, as well as the three-way interaction term between variables Treatment, Fake and Negative, present a negative but not significant relationship with the perceived headline accuracy (p-value > 0.1). Since the interactions are not significant the results are not interpretable. Moreover, it is interesting to notice that when the new variable negative together with the interaction terms are added to Model 3 the interaction term between treatment and fake, that presented a negative sign in Model 2, now presents a positive sign. This suggest that multicollinearity might be existent in the model. Nonetheless in both models, the interaction continues to be not significant (p-value > 0.1). Additionally, the interaction term between the variables fake and negative presents a positive and significant effect on the dependent variable at a 10% significance level. This means that fake news containing negative valence compared to positive valence fake news increases the probability of perceiving the headline as accurate, keeping all things fixed. Therefore, there was found evidence to support H2. Which claims that negative valence increases the probability of rating fake news as accurate, compared to positive valence.

Furthermore, in model 4, the variables *PVD Score* is included in the model. The result shows that *PVD Score* has a negative but not significant result on the perceived headline accuracy. Finally, the results of model 5 which added the variables *COVID-19 Concern* and *COVID-19* News to model 4, shows that *COVID-19 News* does not have a significant relation (p-value > 0.1), while the variable *COVID-19 Concern* presents a negative and significant relation (p-value < 0.05) on the perceived headline accuracy. This gives evidence to support that participant's concerns related to the coronavirus had an impact on the headline's perceived accuracy. However, it does not follow what was expected. Since the results found that participants who are more concerned about the COVID-19, are less likely to perceive a headline as accurate, ceteris paribus. Thus this is evidence to reject the H_3. Moreover, the perceived vulnerability to disease scale and the amount of corona related news consumed by the participants did not present evidence to support, neither to reject the established H_3, since no significant effect for these variables (i.e., *PVD Score* and *COVID-19 News*) was found. There

can also be observed that the sign of the variable *PVD Score* has inverted as compared to Model 4. This is further evidence that collinearity may be present and is an issue to the model.

The logit model does not allow to interpret directly the magnitudes of the coefficients. Therefore, to be able to define the magnitudes both the average marginal effect and odds ratio were calculated. Table B1 and Table B2, in the appendix B, present respectively the odds ratio and the average marginal effect as it relates to the coefficients from the models of Table 8. Yet only significant results are interpreted. The results show for Model 1 that a fake headline compared to a real headline decreases on average the probability of perceiving a headline as accurate by 48.3 percentage points, ceteris paribus. Also, a fake headline decreases by 0.15 the odds of rating the headline as being accurate. Furthermore, the results in Model 3 report that if a headline is both fake and contains negative valence news there is an increase of 3.9 (=3.209+0.691) of the odds of rating that headline as accurate, compared to a fake headline containing positive valence news, ceteris paribus. Lastly, the results in Model 5 exhibit that a 1 point increase in the level of concern regarding the coronavirus (variable *COVID-19 Concern*) decreases by 0.2 percentage points the probability of perceiving a headline as being accurate. This suggests that for each 1 point increase in the level of concern related to the COVID-19, the odds of perceiving the headline as accurate decreases by an 0.99 factor.

Moreover, to test whether the addition of the variables *PVD Score, COVID-19 Concern,* and *COVID-19 News*, create a statistically significant improvement to the model the Wald test is performed. The Wald test results (chi2(3) = 14.62, p-value = 0.002) show evidence, that given the p-value<0.01, the null hypothesis, that the coefficients of the three variables are simultaneously equal to zero, can be rejected. Therefore, having the three variables introduced to the models increased the fitness of the model (i.e., statistically significant improvement). This can also be verified by the model Pseudo-R2, which specifies the model improvement over one model with just a constant term. The Pseudo-R2 demonstrate an improvement along with the models (i.e., an improvement from Model 1 to Model 5)

As a post examination, the collinearity diagnostic shows that the highest variance inflation variance (VIF) is 6.73 for the variable Treatment*Fake*Negative and the condition number of all variables is 21.21. These test results are shown in Tables A4 and A5 (appendix A). So the results are below the rule of thumb of 10 for the VIF (Kutner et al., 2005) and below the threshold of 30 for the condition number (Belsley, 1991). Yet these rules of thumbs values are controversial and cannot assure a definitive conclusion. (O'brien, 2007). Nevertheless, when

applying their threshold the result does not indicate evidence that multicollinearity is a major concern in the model. Still, multicollinearity concerns should be considered because as stated before some variables and interaction terms had their sign reversed with the inclusion of other variables.

5. Discussion

5.1 Implications

In the randomization check, for the variables collected at baseline, the null hypothesis (i.e., that the medians across groups is equal or that there is no difference between the groups distribution), could not be rejected across the randomizations check tests for all these variables. Therefore this gives evidence that the method used was able to successfully ensure randomization across the treatment groups. So, eliminating at first, doubts of selection bias. Furthermore, opposite to Martel et al. (2020), who used the same reliance induction method adopted herein, our study did not present evidence to confirm that the manipulation was overall successful. In their study evidence was found suggesting the manipulation was successful since they have found that the majority of the participants were consistent when asked to signal what they were asked to consider (emotion or reason) when evaluating the headlines (i.e., the emotion group reported higher use of emotion compared to the reason group and the participants in the reason group reported higher use of reason compared to the emotion group). However, in our study, the manipulation check results did not suggest consistency across the treatment groups. The results provide evidence that the manipulation was successful only for the participants in the reason group and not for those in the emotion group. So overall this could have a high impact on our results, but does not necessarily demonstrate that the manipulation was not successful. It could be that participants in the emotion group did not want to report that they used emotion when judging the headline accuracy. Or even that since in general the samples consisted of highly educated people, rationality reigns above anything.

This study was not successful howsoever to produce any evidence to support that there is a difference between reliance on emotion versus reliance on reason in fake news susceptibility. So there was no evidence found to reject, neither not to reject H_1. Yet it does not mean that there is not a difference in effects. But instead, it means that this research was not able to find any evidence. In contrast to our results, Martel et al. (2020) found that reliance on emotions

compared to reliance on reason raises fake news acceptance. Furthermore, when looking at the H2 there was found evidence that negative valence headlines compared to positive headline valence increase fake news acceptance. This is in accordance with the part of the literature on information valence, which states that negative valence increases news dissemination (Heath, 1996; Fessler, Pisor, & Navarrete, 2014; Bebbington, MacLeod, Ellison & Fay, 2017; Boyer, 2018). Yet this relation was only found at a 10% significance level, which in many types of research is not considered as a valid effect. Still, the finding supporting H_2 is important since fake news is, in general, more negative than real news (Paschen, 2019). So, people will be even more misled by negative fake news, because it increase fake news susceptibility compared to positive fake news and is also more common than negative real news. Moreover, no evidence was found to support H_3, since the perceived vulnerability to disease level and the amount of coronavirus news consumed did not present a statistically significant relation on the perceived headline accuracy. There was found however that being more concerned about the COVID-19 decreases the chances of rating a headline as accurate. All these findings should be examined simultaneously with these study limitations.

5.2 Limitations

This research does not exist without its limitations. And being conscious of these limitations is important to interpret these research findings, as well as its validity. The sample used in this study consists of 170 participants. When comparing our total sample size with the sample used in some published studies about fake news, such as Pennycook et al. (2020a), there is verified that those studies in their majority have more than 1000 participants. This high amount of participants gives a higher statistical power for the statistical analysis results and gives support to their findings. So the first limitation of this study is the sample size, which is thus transformed in statistical power.

Next to that, most of the participants herein were contacted directly or indirectly by myself. Therefore it is likely that the participant's sample used in this research does not represent in a balanced way the outside world population (i.e., that possibly there is a lack of population representativeness in our sample). The lack of representativeness can be verified by taking, for example, the participant's level of education into account. The majority of the participants have a university degree. Yet, this distribution does not follow the reality of the outside world, since most people don't follow university studies. When taken into account this shows that selection bias could be present in our sample.

In addition it would have been interesting to ask participants in the emotion group to which extent they used reason when judging the headlines accuracy and to the participants in the reason group to what amount they used emotion when reporting the headlines accuracy. This data would then be combined with the data collected from the question that was asked in our survey, to which extent participants used their given emotion when judging the 20 headlines. And there could be compared to which extent participants in both treatment groups used their reason and emotion when judging the veracity of the headlines.

In order to know how big the optimal sample size is, a power analysis can be done. Having enough power decreases the chances of encountering a type 1 error (α), type 2 error (β), or power of the test (1- β). And it gives support to our results. For this study, no power calculation was done. Because to do so, this need to be based on some data, which was not necessarily available. For further research a power calculation could be done, based on this study data, to test the hypothesis more suitably.

In the method used by this study, no control group was established, which limits the interpretability if no treatment was given to the participants. For better comprehension of the specific effect of emotion and reason in fake news susceptibility and to find more precisely the difference between groups, a next research should consider also a control group. Also, it could be said that the methodology used to divide the news in positive and negative is pretty amateurish from a scientific perspective. Since the news headlines chosen to be of negative and positive valence were selected by myself by pure gut feeling and afterwards submitted to a percentage agreement test by two independent reviewers. For a next research, the methodology to account for the news valiance division could be improved.

5.3 Future research

A lot of studies have contributed to a better understanding of fake news and how it affects human beings. Yet still, there is a lot of unexplored territories concerning fake news in science to be researched. For future research, I propose some different approaches to subjects already studied. Not necessarily in the COVID-19 context, since such a pandemic is something unusual and will probably have an end. First I propose to incorporate fake news susceptibility, with political ideology and the valence of the information. Some studies found that distinguish political views is related to differences in how people process news valence (Carraro, Castelli & Negi, 2016). So this could be brought to the fake news context. Secondly, it is important to have a better look at different types of emotions and focus on those who have a higher relation

in fake news acceptance. Lastly, I propose that this study should be redone, with the improvements mentioned in the implications. It would also be interesting to use an emotion scale (e.g., PANAS scale and Discrete Emotions Questionnaire) and different fear scales (e.g., Fear Survey Schedule-II, Taylor Manifest Anxiety Scale, Welsh's A-Scale, and Bendig's Emotionality Scale) to verify more precisely the effect of specific emotions and fear in fake news susceptibility, not only for the COVID-19 context but in general.

6. Conclusion

A lot of research has been done to understand how fake news misleads people and to comprehend ways to combat their effects. This study combined the fake news theme, with reliance on emotion and reliance on reason. Also, it incorporates headline valence, as well as brought the COVID-19 context to such a theme. In previous literature, there were things written on all of these topics. However, no yet a study was conducted to connect all these topics at once. So this study was an attempt to pursue discoveries of these subjects combined. This study's main subject of interest was to find evidence that reliance on emotion increases fake news acceptance as being accurate, compared to reliance on reason, as stated in Martel et al. (2020). But no significant result was found to support this hypothesis. Furthermore, there was found evidence that negative valence news increases the probability of rating fake news as accurate compared to positive valence news. Also, that people who self-reported a higher concern of the coronavirus judge on average more news as accurate. Yet this is not specifically for fake news. In summary, this study was not able to confirm neither to reject H_1, while it was able to find evidence suggesting that H_2 is accurate, and it discovered evidence to reject H_3. The findings also present some doubts regarding their external validity, and for further research, these should be taken into consideration for improvements.

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8. Appendix

Appendix A

Table A1 : *Main Variables Description*

Variable name	Description
Treatment	Binary variable indicating which treatment was given to that person (0 = reason, 1 = emotion)
Age	Continuous variable indicating the participant age (in years)
Gender	Dummy indicating the person gender (0= female, 1= male).
Education	Categorical variable indicating the highest attained level of education (1= Highschool, 2= Bachelor, 3= Master, 4= PhD)
Brazilian	Dummy indicating if you are Brazilian (0= not Brazilian, 1= Brazilian)
Duration	Continuous variable indicating the total time the participant spent to finish answering the survey (in minutes)
COVIR-19 Concern	Variable indicating how concerned the participant is regarding the COVID-19. Measured from 0 (not concerned at all) to 10 (extremely concerned).
COVID-19 News	Categorical variable indicating to which extent the participant proactively checked news regarding the COVID-19 (1= never, 2= rarely, 3= sometimes, 4= often, 5= very often).
PVD Score	Variable indicating the average level of the participant perceived vulnerability to disease using an average 15-item measure (1= strongly disagree…..7= strongly agree).
Consistent	Dummy indicating if the participant indicated his allocated treatment group (i.e., he was consistent) when answering the manipulation check question (0= not consistent, 1= consistent).
Extent	Categorical variable indicating the extent the respondent reported usage of his allocated treatment when judging the news headlines (1= none at all, 2= a little, 3= a moderate amount, 4= a lot, 5= a great deal).
Fake	Dummy indicating if the news headline is real or fake (0= real, 1= fake).
Negative	Dummy indicating if the news headline consists of an headline with a negative or positive valence (0= positive, 1= negative).
PVD GermAversion	Variable indicating the level of the participant germ aversion using an average 8-item measure (1= strongly disagree…..7= strongly agree)
PVD Infectability	Variable indicating the level of the participant perceived infectability using an average 7-item measure (1= strongly disagree…..7= strongly agree).
Perceived Headline Accuracy	Dummy indicating if the news headline was perceived as being accurate (0= perceived as not accurate 1= perceived as accurate).

Table A2: *Shapiro-Wilk Normality test*

Variable	Obs	W	V	z	Prob>z
Duration	170	0.25	97.139	10.442	0.000001
Age	170	0.83	22.068	7.06	0.000001
COVID-19 Concern	170	0.934	8.489	4.88	0.000001

Table A3: *Correlation Matrix*

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Perceived Headline Accuracy	1.000								
(2) Treatment	0.004	1.000							
(3) Fake	-0.444*	0.000	1.000						
(4) Negative	-0.030	0.000	0.000	1.000					
(5) PVD Score	-0.013	0.040*	0.000	0.000	1.000				
(6) PVD Germ Aversion	0.014	0.104*	0.000	0.000	0.822*	1.000			
(7) PVD Infectability	-0.038*	-0.048*	0.000	0.000	0.772*	0.272*	1.000		
(8) COVID-19 Concern	-0.067*	0.151*	0.000	0.000	0.376*	0.337*	0.259*	1.000	
(9) COVID-19 News	-0.03	0.072*	0.000	0.000	0.239*	0.182*	0.201*	0.448*	1.000

*** p<0.01, ** p<0.05, * p<0.1

Table A4: *Collinearity Statistics*

Variables	VIF	SQRT VIF	Tolerance	R-Squared
Treatment	4.02	2.01	0.249	0.752
Fake	3.82	1.95	0.262	0.738
Negative	3.82	1.95	0.262	0.738
Treatment*Fake	5.82	2.41	0.172	0.828
Treatment*Negative	5.82	2.41	0.172	0.828
Fake*Negative	5.73	2.39	0.175	0.826
Treatment*Fake*Negative	6.73	2.59	0.149	0.851
PVD Score	1.17	1.08	0.852	0.148
COVID-19 Concern	1.41	1.19	0.710	0.290
COVID-19 News	1.26	1.12	0.794	0.207
Mean VIF	3.96			

Table A5: *Collinearity Diagnostic*

	Eigenvalue	Cond Index
1	7.058	1
2	1.526	2.151
3	0.884	2.825
4	0.845	2.890
5	0.221	5.650
6	0.155	6.751
7	0.149	6.893
8	0.072	9.910
9	0.044	12.633
10	0.030	15.334
11	0.016	21.212
Condition Number		21.212

Appendix B

Table B1: *Odds ratio results from the coefficients in Table 6*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Treatment	1.02	1.031	1.042	1.044	1.099
Fake	0.148***	0.150***	0.080***	0.080***	0.078***
Negative			0.691	0.691	0.689
Treatment*Fake		0.976	1.011	1.011	1.014
Treatment*Negative			0.982	0.982	0.982
Fake*Negative			3.209*	3.209*	3.235*
Treatment*Fake*Negative			0.945	0.945	0.944
PVD Score				0.959	1.046
COVID-19 Concern					0.992***
COVID-19 News					0.998
Constant	2.248***	2.237***	2.707***	3.219**	3.699**
Observations	3,400	3,400	3,400	3,400	3,400

*** p<0.01, ** p<0.05, * p<0.1

Table B2: *Average marginal effect results from the coefficients in Table 6*

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Treatment	0.005	0.008	0.01	0.011	0.023
Fake	-.483***	-0.480***	-0.628***	-0.628***	-0.628***
Negative			-0.092	-0.092	-0.092
Treatment*Fake		-0.006	0.003	0.003	0.003
Treatment*Negative			-0.004	-0.004	-0.004
Fake*Negative			0.289*	0.289*	1.289*
Treatment*Fake*Negative			-0.014	-0.014	-0.014
PVD Score				-0.01	0.011
COVID-19 Concern					-0.002***
COVID-19 News					0.00
Observations	3,400	3,400	3,400	3,400	3,400

*** p<0.01, ** p<0.05, * p<0.1

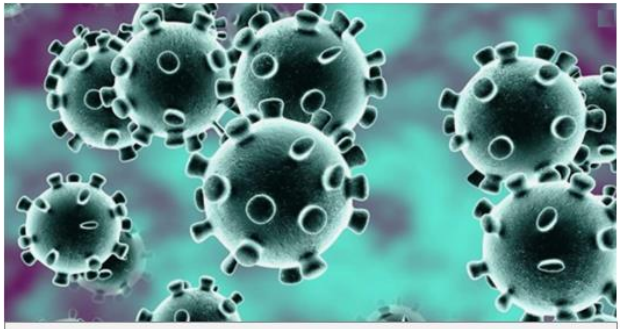
Notes. When the average marginal effect is run in Stata for Models 3, 4 and 5 only the coefficient results are displayed, while the standard errors are missing and the following message pops up *"warning: variance matrix is nonsymmetric or highly singular"*. Searching for an explanation, there was encountered a post from Jeff Pitblado from StataCorp, suggesting that this occurs because there is an "sparse indicator problem".

Appendix C

Figures C1: *Fake Positive Headlines*

CITYSCROLLZ.COM

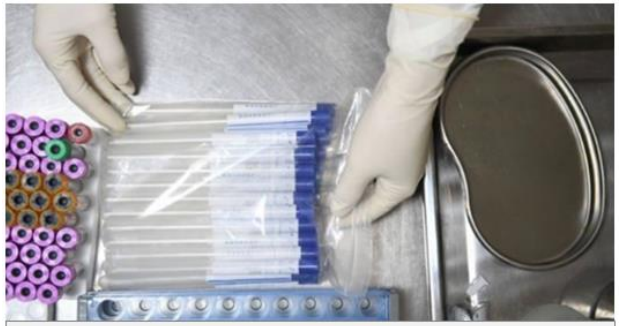
Chinese Doctors Confirmed African Blood Genetic Composition Resist Coronavirus After Student Cured



FILMDAILY.COM

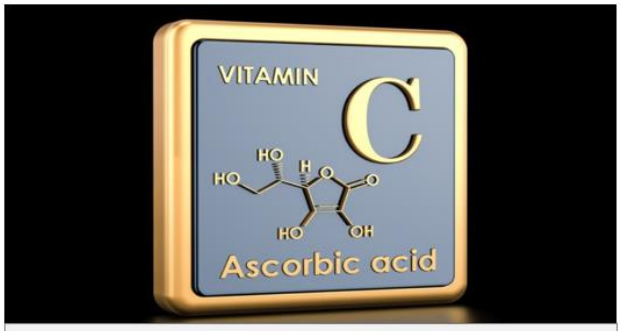
Is Colloidal silver a cure for coronavirus? – Film Daily

Is Colloidal silver a cure for coronavirus as televangelist in the US and severa...



FOX46CHARLOTTE.COM

University of Tennessee scientist may have found coronavirus cure.



HEALTHIMPACTNEWS.COM

Vitamin C protects against Coronavirus.

HEALTHIMPACTNEWS.COM

Coconut oil's history in destroying viruses, including Coronaviruses.

Figures C2: *Fake Negative Headlines*

TECHTIMES.COM

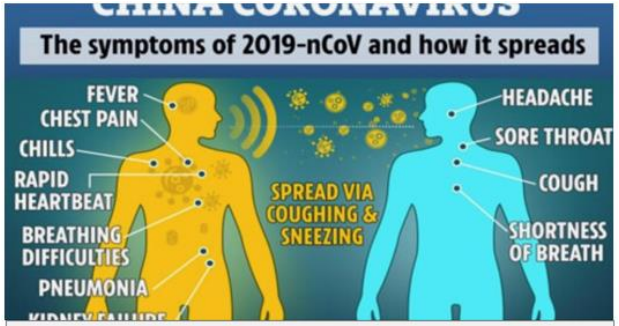
Covid-19 is Now Mutating Into Something Indescribable That is Now Found in Brazil!

CBN2.COM

Vatican confirms Pope Francis and two aides test positive for the Coronavirus.

BLUNTFORCETRUTH.COM

Governor Cuomo Signs Law Using Coronavirus as an Excuse to Take 'Temporary' Dictatorial Powers – Blunt Force Truth.



COERCIONCODE.COM

Unbelievable – Gates Foundation Predicted 65 Million Deaths Via Coronavirus 3 Months Ago!!!

WASHINGTONEXAMINER.COM

328 Chinese nationals caught entering US illegally

At least 328 Chinese national trying to enter the United States illegally since...

Figures C3: *Real Positive Headlines*

THEGUARDIAN.COM

Coronavirus in Europe: Germany and Austria reopen restaurants as new normal beckons

SCIENCEMAG.ORG

Japan ends its COVID-19 state of emergency

CNET.COM

Amazon plans to prosecute sellers for price gouging during coronavirus outbreak.

NBCDFW.COM

Dallas County Reports No COVID-19 Deaths, Lowest New Case Number Since Late April

NOCAMELS.COM

Israeli Bio-Defense Lab Says It Found An Antibody That 'Neutralizes' The Coronavirus

Figures C4: *Real Negative Headlines*

STATNEWS.COM

Biopharma companies are spreading misinformation – and taking advantage of it

STATNEWS.COM

CDC: Coronavirus spread may last into 2021, but impact can be blunted

CBN2.COM

Police In The US Spread A False Claim That Meth Is Contaminated With Coronavirus

BUSINESSINSIDER.COM

Trump spent the last 2 years slashing the government agencies responsible for handling the coronavirus outbreak.

SCIENCEMAG.ORG

Why airport screening won't stop the spread of coronavirus

Temperature checks and health questionnaires very rarely catch infected…

Appendix D

Figure D1: *Detailed diagram of the survey*

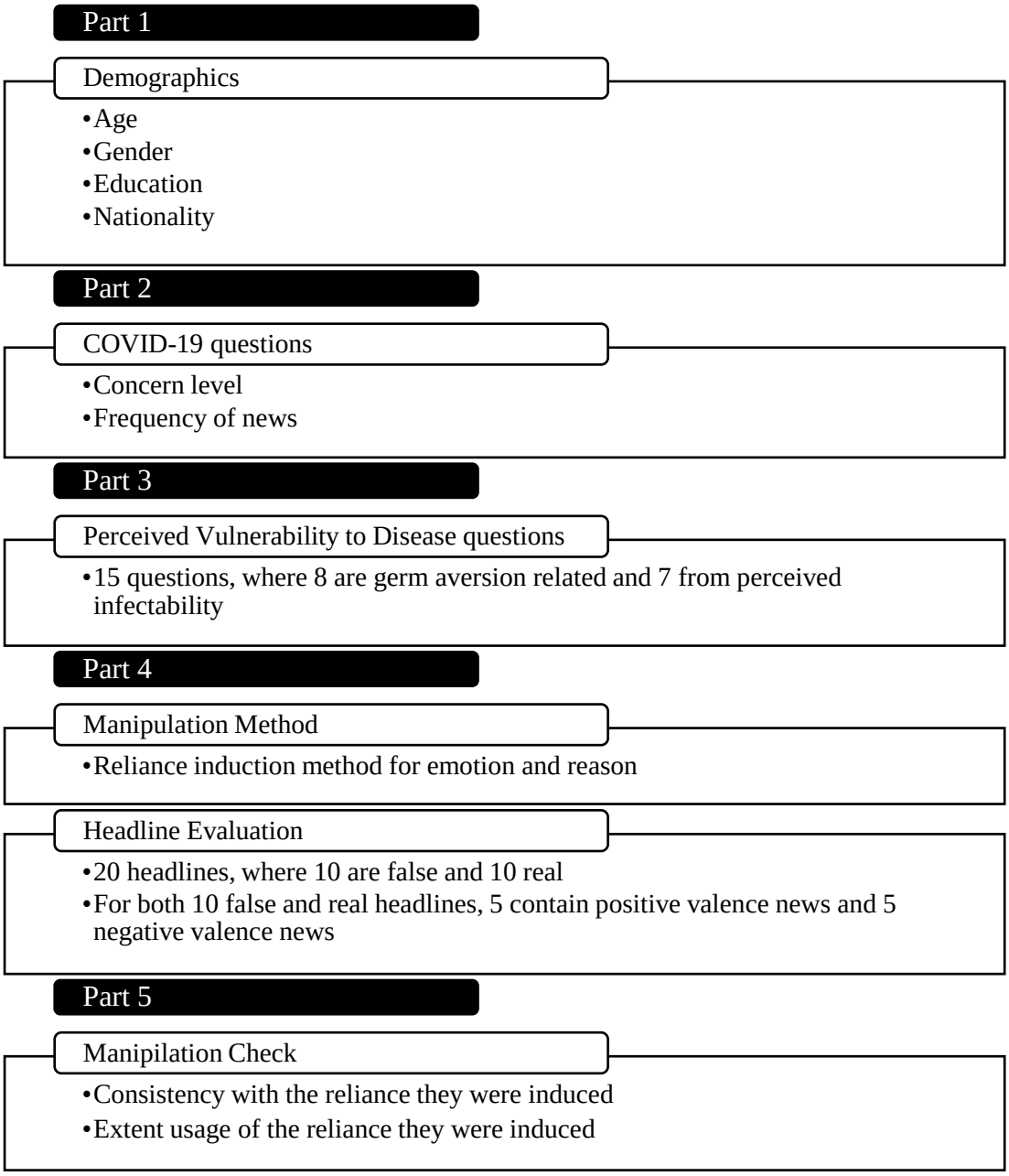


Table D2: *Perceived Vulnerability to Disease Scale*

Participants responded to each item on a 7-point scale (with endpoints labelled ‘‘strongly disagree” and ‘‘strongly agree”).

Questionnaire	Reverse-scored	Perceived Infectability	Germ Aversion
It really bothers me when people sneeze without covering their mouths.			x
If an illness is ‘going around’, I will get it.		x	
I am comfortable sharing a water bottle with a friend.	x		x
I do not like to write with a pencil someone else has obviously chewed on.			x
My past experiences make me believe I am not likely to get sick even when my friends are sick.	x	x	
I have a history of susceptibility to infectious disease.		x	
I prefer to wash my hands pretty soon after shaking someone’s hand.			x
In general, I am very susceptible to colds, flu and other infectious diseases.		x	
I dislike wearing used clothes because you do not know what the last person who wore it was like.			x
I am more likely than the people around me to catch an infectious disease.		x	
My hands do not feel dirty after touching money.	x		x
I am unlikely to catch a cold, flu or other illness, even if it is ‘going around’.	x	x	
It does not make me anxious to be around sick people.	x		x
My immune system protects me from most illnesses that other people get.	x	x	
I avoid using public telephones because of the risk that I may catch something from the previous user.			x

Literature:

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. Personality and Individual differences, 47(6), 541-546.