Viruses, Vaccines, and Health Decision-Making

Background

Misinformation on social media has become rampant, a problem especially accelerated by social media-dependent communication throughout the entire world during the COVID-19 pandemic, beginning in March of 2020. Dr. Valerie Reyna's Laboratory for Rational Decision Making at Cornell University began to study the nature of social media communication during COVID-19 from a psychological perspective, particularly what meaning or 'gist' humans extract from social media messages during such a time. This study is ongoing, and while the results I report here are preliminary, this work aims to investigate how meaning is made through social media messages during difficult times. Specifically, this work has the potential to reveal how key words from social media messages (extracted using a machine learning model) may convey different baseline meanings or 'gists'—a question of great relevance to domains such as public health.

Literature Review

Misinformation on social media spreads easily because more 'gisty' social media posts tend to be more widely shared, regardless of whether they are accurate or not (Broniatowski & Reyna, 2020); Broniatowski et al. 2016). In order to combat this misinformation, reliable sources must provide accurate information that is presented in a gisty, understandable manner (Reyna et al., 2021). One rising method of combatting social media misinformation has been fact-checking, which often entails correcting spreading misinformation, or in some cases, removing misinformation from circulation (Reyna, Broniatowski, & Edelson, 2021).While this method may provide modest benefits, people often tend to continue sharing misinformation even if they know it is incorrect, because when people do not understand a scientific concept or correlation,

they find it helpful to connect the dots in a way that make logical sense to them, which often come from gisty messages (Reyna, Broniatowski, & Edelson, 2021). Fact-checking alone cannot slow the spread of social media misinformation, but putting similarly gisty, yet accurate, information into circulation may curb the popularity of inaccurate social media posts (Reyna, Broniatowski, & Edelson, 2021).

Fuzzy trace theory (FTT) posits that humans process information in two parallel ways, verbatim and gist—verbatim is the surface representation of information (e.g. exact words, images, graphs, etc.) and gist is the bottom line meaning (Reyna & Brainerd, 2023). The degree of reliance on verbatim and gist processing differs across development, with adults tending to rely more on gist for decision-making (Reyna & Brainerd, 2023; Reyna, Broniatowski, & Edelson, 2021).

Per FTT, information communicated in a "literal, dry, and emotionless" way often lacks a bottom-line meaning, sometimes leading people to create more gist-based, incorrect explanations on their own (Reyna, 2021, p. 4). While the World Health Organization is adept at providing understandable messaging in their short infographics, they often hesitate to detail the gist for their audience, favoring rote facts that may fail to inspire behavioral changes. For example, one infographic of theirs on child vaccinations has the large heading: "There is growing evidence that children can be safely vaccinated against COVID-19" (*World Health Organization*, 2022). On January 3, 2022, the CDC recommended COVID-19 vaccination for individuals 5 years and older, and this infographic was published nearly three months later (*COVID-19 Vaccine for Children and Adolescents*, 2022). While the heading is literally true, it is misleading. If a parent was skeptical of vaccinating their children in 2022, "growing evidence" of safety may imply a lack of current sufficient prior evidence, which was not true as the vaccine had already been

approved for children months before. This could have been phrased in a more gist-based way, while preserving accuracy yet reassuring parents that the vaccine is already safe. In our time, scientific information "and misinformation are in a battle for the gist," as while people may receive correct scientific information, if it fails to communicate the gist, people will not necessarily be able to grasp its bottom-line meaning (Reyna, 2021, p. 1). Thus, creating more gist-based, yet accurate, public health messages will aid in the public's understanding of medical concepts that they are not able to fully grasp on their own. The present report is subsumed under a larger study that could potentially provide empirical evidence for how people create gists from social media communication. While public health messaging has long taken a literal tone for fear of being seen as biased or persuasive, it is necessary to move away from this form to create more effective messaging that can spur on differences in individuals' behavior.

FTT introduces the concept of the status quo gist, as the interpretation of the gist may be altered depending on the status quo (i.e., as "okay" or "not okay") (Reyna, 2012; Reyna, Broniatowski, & Edelson, 2021). While the general gist may support certain safety measures like masking, the status quo gist communicated through social media may differ. FTT emphasizes the importance of communicating gists around COVID-19 that call attention to people's core values, ones that individuals want to reflect in their COVID risk-reduction efforts (Reyna, 2012). Once noticed, more gist-based communication leads to greater virality on social media (Broniatowski & Reyna, 2020; Broniatowski et al. 2016). In a study of how social media virality indicates trend changes in COVID-19 preventative measures, Ding and colleagues found that when there was an uptick in certain public health measures, such as COVID-19 vaccinations, there was a similar uptick of negative reddit posts about the topic (Ding et al., 2024). This paper argues that content moderation could be a useful tool to stop the spread of disinformation. Both this study and the

current research project are interrogating the reality of public health in the screen age, and considering how social media can be utilized positively.

In a paper studying how information was disseminated on social media during the 2014 Disneyland measles outbreak, Broniatowski et al. found that messages that expressed a more clear bottom line gist were more likely to be shared (Broniatowski et al. 2016). Messages including verbatim statistics also had increased virality, although not to the same extent as gisty messages. Broniatowski and colleagues concluded that gisty messaging aides in the understanding of complex scientific topics, and using the knowledge that gist-based messaging is effective and popular, healthcare providers and public health organizations should refine their messaging using gist to become more effective. The current research project, studying exactly how people create gists from social media generated prompts, may elucidate the nuances of how to alter messages to create stronger, more cogent communications.

In a recent study, Edelson and colleagues found that the extent to which college-aged people endorse categorical thinking and gist principles correlated with COVID-related risks (Edelson et al., 2024). Greater endorsement of categorical thinking and gist principles correlated with taking fewer COVID-related risks. Categorical thinking captures the most basic gist by creating simple, binary distinctions (e.g., “It only takes once to get COVID-19.”) (Edelson et al., 2024, p. 357). Gist principles are social values boiled down to a simple, gist-based form (e.g., “You should not hurt other people by giving them COVID-19.”) (Edelson et al., 2024, p. 357). Gist principles involve values associated with social responsibility (as in the previous example) or risk avoidance. This study suggests that public health messaging should focus on “gist-based thinking and retrieval of simple core values”. This study also notes that future work should test

gist-based public health messaging. The current research project may fill this gap in the realm of social media, testing the dissemination of information through social media messaging.

Problem Statement

During the height of the COVID-19 pandemic, different messaging campaigns led to different impacts on real world behavior. In trying to convince people to mask, what got through to community members? Was it mentions of the immunocompromised and the elderly? Was it repeated references to science and masking? Did emphasizing the risk of death enrage people, or did it inspire them to be more cautious? Particularly, what kind of qualitative gists do people extract, especially during a public health crisis, from the corpora of social media posts and messages they are exposed to every day? The project I was part of this summer, aims to address these questions. These are questions that the Reyna lab is working to answer with this study, analyzing survey participants' responses to social media-based prompts.

Methodology

Social media posts and messages were sourced between March 3, 2020 and May 1, 2020, later referred to as 'Wave 1'. Data collected from social media for 'Wave 2' between August 15, 2020 and October 13, 2020. These social media posts were grouped based on similarities, and then prompts, known as "topics", were generated using a machine learning topic model. For each social media platform per wave, the model generated 50 sets of 10 words or 10 examples each, with one set referred to as a 'topic'. An example of a words only topic is "city coronavirus york florida state residents mayor cuomo nursing home". Participants – students and adults – were provided with these topics grouped as examples only, topics only, or both, and they were asked to summarize the gist of each topic. Number of participants varied for each cell of the design, but for the first recruitment platform (college students), the number of Wave 1 participants ranged

from 53-66, and the number of Wave 2 participants ranged from 57-62. For the second recruitment platform (adults), the number of Wave 1 participants ranged from 48-50, and the number of Wave 2 participants ranged from 47-52.

Our team categorized participants' responses based on strict decision rules. An example of a category is "The impact of Covid-19 (coronavirus, virus) on nursing homes (long term care facilities)". As a Laidlaw scholar this summer, my primary job has been to test the reliability of these categories, which determines their consistency and ensures that these final categorizations are strong and reliable, as they communicate the overall gists our participants extracted from the topics, and would be key to any future analyses.

Sections of the survey were divided into different kinds of questions (e.g. words only, examples only, and both) and further divided into different social media platforms (e.g. Facebook and Twitter). An example of one section would be "Twitter Words Only", and for each section like this, the reliability process would be carried out using two randomly selected topics from the section. The inter-rater reliability process entails repeating the categorization process for these topics.

The reliability process is completed by at least two people. The first person is the original categorizer of the responses that participants provided. This step of the process was already completed. The second person is the second categorizer of these topics, and categorizes them without seeing the first person's categories, based on decision rules that are followed by all categorizers. An example of a decision rule would be that categories must be as specific as possible, and for variances in specificity, new categories should be created. The purpose of the reliability process is to compare one person's categories with another's, to test the inter-rater reliability of these categories.

During my first Laidlaw summer, it was primarily my job to find the reliability for many of the Wave 1 and Wave 2 categorizations.

Findings

Ultimately, for Wave 1, 21 out of 30 topics were found to have high reliability. For Wave 2, which is the data I primarily worked with, 21 out of 24 topics were found to have high reliability. This is based on the percent of responses matched exactly, under each category.

There did not seem to be specific words in the topics that led to higher reliabilities, even looking at topics with very high reliability (90% or above). The clearest indicator of what will lead to sufficient reliability is a very coherent topic, where the words portray obvious, strong commonality or communicate a bottom-line meaning. An example of a topic with a very high reliability is "covid coronavirus nfl football sports nba game mlb stayhome news," which had a reliability of 93.10%.

In Wave 1, from the first recruiting platform (college students), 13/19 (68.42%) topics tested had high reliability, and from the second recruiting platform (adults), 9/11 (81.82%) topics tested had high reliability. In Wave 2, from the first recruiting platform, 15/18 (83.33%) topics tested had high reliability, and from the second recruiting platform, 6/6 (100.00%) topics tested had high reliability. This indicates strong overall inter-rater reliability for the qualitative categorization process.

Discussion

These results demonstrate for the first time how coherent semantic themes can be extracted from thousands of social media messages. The reliabilities were the last step in this process of completing the categorizations. We will now pivot to different areas of this project, specifically more quantitative ones. At the very end of my research for the summer, I formatted

the correlations and descriptives for the dataset associated with this project. Next steps will include analyzing these correlations and descriptives, and examining findings across different demographic factors of the participants like age, sex, and nationality. As a member of this research team, I have begun learning how to use statistical softwares like IBM SPSS and running analyses like correlations, and I hope to continue working on this. I am interested to see how the reliabilities done on Waves 1 and 2 will contribute to later analyses, and particularly how topics with low reliability may reveal interesting findings about how those topics elicit less coherent gists than other topics.

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