CONVERGE COVID-19 Working Groups for Public Health and Social Sciences Research

Research Agenda-Setting Paper

This paper was written to help advance convergence-oriented research in the hazards and disaster field. It highlights areas where additional research could contribute new knowledge to the response to and recovery from the pandemic and other disasters yet to come. Questions about the research topics and ethical and methodological issues highlighted here should be directed to the authors who contributed to this paper.

Working Group Name:

Social Media Data, Machine Learning, and Predicting Online Disinformation Propagation

---

Working Group Description:

This Working Group is comprised of a team of computational social scientists, psychologists, and public health specialists who specialize in the analysis of experiential narratives, social media data, and machine learning. The group predicts the spread of COVID-19 disinformation in social media networks. Leveraging social science, public health, and computer science, it will correlate group-level psychological traits with the spread of disinformation related to COVID-19 across social media.

Research Justification:

A well-informed populace is critical to a well-functioning democracy. In democracies, ideas compete in the marketplace for attention, and therefore, when the populace is exposed to misinformation, it can have adverse impacts. The 2016 U.S. election and other recent politicized events have demonstrated the ability of misinformation to alter political preferences (Howard, Ganesh, Liotsiou, Kelly & François 2019). The World Health Organization declared the outbreak of the coronavirus disease 2019 (COVID-19) a pandemic on March 11, 2020 (Bedford, et al., 2020). Since then, a significant amount of misinformation regarding the COVID-19 pandemic has since been circulated online and in news media, evolving into an "infodemic" (Oxford Analytica 2020). Online, the spread of misinformation is especially acute in social media groups organizing "reopen" protests, leading directly not only to possible super-spreader events, but also to armed confrontations between protestors and elected officials (Seitz 2020).

Misinformation can include, but is not limited to, content that promotes alternative, medically unsubstantiated methods to prevent the coronavirus, to conspiracy theories, or anti-vaccination messaging. Influence operations, like this emerging infodemic, seek to influence social attitudes and behaviors on a population-wide scale. Malicious actors use misinformation tactics to encourage moral panic, distrust in public institutions, and irresponsible or harmful social behaviors, such as dismissing medical expertise, encouraging inter-ethnic violence, and violent anti-regime protests.

Combating this misinformation uses valuable resources needed to track pandemic data and provide required public health information to the public. Current efforts in curbing health misinformation, such that around

COVID-19, have largely relied on the efforts of human fact checkers, who work tirelessly to identify social media posts conveying false or misleading information. These approaches are laborious, expensive, and heavily limited by availability of experts. Unsurprisingly, these challenges become more pronounced during global public health crises and emergencies—partially due to the evolving evidence being put forth by infectious disease experts regarding the foundations of the illness, or the myriad socio-political-economic repercussions. Further, crisis events like these subject large populations to anxiety, stress, and uncertainty, increasing their vulnerability to misinformation as they engage in collective sensemaking of the volatile situation surrounding them. Moreover, during health emergencies, information often plays out in real-time; but it can be several days before anyone with a scientific background is able to debunk a false claim. Public health organizations like the CDC, state public health departments, and public safety forces are in need of tools to augment their surveillance capabilities and to dispel misinformation before it influences unwanted social or political actions.

This Working Group targets several questions around this infodemic: What determines when and why individual social media users spread misinformation about COVID-19? What psycho-social factors determine how people react to different types of information about COVID-19? How can we use this knowledge to assist public health and safety responders to provide the public with quality, effective counter-information, and reduce adverse psychological effects? And, at what point does exposure to misinformation lead to changes in social behavior?

Adopting an interdisciplinary lens, we will examine these aspects of online social response to COVID-19 information through social science and public health perspectives, and by applying novel computational methods. Then using a human-centered machine learning approach, our social media data analytics process and social climate assessments will directly involve fact-checkers, stakeholders, and domain-experts in public health, to evaluate the categories of information being investigated, along with its content, and how it is spreading over time in the online social networks as well as the offline world. Our interdisciplinary team will further develop a system dynamics technique, to collect and analyze narrative dialogue about specific geo-political topics found through open sources including social media, published empirical research, content knowledge from periodicals and online sources, general news media, and historical case references to enrich our data set. Lastly, we will conduct online anonymous interviews to detail first-person accounts of how policies related to COVID-19, like social distancing, affect the psychological health of individuals and if these effects also correlate with beliefs in various forms of misinformation.

Prioritized Working Group Research Agenda:

Media Information and Social Climate Framework

We will create a social media information framework to classify COVID-19 related misinformation. Using social media data collected using the Twitter Application Programming Interface (API), and Facebook CrowdTangle Platform, we will utilize Natural Language Processing (NLP) and Machine Learning (ML) methodologies to correlate group-level psychological traits and the spread of COVID-19 misinformation through social media. In particular, we will detect linguistic features that are indicative of psycho-social processes and influence factors. For example, previous research has demonstrated that it is possible to identify particular emotional and personality content from linguistic features in written and social media text to assess patterns, themes, and psychologically-based content (e.g., Panicheva et al. 2016; Tausczi & Pennebaker, 2010).

Next, we will develop a ML approach to detect characterizing attributes of COVID-19 information. In contrast to prior work that has adopted a purely data-driven approach for detection, our ML techniques will consider COVID-19 misinformation within the larger technological, political, and sociological context through the iterative involvement of social and health science scholars. For example, our ML models will

consider various ecological perspectives, as gleaned through the content of social media posts and the social network structures of the individuals who share them, the attitudes and beliefs of the individuals themselves, and the characteristics of their social networks (Wang, McKee, Torbica, & Stuckler, 2019). Moreover, misinformation is often embedded in story formats, and in fact, emotions can also be used to promote and make misinformation salient, such as by embedding fear into misleading claims. Evidence for phenomena such as message fatigue is also relevant to our inquiry (Tasnim et al. 2020). Accordingly, our ML models will use guidance from health communication theories that would help capture the narrative sentiments underlying COVID-19 misinformation. Finally, using digital trace data from social media as well as other online platforms, including geo-located meta-data, check-ins, and pictures, we will correlate propensity to spread misinformation with verified political activities including voting, signing petitions, and/or engaging in protest.

Psychological Impact on Populations

Evidence from medical, social, and behavioral science-informed investigations of the effects of COVID-19 on individuals and communities is continuing to be reported. Standards and recommendations have rapidly been released from the public health community in an effort to summarize best practices for the general public and health providers in their daily operations during a time of rapidly elevating workload and occupational/personal stress, as well as maintaining a measure of self-care through this time (CDC, 2020; SAMHSA, 2020; SAMHSA, 2020; IASC, 2020). One recent study of the psychological impact of COVID-19 on healthcare workers in Wuhan, China, has identified that this community is one particularly at risk for experiencing mental health issues due to their direct exposure (Kang, Ma, Chenb, Yangb, & Wang, 2020, in press). Effects of such aspects as quarantine and social distancing; drastic fluctuations in workload, work process, or income; and physical or mental exposure to COVID-19 through direct/indirect illness or professional responsibilities, have significantly impacted people around the globe (Brooks, et al., 2020). A number of community interventions and research priorities should be considered as we navigate through experiences related to the COVID-19 pandemic (Holmes, et al., 2020; Pfefferbaum & North, 2020; Torales, O'Higgins, Castaldelli-Maia, & Ventriglio, 2020; Van Bavel, 2020).

As communities continue to experience the impacts of COVID-19, it is critical that community leaders understand the full range of what their people are experiencing in their daily lives. This should include reactions to public health measures taken to reduce the spread of disease, as well as the actions, communications, and attitudes of leaders, supervisors, businesses, and other members of the general public. Particular members of the public depending on various psycho-social factors, such as how well someone tolerates a reduced sense of control or manages different aspects of fear response, may be more susceptible to stress and mental health effects (Bedford, et al., 2020; Schimmenti, Billieux & Starcevic, 2020; Taha, Matheson, Cronin, & Anisman, 2014). Similar factors, including economic downturns and political instability, may also explain susceptibility to influence operations. Stress, moral panic, and heightened vulnerability may lead individuals or groups to engage in political activity that is different from their everyday experience (Case and Deaton 2020). A more stressful environment may thus presage more political instability.

We will leverage current COVID-19 research, mental health pandemic consultation guidelines and research developed by working group members, to create and conduct an online, anonymous, experiential interview, guided by social media analysis, in order to assess how communities have been impacted by the COVID-19 pandemic (Crooks, 2020; Crooks, et al., 2020; De Choudhury, Morris, & White, 2014; De Choudhury & De, 2014). We will conduct an online interview over a number of weeks using Qualtrics survey software licensed through Georgia Tech. We will then analyze the online interview data to understand first-person experience of the impact of COVID-19 for each community assessed. Further, drawing upon De Choudhury's prior research that has revealed the potential to understand people's mental health needs via social media (De Choudhury, Morris, & White, 2014; De Choudhury & De, 2014), we will focus our analysis on the COVID-

19 related experiences of faculty, healthcare workers, and first responders by conducting an exploratory social media analysis to discover key experiences related to psychological impact of COVID-19 on these professional groups. Our data collection methodology will be comprised of a range of specialized, fielded instruments, and open-ended interview questions designed to collect relevant data for immediate exploration of community needs as a result of COVID-19 impact, and utilize psychoanalytic social science research methods (Dahmer, 1993). Of particular interest will be to investigate how social distancing mandates, re-opening of economic activities, and widespread consumption of news via online means has been impacting people's psychological wellbeing, and how misinformation on COVID-19 may be exacerbating these experiences. With statistical modeling, we will particularly seek to unpack the relationship between the extent of exposure to misinformation and various clinically grounded mental health outcomes and social behaviors.

Significance of Research and Collaborative Funding Pursuits:

The significance of this research contributes to ongoing debates in national security and social sciences about social influence operations. Future research can assist in discovering latent dimensions and unique linguistic identifiers regarding psycho-social influence factors and susceptibility to mis/disinformation campaigns designed to weaken individual trust in democratic institutions. This research will also lead to a greater understanding of the psychological impacts of COVID-19 on community members from a range of demographics, occupations, and lived experiences.

If successful, the project will advance the technical and practical use of psychoanalytic social science methods, social media data for discovery of social climate, natural language processing, and machine learning based techniques during global public health and other emergencies impacting national security. It will also lower barriers by providing tools to relevant stakeholders in an unprecedented manner to address infodemics. For instance, the outcomes of this work will facilitate public health and fact checking organizations attend to COVID-19 misinformation more directly, and devise strategies to counter misinformation through public interventions and policy change.

Priority Research Topics and Specific Research Questions:

Priority Research Topics	Potential Research Questions
1. Social Media Disinformation & COVID-19	• What determines when and why individual social media users spread misinformation about COVID-19 • What psycho-social factors determine how people react to different types of information about COVID-19? • At what point does exposure to misinformation lead to changes in social behavior?
2. Psychological Health Impacts on Target Populations	• How can we use this knowledge to assist public health and safety responders to provide the public with quality, effective counter-information, and reduce adverse psychological effects?

Ethical / Methodological Considerations:

We have previously received Georgia Tech IRB Exemption approval for the collection of our social media data and will obtain IRB approval for the narrative interviews. A major methodological challenge will be developing a ground-truth set of labels for tweets that are categorized as disinformation. We will utilize the latest advances from public health, medicine, and social science to develop these class labels, which should serve, independently of the project, as a useful guide for further disinformation research related to COVID-19.

Contributors:

David Muchlinski, Georgia Institute of Technology, School of International Affairs, Social Scientist
Courtney Crooks, Georgia Tech Research Institute/Georgia Institute of Technology, School of International Affairs, Psychologist
Munmun De Choudhury, Georgia Institute of Technology, School of Interactive Computing, Computer Scientist
Rebecca Christofferson, Louisiana State University, School of Veterinary Medicine, Pathobiological Scientist
Nadine Kaslow, Emory University School of Medicine, Psychiatry & Behavioral Sciences, Psychologist
Wesley Shrum, Louisiana State University, College of Humanities & Social Sciences, Sociologist

References:

Bedford, J., Enria, D., Giesecke, J., Heymann, D. L., Ihekweazu, C., & Kobinger, G. (2020). COVID-19: towards controlling of a pandemic. Lancet, 395, 1015-1018. Retrieved from https://doi.org/10.1016/50140-6736(20)30673-5

Boyd, R. L., & Pennebaker, J. W. (2017). Language-based personality: A new approach to personality in a digital world. Current Opinions in Behavioral Science, 63-68.

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. The Lancet, 395, 912-920. Retrieved from www.thelancet.com

Case, A., & Deaton, A. (2020). *Deaths of Despair and the Future of Capitalism.* Princeton University Press.

Center for Disease Control. (2020). Coronavirus Disease 2019 (COVID-19): Stress and Coping. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/managing-stress-anxiety.html

Crooks, C. L. (2020, manuscript in preparation). Influence and Vulnerability in the Information Environment: Implications for Cyber-Enabled Information Operations and National Security. In M. Kosal, *Innovate for Future Threats: Disruptive Innovation Efforts and Uses of the Technology Environment by State and Non-State Actors*.

Crooks, C. L., Muchlinski, D., Cross, E., Jurczyk, K., Martin, S., & Srivastava, R. (2020, manuscript in preparation). Qualitative analysis of social response to COVID-19 outbreak through Twitter observational study.

Dahmer, H. (1993). Psychoanalytic social research. Free Associations, 3(4), 490-99.

De Choudhury, M., & De, S. (2014). Mental health discourse on reddit: Self-disclosure, social support, and anonymity. Eighth international AAAI conference on weblogs and social media.

De Choudhury, M., Morris, M. R., & White, R. W. (2014). Seeking and sharing health information online: comparing search engines and social media. Proceedings of the SIGCHI conference on human factors in computing systems, (pp. 1365-1376).

Grasso, D., Briggs-Gowan, M., Ford, J., & Carter, A. (2020). The Epidemic – Pandemic Impacts Inventory (EPII).

Holmes, E. A., O'Connor, R. C., Perry, V. H., Tracey, I., Wessely, S., Arseneault, L., & Ballard, C. e. (2020). Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. The Lancet, 1-14. Retrieved from https://doi.org/10.1016/S2215-0366(20)30168-1

IASC Reference Group on Mental Health and Psychosocial Support in Emergency Settings. (2020). Addressing Mental Health and Psychosocial Aspects of COVID-19 Outbreak (Version 1.5).

Kang, L., Ma, S., Chenb, M., Yangb, J., & Wang, Y. e. (2020, in press). Impact on mental health and perceptions of psychological care among medical and nursing staff in Wuhan during the 2019 novel coronavirus disease outbreak: A cross-sectional study. Brain, Behavior, and Immunity, xxx-xxx.

Oxford Anaytica. (2020). Misinformation will undermine coronavirus responses. Retrieved from Expert Briefings: https://www.emerald.com/insight/content/doi/10.1108/OXAN-DB250989/full/html

Panicheva, P., Ledovaya, Y., & Bogolyubova, O. (2016). Lexical, morphological and semantic correlates of the dark triad personality traits in Russian facebook texts. (pp. 1-8). Artificial intelligence and natural language conference (AINL), IEEE.

Pfefferbaum, B., & North, C. S. (2020). Mental Health and the Covid-19 Pandemic. The New England Journal of Medicine, 1-3.

Schimmenti, A., Billieux, J., & Starcevic, V. (2020). The four horsemen of fear: An integrated model of undersTanding fear experiences during the COVID-19 pandemic. Clinical Neuropsychiatry, 17(2), 41-45.

Seitz, A. (2020). Virus Misinformation Flourishes in Online Protest Groups. ABC News. https://abcnews.go.com/Health/wireStory/virus-misinformation-flourishes-online-protest-groups-70273076

Sohrabia, C., Alsafib, Z., O'Neilla, N., Khanb, M., Kerwanc, A., Al-Jabir, A., Aghad, R. (2020). World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). International Journal of Surgery, 76, 71-76.

Substance Abuse and Mental Health Services Administration. (2020). Coping With Stress During Infectious Disease Outbreaks. Retrieved from https://store.samhsa.gov/product/Coping-with-Stress-During-Infectious-Disease-Outbreaks/sma14-4885

Substance Abuse and Mental Health Services Administration. (2020). Tips For Social Distancing, Quarantine, And Isolation During An Infectious Disease Outbreak. Retrieved from https://store.samhsa.gov/product/tips-survivors-coping-anger-after-disaster-or-other-traumatic-event/pep19-01-01-002

Taha, S., Matheson, K., Cronin, T., & Anisman, H. (2014). Intolerance of uncertainty, appraisals, coping, and anxiety: The case of the 2009 H1N1 pandemic. British Journal of Health Psychology, 19, 592–60.

Tasnim, S., Hossain, M. M., & Mazumder, H. (2020). Impact of rumors or misinformation on coronavirus disease (COVID-19) in social media. Journal of Preventive Medicine and Public Health.

Tausczi, Y. R., & Pennebaker, J. W. (2010). The Psychological Meaning of Words: LIWC and Computerized Text Analysis Methods. Journal of Language and Social Psychology, 29(1), 24 –54.

Torales, J., O'Higgins, M., Castaldelli-Maia, J. M., & Ventriglio, A. (2020). The outbreak of COVID-19 coronavirus and its impact on global mental health. International Journal of Social Psychiatry, 1-4. doi:10.1177/0020764020915212

Van Bavel, J. J. (2020). Using social and behavioural science to support COVID-19 pandemic response. Nature: Human Behavior. Retrieved from https://doi.org/10.1038/s41562-020-0884-z

Wang, Y., McKee, M., Torbica, A., & Stuckler, D. (2019). Systematic Literature Review on the Spread of Health-related Misinformation on Social Media. Social Science & Medicine, 240, 112552. Retrieved from https://doi.org/10.1016/j.socscimed.2019.112552

This COVID-19 Working Group effort was supported by the National Science Foundation-funded Social Science Extreme Events Research (SSEER) network and the CONVERGE facility at the Natural Hazards Center at the University of Colorado Boulder (NSF Award #1841338). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF, SSEER, or CONVERGE.