Title: Online Misinformation Behavior, Impact, Detection, and Mitigation

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Target category: Areas of Future Opportunity and Investment

Participating members and their affiliations:

Faculty names	Departments	Research Interests
Shi Chen	Assistant Professor, Public Health Sciences, CHHS	Misinformation dissemination dynamics on social media; multimodal health misinformation detection system
Yaoyao Dai	Assistant Professor, Political Science and Public Administration, CLAS	Information manipulation (propaganda and censorship), authoritarian politics, computational social science
Wenwen Dou	Assistant Professor, Computer Science, CCI	Visualization systems for identifying and facilitate decision making related to misinformation; cognitive biases and misinformation
Xue Guo	Assistant Professor, Business Info. Systems & Operations Management, COB	Online reviews, two-sided platforms, text analytics
Mirsad Hadzikadic	Professor, Software and Information Systems, CCI	Agent-based modeling of social systems and agents' decision making based on the agent characteristics and information flow through the society
Min Jiang	Professor, Communication Studies, CLAS	Algorithmic bias; authoritarian politics; Internet governance and regulation
Monica Johar	Associate Professor, Business Info. Systems & Operations Management, COB	Managing sentiment on Twitter, recommendation systems, social networks, knowledge diffusion
Siddharth Krishnan	Assistant Professor, Computer Science, CCI	Misinformation; web-mining; echo chambers; far-right cross-platform data analysis

Sangkil Moon	Cullen Endowed Professor of Marketing, Marketing, COB	Fake consumer review detection on social media
Frederico Batista Pereira	Assistant Professor, Political Science and Public Administration, CLAS	Misinformation; public opinion; elections; Latin American politics
Shannon Reid	Associate Professor, Criminal Justice and Criminology, CLAS	Far-right/alt-right groups and gang; violence and criminality; radicalization online
Antonis Stylianou	Professor of BISOM, Associate Dean, COB	Online reviews, online communities
Dongsong Zhang	Belk Endowed Chair Professor, Business Info. Systems & Operations Management, COB	Building machine learning models for online misinformation detection; fake news detection; fake consumer review detection
Lina Zhou	Professor, Business Info. Systems & Operations Management, COB	Deception detection in online communication, deception behavior and strategies, verbal and nonverbal cues to deception, credibility assessment

Note: CHHS: College of Health and Human Services; CCI: College of Computing and Informatics; CLAS: College of Liberal Arts & Sciences; COB: Belk College of Business

Keywords: Online Misinformation, Extremism, Detection, Propaganda, Social Media

Executive Summary

Misinformation, such as fake news, conspiracy theory, rumors, fake online consumer reviews, and spam blogs, **is false information that is spread, regardless of intent, to mislead**. Online misinformation has been continuously growing in our digital media environments, especially on social media, and compromising the ability of individuals and organizations to make informed decisions in many domains. An economic study [1] based on both proprietary data and expert interviews reports that fake news costs US$78 billion to the global economy each year.

Misinformation can mislead users into believing misinformation and cause severe consequences to both individuals (even death) and the society as a whole. Mis(dis)information campaigns launched by political actors have become a national security issue. According to the Department of Defense's National Military Strategy, America is a target of political and information subversion [2]. In the last month of the 2016 U.S. presidential election campaign, each American was exposed to approximately 204 fake news on average [3]. Those fake news articles (e.g., "Pizzagate") have been accused of increasing political polarization and partisan conflict during the election campaign [4]. In the business context, online misinformation, such as fake business news and fake online consumer reviews, has significantly influenced consumers when making investment or purchase decisions. To earn trust from consumers, many social media companies have been monitoring consumer postings on their platforms. For example, Yelp.com makes great efforts to strengthen the trustworthiness of its website's postings with a filtering algorithm to detect fake reviews [5]. Similarly, Amazon.com verifies if a consumer who writes a product review has a "verified purchase." Health misinformation, especially during large pandemics such as 2014 Ebola, 2016 Zika, and the current COVID-19, is considered the worst. Health misinformation causes unnecessary confusion, frustration, anger, mistrust, and seriously undermines the efforts to fight against the pandemic. Almost 60% of false claims about coronavirus remain online without a warning label. Such fake news has resulted in people sharing rumors, fake stories, and half-truths about the pandemic and possible treatment options across different platforms as people struggle to understand how they can better protect themselves and their families. Addressing the problem of misinformation requires raising awareness of a complex and diverse set of factors not always visible in a piece of news itself, which requires convergent research from multiple disciplines.

This team of UNCC researchers is well-positioned to excel in this field for several reasons. First, it consists of researchers in multiple disciplines, including business, healthcare, public policy, criminal justice, political science, communication, economics, etc., who have diverse expertise and tackle this critical problem in different domains. Second, we conduct convergent research to investigate online misinformation from a wide spectrum of perspectives, ranging from misinformation behavior to building models for automatic detection and mitigation of online misinformation. Our work in this area has been supported by various external grants and reported in the media, including research awards from the National Science Foundation, Pacific Northwest National Laboratory, and Facebook, etc. Third, some team members have already successfully collaborated on research projects and published papers in this field (See details in the following section). Fourth, based on the collective findings from our current research, we are well-positioned to design systems and interventions that increase people's online information literacy, which would lead to far-reaching positive societal impacts.

Evidence of Strength and Excellence

The strengths of the collaboration(s)

Online misinformation is a highly interdisciplinary research area. One of the strengths of this research team lies in diverse expertise and research experience of its faculty members, who have conducted **a wide variety of original research on online misinformation from theoretical, technical, behavioral, and social perspectives**, such as designing and developing interactive visual interfaces that enable systematic investigation of misinformation sources (Dr. Dou, supported by PNNL); online deception behavior and automatic deception detection (Drs. Zhang and Zhou, supported by NSF); online misinformation detection (Drs. Zhang, Zhou, and Moon); understanding of human behavior and its effect on the long-term outcomes of social groups and systems (Dr. Hadzikadic); the dynamics of misinformation in public opinion, particularly in the electoral contexts (Dr. Pereira); information manipulation (Dr. Dai); online misinformation and disinformation propagation and deterrence (Dr. Dai); infiltration and proliferation of health-related misinformation on social media (Dr. Chen, supported by PAC, NCBC, and MIDASN); the role of technology in the spread of misinformation (Dr. Jiang), etc.

The work of faculty on this team has been supported by government funding agencies such as NSF, as well as national labs and industry. The team collectively received a large amount of external funding during the past 5 years. The following is a list of selective external grant support related to combating mis- and dis-information:

- **Lina Zhou** (PI) **and Dongsong Zhang** (Co-PI): "SBE: Small: Behavioral Control of Deceivers in Online Attacks". **National Science Foundation (NSF).** Award #: SES 1527684. September 2015 – Aug., 2020. $499,912.
- **Frederico Batista Pereira** (co-PI). Political Elites and the Appeal of Fake News in Brazil. **Facebook Research Award** on Misinformation and Polarization, 2021.
- **Min Jiang** (PI): "CyberBRICS China Fellow. **Fellowship** from FGV Law School (Brazil) to work on data protection and cybersecurity policy frameworks in BRICS countries". $13,500
- **Shi Chen** (PI): "Comparing the Transmission Dynamics of Real News vs. Fake News: A Network Analysis of Zika Epidemic on Twitter." **Page Center Legacy Scholarship**, School of Communications, Penn State University. #2018FN003. 2018-2019. $3,800
- **Wenwen Dou** (PI): "Deception Detection, Tracking and Factuality Assessment in Social and News Media", **Pacific Northwest National Laboratory**. 2017-2018. $50,000.

Faculty members on this team have published numerous papers on misinformation related issues in top peer-reviewed journals and conferences (See a selective list of publications below, with some co-authored publications). Some faculty members in this team have already **collaborated on research projects and proposals**, such as Drs. Chen, Zhou, and Krishnan on health misinformation; Drs. Zhou and Zhang on online deception cues and strategies, and Drs. Reid and Krishnan on criminal justice):

- **Chen, S., Zhou, L.**, Song, Y., Xu, Q., Wang, P., Wang, K., Ge, Y., and Janies, D. 2021. Comparative Analysis of Viral COVID-19 Sina Weibo and Twitter Contents with a Novel Feature Extraction and Machine Learning Workflow. Journal of Medical Internet Research.
- Safarnejad, L., Xu, Q., Ge, Y., **Krishnan, S.**, Bagarvathi, A., **Chen, S.** 2020. Contrasting Real and Misinformation Dissemination Network Structures on Social Media during the 2016 Zika Epidemic. American Journal of Public Health, 110: S340-347.

- Shan, G., **Zhou, L., & Zhang, D**. (2021). From Conflicts and Confusion to Doubts: Examining Review Inconsistency for Fake Review Detection. *Decision Support Systems*. Forthcoming.
- **Zhang, D., Zhou, L.,** Kehoe, L. J., and Kilic, I. (2016). What Online Reviewer Behaviors Really Matter? A Study of Effects of Verbal and Nonverbal Behaviors on Online Fake Review Detection. *Journal of Management Information Systems*. 33(2). p.456-481
- Ryan Wesslen, Sashank Sathanam, Alireza Karduni, Isaac Cho, Samira Shaikh, **Wenwen Dou**. Investigating Effects of Visual Anchors on Decision-Making about Misinformation. *Computer Graphics Forum* 38 (3), 161-171, 2019

Group's contribution to student education and research training:

Faculty members on this team have been continuously involving graduate students, especially doctoral and minority students, in research projects. For example, two female doctoral students of Dr. Zhou completed their Ph.D. dissertations on online misinformation; one of Dr. Zhang's current Ph.D. students is doing his Ph.D. dissertation on deepfake detection; Alireza Karduni, one of Dr. Dou's Ph.D. students, successfully defended his Ph.D. dissertation on visual analytics of misinformation in Fall 2020.

Area excellence and national prominence

- Dr. **Pereira's** research on fake news in Brazil (Facebook Research award) made it to the front page of Brazil's most important newspaper, Folha de São Paulo, on Jan. 10, 2021;
- Drs. **Zhou** and **Zhang** are recognized by recent studies of Stanford University and the University of Arizona published in 2020 as the top 2% of the world's most cited researchers in the information systems field.
- Dr. **Chen** was selected as the roundtable speaker in the 2019 APHA national meeting to present the findings of his work on "Contrasting Real and Misinformation Dissemination Network Structures on Social Media during the 2016 Zika Epidemic".
- Drs. **Reid** and **Krishnan**'s work has been noted through interviews in both national and international news outlets (e.g., The Guardian, Washington Post, The Conversation, The 74, Mammamia podcast (AUS), Radikaal podcast, WFAE, WPR, Indus News (Pakistan)).
- Dr. **Hadzikadic** is the founding editor of the Journal of Policy and Complex Systems, and the founder of the Conference on Complexity and Policy Studies. He is also a past president of the Computational Social Science Society of the Americas.
- Dr. **Dou** was selected as a PNNL summer faculty fellow for her work on misinformation. Her team won first place presenting misinformation work at the Science Slam at ICWSM 2018.

How additional resources might be used to build or expand upon past success

Additional resources can help us expand our past success in research on online misinformation in several ways: recruiting the best faculty to strengthen and enhance the highest level of interdisciplinary and collaborative research and scholarship in this area; providing course relief to enable faculty members to have more time to prepare for large-scale external research grants; forming strong interdisciplinary research teams working at the intersection of two or more disciplines; increasing outreach activities to seek research partnerships and develop collaboration opportunities for grants and collaborative projects with scholars in other academic and/or industry; and enabling faculty to support and involve more qualified graduate students in research.

Alignment with Regional and National Priorities

Online misinformation research is well aligned with national priorities. With the rise of social media that serve content from news organizations and independent producers, it is imperative to increase literacy around mis- and dis-information. There are multiple initiatives in the US, Asia, and Europe focusing on combating misinformation. For example, the UK government has introduced a number of initiatives to help counter misinformation distributed online, including the intelligence services responsible for identifying social media platforms that distribute misinformation and disinformation and tackle communications elements of threats to national security, including disinformation. The **Carnegie Endowment for International Peace** recently gathered 85 proposals made by 51 different organizations exploring what needed to be done to battle against the online forces of mis- and dis-information that contaminate and poison truth.

Online misinformation research is well aligned with national priorities. The 2020 **National Defense Authorization Act (NDAA)** calls for the establishment of a Social Media Data and Threat Analysis Center to address the rising threat of disinformation. Among **NSF's big ideas**, building the human-technology partnership and illuminating social-technological landscape are keys in the future of work at the human-technology frontier. To achieve those goals, understanding online misinformation and developing effective solutions for detecting and addressing misinformation will be essential to building **trustworthy human-technology systems.** Similarly, a core component of the **NIH Strategic Plan for Data Science** is to sustain public trust, patient safety, and data quality and integrity, in which combating against online health misinformation is critical. **Numerous states in the U.S.** have proposed bills providing civil or criminal liability for manipulated media. Virginia became the first state to criminalize deepfakes with a recent amendment to the state's revenge porn law [7].

Discerning between real and fake news has become an increasingly difficult task, especially in the digital domain. With a goal of helping students address this challenge, **UNC Charlotte was selected as one of 10 institutions for the pilot program "Digital Polarization: Promoting Online Civic Literary**," sponsored by the American Association of State Colleges and Universities' (AASCU) American Democracy Project[1]. UNC Charlotte is in a unique position to capitalize on this opportunity and increase our research portfolio with practical impact on combating misinformation.

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[1] https://inside.uncc.edu/news-features/2018-03-13/university-selected-national-pilot-program-combat-fake-news