

My name is Hongtao Hao, and I am applying to the PhD program in Communication at the Annenberg School of Penn to pursue my interest in studying social influence and the spread of misinformation in social networks.

I began my graduate career at Renmin University of China, where I focused on international communication and the digital divide. In my MA thesis, I evaluated the outcome of China's media "Go Global" strategy. Another study I did reviewed how the emerging digital divide increased urban-rural education inequality in China. I was limited to qualitative methods at that time. To better understand the impact of communication technologies, I decided to obtain training in quantitative methods by pursuing a second master's degree in the United States.

At Indiana University, I conducted three selfie studies. Applying content analysis, I compared selfies of Chinese and White women from the perspective of self-sexualization, and examined gender stereotypes in Chinese women and men's selfies. I also did a survey study analyzing the factors that are associated with selfie-editing. These studies allowed me to gain valuable knowledge of how individuals use social media, but missed the broader picture of how communication technologies impact the society. Learning network science through Professor Yong-Yeol Ahn's class and reading literature in this field gave me a sense that it provides an ideal avenue through which I can explore the social impact of digital technologies.

My first research idea is to investigate social learning in social networks. Particularly, I am focused on how individuals reevaluate their beliefs or behaviors after interacting with their social connections. There are conflicting findings regarding how exposure to opposing views affects belief polarization (1,2), and whether network homogeneity benefits social learning (1,3). To examine this, I seek to conduct an experimental study comparing the effect of heterogeneity and homogeneity in networks on reducing biases. Another question regarding social learning concerns network centrality. Egalitarian networks, where people are equally influential, are conducive to building accurate consensus within groups (4). In real life, however, people's influences naturally diverge, as witnessed in modern social media environments. This leads to the question: When building an online community, how can we prevent opinion leaders from emerging, or at least reduce the disproportionate influence some individuals have on others? In terms of influence in social media networks, it often falls on a continuum rather than on dyadic ends (5). I am interested in exploring which segments of an influence distribution are most powerful in shaping the group belief, what characteristics do individuals in these segments share, and whether this pattern varies across different forms of social networks. Research on social learning can bridge differences in beliefs and promote mutual understanding between disparate groups, and therefore has the potential to create a stable future by alleviating biases and conflicts.

My second research interest is to identify individuals or networks of individuals who are most vulnerable to misinformation. First off, I want to look at how to categorize the diffusion of misinformation: is it a simple contagion or a complex one? A recent study shows the diffusion of controversial news is a complex contagion (6). However, controversial news pieces are not necessarily sources of misinformation. In addition, diffusion patterns of true and false rumors differ (7). Therefore, an analysis that focuses on the propagation of false rumors is necessary. I

would also like to examine whether misinformation travels more through weak ties or strong ties. Homogeneity drives the spread of conspiracy news (8), and false news diffuses through a peer-to-peer channel rather than through broadcasting (7). In this regard, strong ties within a homophilous network seem to be more effective paths. This leads to my last questions: What are the characteristics of people who are most likely to spread misinformation? What is their ego network like? Is it highly clustered or not? Is it highly structurally diversified, which indicates one's neighbors belong to different components of a network, or not? These questions are essential in the sense that to contain the spread of misinformation, we need to identify those who are susceptible.

My previous training and research have prepared me well for future PhD studies. Three statistics courses I have taken enabled me to apply basic quantitative methods to my research independently. My experience with processing and visualizing large data sets using R and Python will be useful in my research which involves data analysis. I enjoy building websites and creating interactive web presentations, and this passion may help me carry out online experiments or creatively present study results.

At the Annenberg School, I would like to work on social learning projects with Professor Damon Centola who pioneered the studies in complex contagion and whose recent papers on social learning and bipartisan communication inspired many of the research ideas I have. I wish to receive guidance on my proposals and conduct network analysis studies at the Network Dynamics Group. I would also like to examine the spread of misinformation by collaborating with Professor Sandra Gonzalez-Bailon, as information diffusion is one of her research focuses. Outside of communication research, I seek to continue my interest in Bayesian data analysis by taking relevant courses at the Statistics Department of Penn.

After earning my PhD degree, I aspire to become a professor. I would like to contribute to solving social problems through scientific research. At the Annenberg School, I can pursue training and studies that reduce biases among, and build mutual understanding between people. I am also interested in teaching and mentoring future scientists, hopefully through professorship and/or through developing online resources such as the tutorial blog posts I have created (9).

## References

1. Guilbeault, D., Becker, J., & Centola, D. (2018). *PNAS*. <https://www.pnas.org/content/115/39/9714>
2. Bail et al. (2018). *PNAS*. <https://www.pnas.org/content/115/37/9216>
3. Becker, J., Porter, E., & Centola, D. (2019). *PNAS*. <https://www.pnas.org/content/116/22/10717>
4. Becker, J., Brackbill, D., & Centola, D. (2017). *PNAS*. <https://www.pnas.org/content/114/26/E5070>
5. Centola, D. (2019). Influential networks. *Nat. Hum. Behav*, 3(7), 664-665.
6. Wang, X., Lan, Y., & Xiao, J. (2019). *Nat. Hum. Behav*. <https://www.nature.com/articles/s41562-019-0605-7>
7. Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science*, 359(6380), 1146-1151.
8. Del Vicario et al. (2016). *PNAS*. <https://www.pnas.org/content/113/3/554/>
9. <https://hongtaoh.com/en/projects/#3-blog-posts-of-how-to-series>