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論文審査の要旨及び審査員

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論文審査の要旨 (2000 字程度)

The title of this thesis is “Echo Chamber and Polarization in Social Media: Agent-based Modeling Approach”. It consists of six chapters.

In chapter 1, the author addresses the motivation and contribution of this thesis. The author points out the problem from the increase of fake news as one important issue. The author analyzes that social media platforms or social networking systems (SNS) have been getting more integral to our livelihood as the main sources of information for many people according to the growing accessibility of the internet. The author warns that the ease of obtaining information also comes with the risk of getting misinformation, and online misinformation could be harmful for different reasons ranging from misleading individuals not to take beneficial actions to delegitimizing a country’s democratic system. The author mentions that the proliferation of misinformation is a complex phenomenon that is influenced by multiple factors in general. Then, the author focuses on two factors associated with its rise: echo chamber and polarization. The author discusses that minimizing these two factors is a worthwhile cause to combat the online misinformation problem. The author summarizes that this chapter provides contributions that should answer the following questions: 1) what are the factors influencing the formation of echo chambers and polarization, 2) how an individual person contributes in creating echo chambers and 3) how the author applies these findings in a real-life case.

In chapter 2, the author provides fundamental concepts necessary to understand various aspects of the thesis. Firstly, the author summarizes echo chamber and polarization definitions from multiple studies. Secondly, the author explores what makes SNS-style communication special, and a brief summary on traditional mass media vs. personal social media by comparing and contrasting methods. Thirdly, the author presents a summary on various established models in opinion formation and also discusses what makes some specific opinion dynamics model distinct and what features are relevant to proposed model from voter’s model to bounded confidence model. Fourthly, the author summarizes the Zaller model of public opinion because the explanation of the Zaller model is necessary since it is an established model in the public opinion study as a fundamental assumption. Finally, the author discusses how to establish someones stance on vaccination since one of applications in this thesis of the Zaller model is to study the influence of Facebook pages on vaccination attitudes. And also, the author provides evidence on the potential harm of anti-vaccine movements as well as how it fits proposed modeling purpose.

In chapter 3, the author explains the methodology used in this thesis that is agent-based modeling (ABM). The author mentions the ABM is a type of computational model to simulate the actions of autonomous agents with an internal model governing their behavior. The author points out this method is particularly useful to unfold statistical macroscopic phenomena through the microscopic interactions between fellow agents as well as agents with the environments. The author introduces most agents in this thesis are individual social media platform users connected in a network representing the platform. The author mentions the internal models in agents are built using stylized facts; simpler empirical findings from other research, typically from

fields such as political science and behavioral science, but not limited to them in this case. The author points out using ABM is also useful for its ease of implementing interpretable scenarios representing policies or behaviors observed in real life. The author claims these findings should assist anyone in designing helpful policies to reach the goal, which will reduce the echo chambers and polarization in social media. The author concludes the optimal policies can be obtained by comparing the simulation results of multiple scenarios encompassing all possible parameters which the author calls landscape analysis.

In chapter 4, the author presents the study of echo chambers and polarization formation using established assumptions in the context of social media communication. The author summarizes using ABM to simulate opinion dynamics for a set of population has been well studied. The author points out these models only account for information sharing mechanisms like word of mouth (one-to-one) or mass media (one directional one-to-many) traditionally, while many SNS are distinct from the traditional means of communication in that they allow everyone in the network to spread information into many users at once. The author proposes the adaptation of the Deffuant-Weisbuch model that allows SNS-style information spread in a random network, and observes how the echo chambers and polarization formed. The author discusses that keeping news to have a balanced sentiment distribution is the most effective way of minimizing echo chambers and polarization through comparing four measurements of echo chambers. The author also discusses that users' convergence parameter also determines the distribution of opinion along with the acceptance threshold unlike the original model.

In chapter 5, the author presents the application of information consumption forms public opinion. The author points out most studies on opinion echo chambers and polarization in the internet rely on analyzing users' activity data, while traditional opinion studies are based on self-reported opinion on a particular issue. The author addresses that a gap between the two methods by implementing the Zaller model of public opinion, and a model that describes how people acquire political information from elites or mass media and they convert it to their political opinion as an ABM in the context of SNS. The author remarks that the model is used for two purposes in this thesis: the first is to confirm that the two methods of measuring opinion polarization above can have opposing results, strong echo chamber vs. weak echo chamber, for a single observed population, and the second is to apply the model to study the influence of Facebook pages about vaccination to individual user's vaccination opinion and to find effective policies to combat the influence of Facebook pages that spread anti-vaccination information.

In chapter 6, the author serves the conclusion and recommends future works as possible follow ups. The author firstly identifies that both convergence and acceptance parameters of the agents are influential in determining a society's echo chamber and polarization. Also, the author claims that opinions that are carried by news are also important, and they can minimize echo chambers with diverse opinions as well as reducing extremities in a polarized society. The author claims this research has verified that a society with strong selective sharing preference could lead to a moderate level of perceived echo chamber in the case of the Zaller model application. Also, the author mentions news can increase perceived echo chamber but only when SNS users' opinion distribution is already strongly clustered to one side of opinion. The author finally claims the simulation shown that the currently existing vaccination-related Facebook pages increase user's tendency to support anti-vaccination opinion. The author claims the simulation also reinforces that attaching caution banners from healthcare authorities and deplatforming anti-vaccination information providers are useful to mitigate the influence of anti-vaccination campaigns. The author mentions additional future works from the theoretical and empirical standpoint.

In summary, this thesis focuses upon echo chamber and polarization in social media with agent-based modeling approach in order to confirm the mechanism and to find effective conditioning technique on social network systems. Therefore, this thesis meets the criteria to complete the degree of Doctor of Philosophy.

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