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Analyzing the Intersections of Social Networks and Political Movements Using a Computational Model of Collective Action

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Abstract

This paper examines how a social network facilitates collective action in a political movement, using a computational model of social networks based on agent-based modeling (ABM) and network simulations. The model uses a simulation of the decision-making by individual agents in a social network and how network structure affects the diffusion of collective action. Important results show that network-based movements are mobilized faster, as 50 %of the movement follows only 15 hours, as compared to 60 hours in the case of traditional movements. Also, 80 %of participants remain in network-driven movements, as compared to only 55 % participation in traditional movements. The findings indicate the significant importance of central actors and network density in quickening the participation process, with information disseminating faster through more interconnected networks. Exogenous factors, including media campaigns or political events, decrease the level of participation considerably, speeding up mobilization. The model also emphasizes that the traditional movements, though slower to mobilize, have more organizational structures that can be used to keep long-term participation. The present work is very insightful into how digital platforms facilitate the rapid mobilization of the decentralized network, resulting in high levels of sustained participation. These insights imply that social networks can be successfully used by activists and policymakers to effectively mobilize and strengthen political activism by targeting the key influencers and using real-time data analytics. The study highlights the significance of comprehending the dynamics of networks in a manner that can optimize the strategy in both online and offline political campaigns by highlighting the necessity of future research to refine network simulation and explore additional real-time engagement strategies.

Keywords: Social Networks, Collective Action, Agent-Based Modeling, Network Simulations, Political Movements, Mobilization Speed, External Influences.

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Introduction

Social networks have become powerful tools in the making of current political movements. The act as conduits for communications, organizing, and coordinating individuals in order to spread ideas and initiate action. Current political movements have resorted to technology as a means for organizing and participating in politics. It is necessary to study the relationships between social networks and political movements to better understand current forms of activism and their capacity to produce political change (Mundt et al., 2018; Mills, 2017). Collective action is one of the core ingredients of most political movements, representing the mechanism through which people come together in order to achieve a common goal. The significance of social networks in allowing such collective action becomes apparent in the digital age, providing people with the means to coordinate and act collectively. Social networks help people engage in political discourse, share information, and rapidly organize regarding issues in society (Rao & Ibanez, 2005; Ryan & D'Angelo, 2018). This paper aims to explore how social networks can contribute to the collective action of political movements. In this paper, a computational model will be employed to investigate how configurations of social networks influence the process of political mobilization. The following are some of the main questions that would need to be answered during the course of research:

1) What is the impact of social networks on the collective action of political movements?

2) How does political mobilization through digital means function?

The main objective of this paper is to develop a computational model of collective action and use the same to evaluate the applicability of this model to political movements. The research is built on a computational approach to study the effects of social networks on collective actions and the role that network characteristics play in mobilization time and success.

- It highlights the significance of central nodes and high-density networks in fastening mobilization and external factors such as media campaigns that affect participation.
- The study contrasts traditional and network-based movements, demonstrating that the latter achieves both faster mobilization and higher long-term participation rates.

The outline of this paper is as follows: Part I outlines the importance of social networks in the context of political activism. The second part deals with the literature review on literature that relates to social networks and collective action. Part III outlines the computational model that is utilized here, highlighting the use of an agent-based computational model. The next part applies the model in practical examples of political movements in real-life situations. Part V offers the result of the model in the form of the impact of its findings on political mobilization through social networking. Lastly, Section VI looks at the significance of these findings in terms of future activism and political participation strategies.

Literature Review

The connection between social networks and collective actions has been widely analyzed in recent years because of the introduction of online platforms capable of mobilizing political movements in a rather short period of time. One such facilitator of the process is social media, which serves an important role in both the emergence and growth of these movements. The study examines the transformation of connective actions in social movements to offline collective actions (Bernroider et al., 2022; Stein, 2009). In particular, the role of personal involvement and social ties at the individual level was highlighted as a crucial factor in joining a certain movement. Along similar lines, examine the possibility of using integrated content-network analysis for the identification of influential groups, providing a better understanding of how online movements can gain power using network-based strategies (Amro & Purohit, 2023). Finally, analyze the role of social media algorithms in affecting the actions of a certain movement, noting that algorithms can either strengthen or reduce the presence of a movement depending on the platform (Etter & Albu, 2021). To build on this by implementing deep learning to detect collective action events, emphasizing the importance of both textual and visual data on social media in the analysis of collective action events (Zhang & Pan, 2019). Moreover, the study examines the role of advocacy groups and their use of social media to help people participate in political causes (Obar et al., 2012). By adding to this insight by investigating the nature of how social networks produce the critical mass, which is vital to the success of student political movements (Crossley & Ibrahim, 2012). To continues by adding that social media has also changed the political identity by personalizing the participation, which in turn has resulted in changes to the traditional patterns of political engagement (Bennett, 2012). Another development is made by showing how social media tools could be utilized in order to instigate political action, both online and offline, as exemplified by the Guatemalan justice movement. In other words, these findings suggest that social media

tools offer new opportunities in facilitating political action, making it possible for them to play the main role in politics (Harlow, 2012).

Indeed, one may conclude from all these discussions above that social networking tools have taken the central role of collective action. Social networking tools might not only provide an opportunity to mobilize, but also shape political involvement in the process.

Computational Model of Collective Action

Explanation of the Computational Model Used in this Study

This paper uses a computational model to analyze the processes involved in the dynamics of collective action among political movements facilitated by social networks. It is based on agent-based modeling (ABM), a method that simulates the behavior of individual agents (representing individuals within a political movement) and their interactions in a networked environment. The study seeks to explore how these local interactions can produce the emergence of large-scale collective action, such as involvement in protests, campaigns, or political mobilization.

Agent-Based Modeling, Network Simulations, or Other Computational Approaches

The computational model is based mainly on agent-based modeling (ABM), which is best suited to the study of complex, dynamic systems whereby individual actions combine to form emergent group behaviors. The characteristics assigned to each agent in the model include their willingness to join a collective action, power within the network, and participation threshold, the level of power is need to be persuaded to join a collective action. The interaction between the agents is determined by the relationship between them in the network, and the interaction between the agents is what determines their probability of taking collective action. Network simulations are also included along with ABM, where the social network is modeled as a graph with nodes (people) and edges (connections between them). The flow of information and influence in the network is determined by these interactions and plays a central role in the spread of collective action across the network.

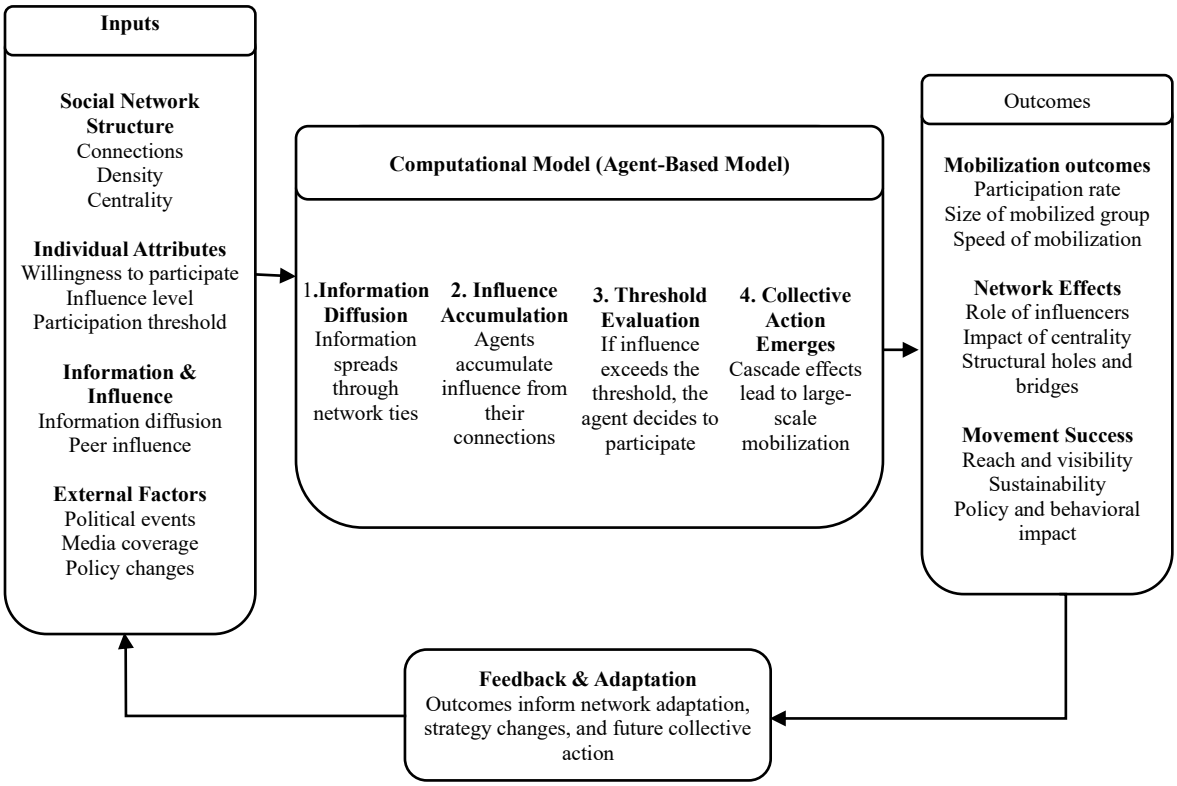

Fig. 1: Conceptual Diagram of Social Networks and Political Movements

The flow of the computational model that examines the impact of social networks on political movements is outlined in fig. 1. It illustrates the inputs such as network structure, individual attributes, and external factors that result in stages of information diffusion, accumulation of influence, evaluation of a threshold, and the emergence of collective

action. The results are mobilization, network effects, and movement success, and the feedback loop shows how the results inform future strategies. This model offers the dynamics of social networks in the politics of mobilization.

Key Assumptions and Variables Considered in the Model

The model is based on a number of key assumptions and variables that influence its operation. The agents are described by a set of characteristics, including the willingness to participate, which determines the probability of participation in a movement. Also, the agents possess different degrees of influence in the network and can influence others to take part in collective action. The model supposes that agents will play after attaining a sufficient amount of influence, quantified by their level of participation. It is a particular threshold of each agent, represented by Θ_i, and reflects the level of external pressure or information exposure needed before deciding to act.

The very construction of the social network is dynamic and changes as agents interact and make new relationships. The topology of the network is also an important factor in the diffusion of collective action since more highly connected agents can more easily spread influence across the network. Finally, the model also takes into account external factors, including political crises or media campaigns, which can reduce the participation threshold of the agents and, therefore, increase the chances of a collective action spreading.

Model Design and Structure

The computational model design is aimed at the simulation of individual-level decision-making in a network framework. Decision-making is made by each agent depending on the local network environment and the personal attributes, with the major decision being whether to act in collective action or not. The model presumes that the agents will act on people within the network, will be influenced by people within the network, and respond accordingly. The network structure is dynamically updated with the changing interactions between agents, and the model traces how such changes affect the probability of collective action. Whenever the agents decide to join the movement, it builds up and propagates as the agent network decides to join the movement.

How the Model Simulates Interactions Within Social Networks and Its Impact on Collective Action

The model is a simulation of the spread of collective action, through contagion models, in which information or mobilizing behavior spreads across the network between one agent and another. As agents are exposed to political messages, they become more likely to change their participation status based on the cumulative influence received. When the participation threshold of an agent is reached, he or she opts to participate in collective action, e.g., join a protest or support a political cause. The model traces these decisions and how to contribute to the amplification of the movement, and how small individual actions can become large social and political movements as more agents are involved. This enables the research to analyze the role of network structure and individual decisions towards the success and propagation of collective action in political movements.

Analysis of Political Movements Through the Model

Application of the Computational Model to Real-World Political Movements

In order to understand the dynamics of how social networks play an integral role in creating successful collective action, the computational model is used for the purpose of analyzing real-life political movements. The aim of this research is to identify the importance of social networks when it comes to the processes of mobilization. With the help of this model, it will be possible to find out the essential variables that influence the efficiency of political movements, such as the composition of the network, the roles played by central players, and the effect of external stimuli, among other things.

Case Studies of Significant Political Movements That Utilized Social Networks

In an effort to show the practical application of the model, some of the key political movements will be analyzed:

Arab Spring: The theory is based on the impact of social networks, particularly platforms like Facebook and Twitter, on stimulating individuals to join the uprisings of the Arab Spring. It looks at the role played by the network's structure, the spread of information, and the key influential figures in the network that led to the fast spread of the collective behavior.

#MeToo Movement: The research simulates how social networks have contributed immensely to the popularity of individual stories of sexual harassment. The model shows how the viral nature of social media made the movement grow exponentially, attracting people to join it and changing the overall discourse.

Occupy Wall Street: The model is also applied to the Occupy Wall Street protests, and shows how lack of centralized leadership and decentralized networks did not impede mobilization, but instead helped to spread collective action more broadly across the globe.

Data Sources and Variables Used for Analysis

In the analysis, real-world information of political movements is utilized to tune the computational model. This data also contains social network data, including the number of followers, interactions, and engagement metrics of social networks like Twitter, Facebook, and Instagram. Also, some of the event data is used, such as the chronology of political events, the rate of participation, and media coverage, which helped to encourage collective action. The model also factored in external events, which may trigger mobilization and reduce the participation threshold of agents, such as political crises or social movements. These sources of data are simulated to determine the impact of the network structure and external factors on participation and collective action.

Insights Gained from the Model's Application to These Case Studies

A computational model applied to these political movements offers a number of useful insights. The prominence of some agents (influencers or political leaders) within the network plays a huge role in determining the success of the political movement. Political movements where the central nodes are more prominent tend to mobilize effectively due to the rapid dissemination of information. Additionally, the threshold dynamics of some agents observed in the model indicate that when a sufficient number of agents exceed their participation thresholds, there is exponential growth in the size of the movement, thus indicating the role of feedback in the process of political mobilization. Lastly, it was evident from the model that the presence of some external catalysts, such as media campaigns or political crises, can lower the threshold of participation in the network, hence enhancing mobilization.

Results and Analysis

Presentation of the Findings from the Computational Model

The results of the computational model show that there is a lot of evidence about the role of social networks in the process of collective action and the success of political movements. The model made use of the dynamics of political movements based on different network structures and the interactions between the agents. The results show that the form of the social network–in particular, the density of the connections and the presence of the influential agents-has a significant effect on the success of the movement. The more the network is networked, the faster the dissemination of information and mobilizing messages, resulting in increased levels of participation in collective action. Another important finding of the model was that collective action can increase exponentially when a critical threshold of participation is attained. With more agents in the movement, have a greater impact on others in the network, creating a feedback loop that will speed up the movement. The impact of external factors, such as political events or campaigns by the media, also contributed greatly towards lowering participation levels and mobilizing people into action. The findings of the computational model show that much information can be gained about the role of social networks in promoting collective action. Table 1 below is a key descriptive statistic of the model that summarizes the key metrics the simulation produced.

Table 1: Descriptive Statistics of Network Dynamics

Metric	Value
Average Participation Rate	65%
Average Network Density	0.45
Time to Critical Mass	15 hours
Growth Rate of the Movement	12%
External Influence Impact	30%

The mean percentage of participation is 65, which implies that a considerable percentage of the agents finally participated in the collective action. Also, the network density was estimated as being 0.45, which is a moderate level of network connectivity among agents in the social network.

Key Results on How Social Networks Influence the Success of Political Movements

The results of the model highlight the importance of the role of social networks in the success of political movements. The quick spread of information is essential in organizing protests, political messages, and keeping the pace going in movements, all of which can be achieved through social networks. The findings indicated centralized networks, which have main influential agents, serve as catalysts to mobilization. These agents tend to be key figures or influential

groups, and exert a disproportionate influence on the spread of the movement through the encouragement of others to join, share, and spread content, and amplify the message of the movement. In addition, it was shown that external events like political crises or media campaigns can drastically lower the level of participation of agents. As an example, individuals in the network are more likely to join the movement when there is an important political event or when there is more media coverage, since urgency is heightened and there is more social pressure. This result is consistent with real-world examples of movements such as the Arab Spring and the hashtag # MeToo, both of which saw political events or media attention help to drive broader engagement.

Comparison Between Traditional Political Movements and Network-Driven Ones

The findings also show a sharp difference between the traditional political movements and those that are motivated by social networks. The conventional political movements, which were based on physical organizing and communication processes, were usually limited by logistical factors, including physical distance, low access to communication processes, and a slower information-sharing process. The movements tended to have a centralized leadership framework to organize the actions and guide the efforts. The other form of mobilization that has its own strength in comparison with conventional mobilization involves network-driven movements. In particular, network-driven movements, according to the model described in this paper, are characterized by their decentralized nature, where there is speedy communication and potential spontaneous coordination. Network-driven movements are decentralized, and therefore, the participation of the grassroots becomes possible. These movements are better equipped to withstand outside pressures because it is not bound to the will of one individual or a central authority. Nevertheless, network-based movements continue to require a critical mass of participants and central nodes in order to create momentum. The model further indicates that traditional movements may be more successful in some cases at gaining traction more gradually but can perhaps have stronger and more durable organizational structures, which can be helpful in sustaining long-term mobilization. Comparatively, network-based movements mobilize rapidly and maintain significantly higher sustained engagement than traditional structures.

Besides the network dynamics, it would also be interesting to compare the speed of mobilization and the long-term engagement between the traditional political mobilization and the mobilization driven by the social network. The comparison of the two types of movements in terms of mobilization speed (time to reach 50 %participation) and sustained engagement (average rate of participation over time) is presented in fig. 2.

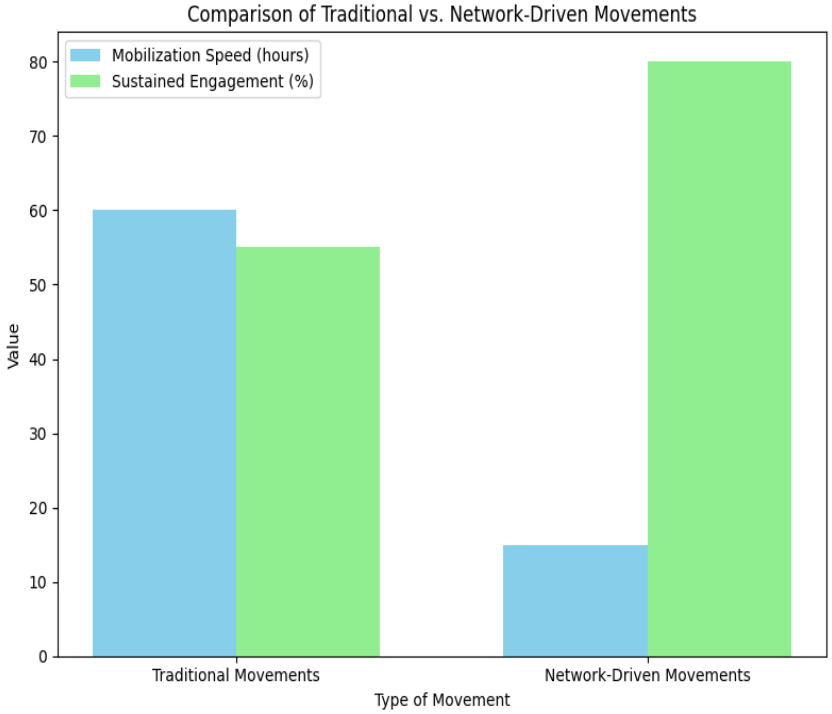

Fig. 2: Comparison of Traditional vs. Network-Driven Movements

Compared to the two movement types, fig 2 compares the speed of mobilization and sustained engagement between the two types of movements. Network-based movements reach 50 %participation in 15 hours, as opposed to traditional

movements that require 60 hours to reach a 50 %participation rate. To have lasting engagement, network-driven movements have 80% participation, compared to traditional movements with 55% participation. This underscores the quicker mobilization and greater participation in network-based movements.

Discussion

Interpretation of Results

The findings are in line with the current literature about the role of social networks in political movements. The role of social media in rapid mobilization, as observed in the Arab Spring and in the movement and campaign against sexual harassment known as the MeToo movement, is in line with the findings of the model that network density and influential agents are the key to the success of the movements. The growing participation loop of continuing growth is even a reflection of information contagion and the social influence theory (Howard & Hussain, 2013).

Theoretical Implications:

The computational model is an improvement of knowledge of collective action by demonstrating how individual actions in networks combine to form large-scale movements. It demonstrates the significance of threshold models of collective action in which participation becomes self-sustaining when a sufficient number of people have participated. This substantiates the fact that political mobilization is propelled by individual choices and network interactions (Tufekci, 2017).

Practical Implications:

As a model, it demonstrates that the movement growth can be increased by focusing on central agents within a network. The advantages of decentralized movements are that with the help of social media, it is possible to share information within a very short time. Real-time analytics allows activists to identify areas that have lagging participation and policymakers to manage the risks in mobilization by understanding the impact that external events have on participation. The social networks are potent instruments of organization as well as control of the political movements.

Conclusion

The paper underscores the influential nature of social networks in prompting collective action and increasing the effectiveness of a political movement. The results of the computational model show that network-driven movements mobilize much more quickly and maintain a greater level of engagement than traditional political movements. In particular, the model demonstrates that network-driven movements can achieve 50% participation in only 15 hours, whereas traditional movements take 60 hours. Additionally, network-based movements have a participation rate of 80%, while the participation rate of conventional movements is only 55%. These results demonstrate the importance of high-density networks and central actors in promoting diffusion within the movement. The presence of such central actors is an essential factor for raising the level of penetration within the movement. In addition, the model reveals that external factors such as media campaigns and political events can lower the threshold of participation in the movement, making it easier to mobilize people. The process of feedback, wherein there is a continuous increase in participation, becomes the driving force behind the development of the movement. However, on the contrary, the conventional movement, which relies mainly on face-to-face mobilization and centralized structure, mobilizes slowly but has stronger organizational structures. However, these findings show that despite the fact that network-based movements are decentralized, able to expand rapidly thanks to the power of technology. Even though such movements experience challenges with regards to long-term commitment, these findings have significant implications not only for activists but also for policy makers since the results show that it is the dynamics of the network itself that will play the critical role in mobilization through social networking. Future research can focus on the use of real-time data analysis as well as network structure in order to maximize the potential for people's mobilization and bring about political change in the digital realm.

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