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Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh



Organizational sensemaking in tough times: The ecology of NGOs' COVID-19 issue discourse communities on social media

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ARTICLE INFO

Keywords: NGO Organizational community Social networks Social issue discourse Issue niche COVID-19

ABSTRACT

NGOs are important civil actors in societies' emergency and disaster responses, and they come together on social media to identify prominent issues and coordinate issue responses. This research explores how U.S. NGO form topic-driven communities on social media to discuss and build representational strategic networks around issues related to the COVID-19 pandemic. Drawing from Issue Niche Theory, we examined how NGOs' networks and discourse evolved before and after the general public paid great attention to the COVID-19 issue and how such patterns changed across the whole issue niche and sub-issue niches. We analyzed the evolution of Twitter-based networks and discourse of 2,588 NGOs in the first five months of the COVID-19 outbreak in the United States. Our analysis revealed important factors that shape tie formation patterns in the NGOs' communities in this novel issue niche. The findings show that NGOs' discourse patterns reflected changes in the communication networks in the NGO community.

Since its first discovery in December 2019, the coronavirus pandemic (COVID-19) has impacted almost every aspect of societies worldwide, generating a wide range of health, social, and economic problems (McKee & Stuckler, 2020). The United States is an example of a society under siege. With the most confirmed cases (over 20 million) in the world, the U.S. has experienced a massive human (344,877 deaths by December 2020) and economic toll (reducing GDP by 7.9 trillion USD) (Johns Hopkins University, 2020).

Nongovernmental and nonprofit organizations (NGOs hereafter) play vital roles in societal responses to the COVID-19 crisis. NGOs are important actors in providing disaster relief and humanitarian assistance in a wide range of public health crises, natural disasters, and humanitarian crises (Doerfel et al., 2013). Many NGOs are routinely part of the civil emergency response system for pre-disaster planning, disaster response, and post-disaster aid (Lai et al., 2019). When a crisis at the magnitude of COVID-19 strike the U.S., networks of NGOs nationwide quickly mobilized to provide relief and assistance.

When NGOs mobilize support and coordinate actions to respond to COVID-19, many use social media such as Twitter to communicate with other NGOs, stakeholders, as well as general public (Guo & Saxton, 2020). Although previous research has examined NGOs' use of social

media for crisis communication, most studies tend to focus on the strategic decisions of individual NGOs (Kaewkitipong et al., 2016; Lin et al., 2016; McPherson, 2015). While this approach offers useful insights to guide individual organizations' strategic communication choices, there has been little attention focused on how communities of NGOs utilize social media to construct shared meaning, make sense of a fast-changing pandemic, and coordinate actions that leverage different NGOs' strengths and expertises. Thus, our study contributes to the literature of organizational ecology that examines how NGOs form communities to address social issues and take on different roles in such communities (Aldrich & Ruef, 2006; Lai et al., 2019; Margolin et al., 2015; Pilny & Shumate, 2012). In addition, our study advances research on community ecology by addressing the affordances of social media that influence relationship formation among organizations during crises.

The COVID-19 pandemic provides a unique context to study how NGOs from different backgrounds come together to identify prominent issues and coordinate actions. In addition, the focus on Twitter as NGOs' communication channel allows us to effectively observe the formation of their distinctive networked communities via features such as retweets and mentions. We propose in this study that when organizations use social media for sense-making and coordinating their responses to major

https://doi.org/10.1016/j.chb.2021.106838

Received 29 January 2021; Received in revised form 21 March 2021; Accepted 19 April 2021 Available online 28 April 2021 0747-5632/© 2021 Elsevier Ltd. All rights reserved.

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social issues/crises, their discourses are more than the simple aggregation of individual organizations' messages. Instead, their repeated interactions on social media reveal what we termed as *issue discourse communities*. Such communities are discourse and topic driven, and could weave together organizations with various expertise and identities. Moreover, we propose that NGOs' interaction patterns in issue discourse communities are shaped by their needs to manage stakeholder expectations, communicate unique identities, and mobilize resources (Yang, 2020). This ecological perspective helps researchers better understand how communities of NGOs use social media in response to emerging social issues such as COVID-19.

The sections below first reviews how NGOs form communities through social media use. Then this research illustrates how unique characteristics of social media may shape the structure of such networks. In addition, we applied organizational network ecology and its recent extension in issue niche theory (Monge et al., 2008; Yang, 2020) to explain how NGOs' networks and discourse evolved as public attention to the COVID-19 issue fluctuated and how such patterns changed across the whole issue niche and sub-issue niches (i.e., health issue and economic issue niche). Findings of the current study offer a holistic perspective to understand how communities of organizations use social media in times of major crises. In addition, practical recommendations are provided to facilitate civil society discourse in anticipation of future challenges such as climate change, global refugee crisis, and income inequality.

1. Literature review

1.1. NGOs' organizational communities on social media

1.1.1. NGO communities on social media

NGOs play important roles in how societies respond to major social issues/crises (Yang, 2020). In comparison to other sectors such as government, business, and media, NGOs' dedicated attention to certain issues, relevant expertise, and local community connections are often irreplaceable (Gray & Hopkins, 2019; Saxton & Guo, 2014). As social media has become increasingly popular, NGOs utilize these platforms in various ways in their operations (Lupien & Chiriboga, 2019; Nah & Saxton, 2013). Studies found that NGOs use social media to increase their visibility and mobilize resources (Nah & Saxton, 2013). Social media also facilitate NGOs' information production, dissemination, and advocacy (Guo & Saxton, 2020; Kaewkitipong et al., 2016; Lovejoy & Saxton, 2012). In times of crises, social media could facilitate NGOs' interactions with important stakeholders such as government agencies, corporations, and local communities during crises (Lin et al., 2016).

Previous studies suggest that NGOs could form organizational communities by participating in communication networks around issues both online and offline (Lai et al., 2019; Margolin et al., 2015; Pilny & Shumate, 2012). Cooper and Shumate (2012), for example, proposed a bona fide NGO network perspective to explain the role of NGOs' inter-organizational relationships. They argue that once NGOs form communities, these organizations tend to leverage collective networks to produce tangible public goods. Such communities have been referred to as "mesomobilization" networks, which allow NGOs to consolidate overlapping identities and temporarily collaborate to resolve emerging issues or shared causes (Bozarth & Budak, 2020; Pilny & Shumate, 2012). Moreover, studies found that when NGOs use mentions and shares to create a networked community on one platform, such relationships can be maintained across different social media platforms, reaping advantages of timely information exchange especially in the context of emergency and disaster response (Brengarth & Mujkic, 2016).

For major social issues such as COVID-19, one or a few NGOs' actions hardly make any difference. As such, it is important to understand how communities of NGOs come together and form connections during the crisis. More importantly, we argue that as the context of communication, social media could also influence tie formation patterns. In the section below, we discuss these social media characteristics in greater detail.

1.1.2. Unique affordance of social media

Topic-driven communities. Social media support the formation of different types of communities. For instance, it allows individual users to connect with like-minded others based on shared interests, ideologies, or perspectives (Kaewkitipong et al., 2016; Zou et al., 2020). Such communities may be based on pre-existing social connections or individual attributes. In the context of a major global crisis, social media can support the formation of topic-driven communities. Such communities are topic-driven in the sense that they tend to form around specific discussion topics instead of a set of actors. When an organization posts a tweet, for example, its followers, publics, and other organizations can respond to this tweet by liking, replying, and retweeting it. An organization could also initiate relationships with others by mentioning certain users. Over time, these communication behaviors can lead to new relationships or catalyze collective actions (Pilny & Shumate, 2012). For NGOs, joining a topic-driven community means that they could potentially leverage connections without existing ties as long as they are interested in the same topic. This potentially allows NGOs with vastly different backgrounds to come together and focus on the same issue. Moreover, as the crisis progresses, the repeated interactions among actors could allow network structure to take shape and evolve.

Multi-mode communication. Another important affordance of social media, in particular for Twitter, is that it allows a message to be in multiple communication modes (Bruns & Highfield, 2015). An organization can send a message that is intended for one particular receiver as well as for all of the other potential audience. Such a semi-public nature of communication in the social media space effectively combines interorganizational communication with mass communication. In other words, inter-organizational communication on social media could serve multiple functions (Saxton & Guo, 2014). While NGOs communicating with each other to exchange information, express solidarity, or coordinate actions, their publicly visible interactions could serve strategic communication purposes such as attracting public attention, increasing public awareness, constructing unique identities and fulfilling stakeholder expectations (Yang, 2020; Yang & Saffer, 2020). This type of relationship is known as representational ties, which refers to relationships that can be used to signal partner relationships to the public and not necessarily formed to exchange information or resources (Shumate & Contractor, 2013, pp. 449-474). Organizations may utilize different features on social media (e.g., tag, retweet) to form a variety of representational ties and position themselves strategically within an issue network to facilitate building of organizational community (Lai et al., 2017; Liu & Shin, 2019). Representational ties could help them mobilize resources, meet stakeholder expectations, gain legitimacy and influence social issues (Roloff, 2008; Young & Leonardi, 2012).

The idea that a substantial number of NGOs' ties on social media are representative ties makes two important differences in the structure and evolution of organizational communities that are formed on social media. First, such communities may be highly responsive to public attention and trends. This is because when issues receive different levels of public attention, taking actions on these issues may benefit organizations in different ways. Generally speaking, a highly visible public issue may help NGOs attract more attention, donation, and other resources than an obscure issue (Yang, 2020). Second, organizations use social media to strategically express their unique identities or manage important relationships on social media. For instance, Fu (2019) found that NGOs treat Twitter as an important tool to manage relationships with other NGOs. Raja-Yusof et al. (2016) found that NGOs leverage the visibility of relationships to engage the public and pursue their missions and goals. In other words, NGOs may prioritize strategic communication goals on social media.

Recognizing the unique affordance of social media and related factors that may affect inter-organizational networks among NGOs, we now turn to a theory that could provide a useful framework for understanding how NGOs' issue discourse communities form around pressing issues emerged during the COVID-19 pandemic.

1.2. Issue niche and the evolution of issue discourse communities

In this section we first briefly introduce the issue niche theory (Yang, 2020). Additionally, we apply this theory to the context of socially mediated communication, and explore how theoretical concepts can be applied to explain tie formation patterns in NGOs' topic-driven issue discourse communities.

1.2.1. Issue niche theory

Issue Niche Theory (INT) is an extension of the organizational ecology theory with important differences (Aldrich & Ruef, 2006). Organizational ecology theory (also known as community ecology or institutional ecology theory) is a theoretical perspective that studies the formation, growth, maintenance, and demise of communities of organizations and the evolution of relationship networks among them (Hannan & Freeman, 1977). Similar to organizational ecology theory (Doerfel et al., 2013; Hannan & Freeman, 1984; Monge et al., 2008), INT assumes that organizational communities form around niche space and build inter-organizational networks (Yang, 2020). Such networked communities around social issues vary in size and composition and they evolve over time (Chung et al., 2021). Unlike organizational ecology theory, however, INT defines niche not based on resources but based on the socially constructed issue perceptions. Issue niche is defined as "an issue space that channels public attention and provides a space for the communication of identities and ideologies" (Yang, 2020, p. 49). Since issues are formed in the process of discourse, this theory is highly applicable to understanding discourse-based communities. Key theoretical constructs in INT include issue niche formation, niche width, and organizational identity-related niche partitioning (Yang, 2020).

1.2.2. Applying issue niche theory to social-mediated communication

Topic driven discourse and niche formation. According to INT, when an issue emerges, issue stakeholders start engaging in this topic by sharing information and discussing solutions (Yang, 2020). In the context of Twitter, this means that NGOs begin to tweet about the COVID-19 issue, suggesting what they and the public can do to help. They could also retweet or mention other NGOs or other partner organizations either to call for actions or announce actions/plans, and effectively bring in more actors to a discussion. This topic-driven discussion process is highly identical to that of issue niche formation. According to INT, an issue niche begins to take place when a group of issue stakeholders problemize a social reality, communicate with each other to articulate the causes and remedies (also known as claimsmaking) (Yang, 2020). The communication process is fundamental to issue niche formation. Communication helps issue stakeholders construct realities that define the issues at hand and may also guide their attention on how to distribute resources, how to form connections, and how to plan further actions (Young & Leonardi, 2012).

Moreover, complex issues such as COVID-19 may affect or are related to a range of other issues (Kim et al., 2021, pp. 1–9). In other words, even though the major concern of NGOs' tweets is about the COVID pandemic, their discourse may fall into different sub-issue topics (e.g., health, economic, humanitarian aids, research, just to name a few). As different NGOs join the conversation, they may identify different sub-issue topics that deserve attention and devote their discussion to these areas. Some of such sub-issue discussion topics may remain relevant throughout the pandemic, whereas other topics may be replaced by other concerns. The identification of major sub-issue discussion topics is important because it demarcates issue communities, which serve as the basis of further analysis. In this study, as is further discussed later, we recognize issues evolve over time, so would related discussion topics. As such, we ask: **RQ1.** How do changes in an issue niche affect the NGO community's issue discourse and network structure?

Public attention and issue niche width. Another important idea that the INT proposes is that public attention associated with an issue can be conceptualized as resources supporting NGOs to achieve their goals and mobilize collective and/or connection actions (Yang, 2020). Public attention is critical here because it is the prerequisite for the formation of issue niche. Without adequate public attention, objective social conditions may not be recognized as social issues. Moreover, public attention is also the prerequisite for resource mobilization and actual actions and social change. Without adequate and sustained public attention, issues may fall out of the public domain too quickly and thus fail to attract resources to address such issues (Hilgartner & Bosk, 1988). When an issue receives relatively little attention, it would be difficult to convince the public or stakeholders that they need to channel attention and resources to this issue. As such, fewer organizations would pay attention to the issue or discuss it in public. In contrast, when an issue attracts broad public attention, publics and stakeholders may demand organizational actions, and therefore motivate or compel organizations to enter the issue niche and build relationships to advance their goals and objectives (Roloff, 2008). In the context of COVID-19, Wang et al. (2020) studied networking activities among health agencies and stakeholders. They found that as the COVID-19 conditions continues to unfold, these organizations' communication regarding COVID-19 changed from scarce to active, and their networks also show an increasing connectivity as they coordinate on their crisis response. As such, the INT argues that public attention determines the niche width of an issue niche, which further has profound influence on organizational community behaviors (Yang, 2020).

This proposition about issue niche width is highly compatible with the dynamics of public attention on social media platforms. At any given moment, there are hundreds and thousands of accounts and topics competing for public attention. For NGOs to join a topic that is already trending could make it easier for them to attract public attention and stay relevant. A trending topic would thus support a larger community of NGOs than an obscure one. As such, based on INT and characteristics of social media, we propose that across COVID-19 whole issue and subissue niches, NGO communities' network sizes would expand in response to growing public attention:

H1. As COVID-19 grows into a prominent issue, the network sizes of NGO communities would increase both in the whole COVID-19 issue and sub-issue niches.

Strategic communication needs and niche partitioning. As organizations enter the issue niche and form connections, INT suggests that niche partitioning may occur based on organizations' identities (Yang, 2020). Organizational identities are functions that "map producers, audience members, and defaults about the feature value" (Hannan et al., 2007, p. 102). Identities may manifest in an organization's mission, form of authority, and core technology (Hannan & Freeman, 1977). Organizational identities serve many strategic purposes such as enhancing reputation, attracting stakeholder support, and forming competitive advantages (Bartel et al., 2007).

INT defines NGOs' issue identities according to organizations' issuerelated interests, demands, actions, and sympathetic issue stakeholders (Yang, 2020). There are different ways to categorize NGOs' issue identities. Based on the range of issues that NGOs focus on, NGOs can be categorized into specialists and generalists (Pilny & Shumate, 2012). NGOs with wide issue focuses are generalists and the ones with narrow focuses are specialists (Yang, 2020). Based on the content of NGOs' mission statements, NGOs can be grouped together based on what they could offer to stakeholders (e.g., advocacy, research, etc.), which we termed as service identity here. When NGOs share information and build connections with various partners on social media, NGOs with different service identities could behave differently.

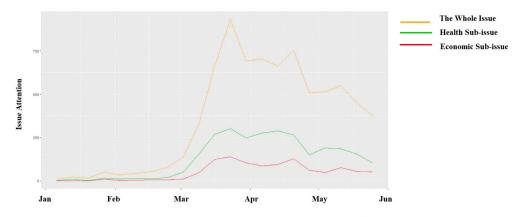


Fig. 1. Issue attention plot of the two sub-issues and the whole issue based on NGOs' interaction: The red line represents the economic sub-issue and the green line depicts the issue attention evolution of the health sub-issue. The orange line describes the issue attention evolution of the whole COVID-19 issue.

Specifically, generalists and specialists occupy different niche positions and demonstrate varied relationship-building patterns. Previous research suggests that generalist NGOs, with their abundant resources, longer tenure, and stronger reputations, often act as issue leaders (Margolin et al., 2015; Sun et al., 2020). When an issue has not gained much public attention, generalists tend to function as the face of an issue and promote its salience in the public agenda (Shumate et al., 2005; Yang, 2020). On the other hand, when an issue has gained critical public attention, stakeholders would have a refined understanding of the issue and seek to deepen collaborations with experts with specific expertise. As such, specialists falling in narrow sub-issue areas may experience increasing opportunities to build ties because of their specialties (Sun et al., 2020). Following this logic, we propose:

H2a. For the overall COVID-19 issue and major sub-issue niches, generalist NGOs are significantly more active than specialist NGOs at the low public attention stage.

H2b. For the overall COVID-19 issue and major sub-issue niches, specialist NGOs are significantly more active than generalist NGOs at the high public attention stage.

Moreover, NGOs' service identity could affect the type of topics they want to engage in. As noted by Ganesh (2003), "NGO identities derive prima facie not so much from a sense of internal coherence as they do from external audiences, discourses, and issues that NGOs identify themselves with or against" (p. 560). COVID-19 is an emerging and multifaceted issue. Different sub-issue may primarily affect certain audiences. For example, people who live in assisted living facilities face different challenges than children who depend on the school systems for meals. As such, when NGOs choose different topics to focus on, they could communicate with vastly different audiences. As NGOs begin to grasp COVID-19 issues and explore solutions, NGOs with different service identities may begin to identify with different sub-niches. What is interesting in the current research context is that the COVID-19 is a novel issue. As such, it is unclear which types of NGOs with what service identities would identify with the whole and sub-issue niches and become active in subsequent issue discourse. To explore how NGOs with different identities position themselves in this novel issue, we ask:

RQ2. As the whole issue and sub-issue niche evolve, how do the activity of NGOs with different service identities change?

The co-evolution of network and discourse. The INT recognizes that while organizations' networks could enable or constrain their opportunities, the actions of involved organizations may in turn reshape networks as well. In the context of social media, previous research suggests that actors occupying central network positions tend to promote their agenda and topics to the center of discourse (Saffer et al., 2019). In other words, as NGOs with different identities join these

discourse communities, their active participation may further change the discourse and network structure. To explore the connections between organizational networks and changing discourse topics, we ask the following question:

RQ3. As the COVID-19 issue evolves, how are changes in the issue networks and discourse topics related?

2. Method

2.1. NGO sample and data collection

We sampled U.S. NGOs through two steps. First, we identified the top 1,000 U.S. NGOs based on revenue (GuideStar, 2020). Second, since not all NGOs active in the COVID-19 issue were the ones with high revenues, we identified additional 1,588 U.S. NGOs that have tweeted about the COVID-19 issue from a large COVID-19 Twitter database¹ (Chen et al., 2020). This method allows us to sample both elite and grassroots NGOs active in the COVID-19 issue niche ($N_{ngos} = 2,588$).

Further, using Twitter REST API, we retrieved the most recent 3,200 tweets² (max limit imposed by API) for each NGOs' account. A total of 8,281,600 tweets sent by NGOs were extracted. We eliminated tweets sent before January 7, 2020, the date when the U.S. reported its first COVID-19 case. After this step, we retained 1,137,742 tweets (13.74%). Further, we removed tweets irrelevant to COVID-19 using the keywords list compiled by Chen et al. (2020). Finally, 267,322 pandemic-related tweets were retained. We further identified 8,802 tweets (3,720 mentions and 5,070 retweets) of NGOs either mentioning or retweeting another NGO since the focus of this study is communication within the NGO communities.

The 8,802 tweets were separated into two issue attention stages for further analysis. We used March 20 as the cut-off point because the number of tweets exponentially grew around this time for the overall issue and sub-issues (see Fig. 1). Moreover, according to the number of news collected on COVID-19 during this period, the pattern is also consistent (see Fig. 2), indicating that the public attention did rise around our cut-off date. Therefore, our decision to cut off the data into low/high public attention stages in our analysis was supported by (1) major events, (2) the number of tweets sent by NGOs, (3) the number of COVID-19 news. This cut-off point is also consistent with the timeline of

¹ The database contains tweets collected through Twitter Streaming API based on a long list of keywords related to COVID-19. For details, please see Chen et al., 2020. NGOs were identified from the database using information from their bios. We manually read all the bios and eliminated accounts that were not NGOs.

² We conducted the data mining on May 29th, 2020. The 3200 tweets from each account was enough to capture U.S. pandemic-related discussion.

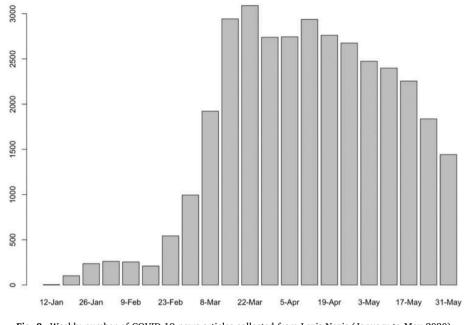


Fig. 2. Weekly number of COVID-19 news articles collected from Lexis-Nexis (January to May 2020).



2.2. Independent variables

NGO service identities. On Twitter, NGOs express their identities through self-created profile descriptions. To classify each NGO into a subcategory based on topics they associate themselves with, we used Latent Dirichlet Allocation (LDA) on NGOs' twitter bios. Based on the results, researchers labeled the identified nine topics (issues) based on top-word lists: human rights, research, service providers, healthcare, U. N./global,⁴ advocacy, foundation, news, and others. NGOs were manually coded into the nine categories. The accuracy of the human coding on NGOs' service identities was validated by two researchers, who each coded 30% of the bios separately and achieved an acceptable inter-coder reliability (Cohen's Kappa = .72; McHugh, 2012). Note that although our focus is on US NGOs, a number of global NGOs were included in the sample because their headquarters are in the U.S and they actively engaged with US NGOs.

Generalist/Specialist. Based on twitter bios and their service identities, NGOs were coded into generalists and specialists. Following Yang (2020), if NGOs worked in multiple areas under their service identity, they were coded as generalists. For those working on a single social issue area, they were coded as specialists. For example, the California Health Care Foundation was coded as a generalist because their goals are "improving California's health care system" and they work on a range of health related issues. In comparison, American Cancer Society Cancer Action Network was coded as a specialist because they specialize in fighting cancer. Randomly selected 30% of the data were coded by two researchers, and the inter-coder reliability for this variable (Cohen's Kappa = .76) was satisfactory.

2.3. Control variables

Past research suggests organizations' reputation (Doerfel & Taylor, 2017), the level of uncertainty organizations face from the environment (Margolin et al., 2015), ideologies (Ronfeldt & Arquilla, 2001), and geographical proximity (Atouba & Shumate, 2015) affect their network building. Therefore, we introduce the number of followers as a proxy of NGOs' reputation on Twitter. The number of confirmed cases and unemployment rates to account for the uncertainty in the NGOs' environment. Lastly, NGOs' ideologies are also controlled.

The number of followers. This variable was collected based on NGOs' number of twitter followers at the time of our data extraction (M = 85,409, SD = 464,270). We used Box-Cox (B.C.) transformation to normalize this variable before fitting ERGMs (Sakia, 1992).

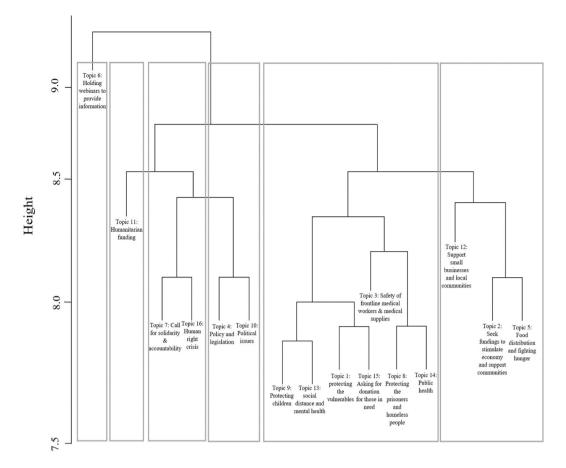
The number of confirmed cases. The cumulated number of confirmed COVID-19 cases in each state was extracted on two dates: March 20th for the low (M = 861, S.D. = 1,951) attention stage and June 4th for the high attention stage (M = 1,201,928, S.D. = 2,526,494) (Johns Hopkins University, 2020). This variable was also B.C. transformed.

Unemployment rate. The unemployment rates for all states were collected from the Bureau of Labor Statistics in March and May, for low (M = 4.89, S.D. = 1.46) and high attention (M = 12.9, S.D. = 3.19) stages. We decided to control the number of confirmed cases and unemployment rate of NGOs' states because we may expect that NGOs' attention to the COVID-19 issue may be exposed to offline variables like these.

NGOs' ideologies. We classified each NGO into one of three ideological categories: liberals, conservatives, and neutrals. We first filtered out all bios and the most recent 3,200 tweets that may potentially contain information on NGOs' ideologies by searching for keywords (e. g., "conservative", "conservatism", "federalist", "republicans", "progressive", "liberal", etc.). If the bios contained keywords that signaled NGOs' ideologies such as "progressive", and "liberalism", they were categorized as "liberals". If the bios included keywords such as "conservative" and "federalist", NGOs were classified as "conservatives". Those with keywords of "non-partisan" and "neutral" were classified into "neutrals". For NGOs that did not have any ideology related keywords in bios, we manually coded their ideologies by reading their recent tweets filtered in the aforementioned way. Finally, two

 $^{^3}$ California enacted the first stay-home-order in the U.S. on March 19. One day later, the states of Illinois and New York issued the same order. It is likely that as millions stayed at home, public attention to COVID-19 issue also exploded.

⁴ Categories are mutually exclusive. We coded UN NGOs as a separate category regardless of their issue interest because their agenda tend to be global in reach.



Note: This figure was generated using Ward's minimum variance method based on the pairwise Hellinger distances using the topic-document probability computed from our LDA model.

Fig. 3. Cluster dendrogram of 16 topics. Note: This figure was generated using Ward's minimum variance method based on the pairwise Hellinger distances using the topic-document probability computed from our LDA model.

researchers coded 30% of the NGOs by reading their bios and tweets and reached a good inter-coder reliability (Cohen's Kappa = .74).

NGOs' headquarter location. Based on NGOs' Twitter profiles, we coded NGOs' headquarters location. If an NGO was located in the U.S., we extracted the state where a headquarters was located. For global NGOs, their location was coded as "global".

2.4. Analytical procedure

To analyze the co-evolution of issue discourse and issue network, we applied topic modeling and network analysis. First, to identify the subissues of the COVID related discourse among NGOs, we used the LDA topic modeling, a method developed to discover latent topics in texts (Blei et al., 2003). Details of the topic modeling procedures can be found in Appendix A. We manually read 10% of all tweets assigned by the LDA model to these two issues, and the accuracy of the assignment is 86.25%. Next, we extracted networks of NGOs who either mentioned or retweeted other NGOs in each identified issue niche. Retweets and mentions were combined to construct the networks because we consider both types of communication as meaningful interactions (Ihm, 2019). Based on the LDA analysis, we identified two sub-issues - health and economy - which allowed us to construct six networks: health issue networks at high and low attention stages, economic issue networks at the high and low attention stages, and whole COVID-19 networks at the high and low attention stages.

Then, Exponential Random Graph Models (ERGMs) were used to analyze tie formation patterns in NGO networks. ERGM is a network analysis tool that analyzes the structure and process of social networks and accounts for interdependencies among network nodes (Lusher et al., 2013). ERGMs estimate the likelihood of network configurations using the Markov chain Monte Carlo maximum likelihood estimation (Shumate & Palazzolo, 2010). All networks are directed and the tie direction means the direction of the retweet and mention actions. A significant estimation in ERGMs means a network structure appears more frequently than by chance alone. The R package "ergm" was used to fit the models (Hunter et al., 2008a). Goodness of fit statistics for all ERGM models were checked and reported in Appendix G. All models have satisfactory goodness of fit statistics and the simulated network results from maximum likelihood estimation (the boxplots) match observed statistics well (solid lines; Hunter et al., 2008b).

3. Results

We ran LDA models to answer RQ1, which explore how the discourse evolves as the issue evolves. Based on the topic-document probability generated by our model, pairwise Hellinger distances⁵ between topics were computed. Based on Ward's minimum variance method (see Fig. 3), we chose to collapse the smaller topics into six topics: health, economic, policy & advocacy, human rights, announcing funding, and information (see Appendix B). As aforementioned, the topic assignments

⁵ Hellinger distance is a method to calculate two probability distributions (Wu & Karunamuni, 2015).

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How would your community respond if a **#pandemic** spread there? This article by LeadersLink Founder @KathleenKoch1 is packed w/advice for leaders who would have to make difficult decisions to keep citizens safe. **#coronavirus @ASTHO @isea_safety** @NACoTweets leaderslink.org/expertadvice_a...

6:32 AM · Feb 11, 2020 · Twitter Web App



UNFPA ② @UNFPA · Apr 18, 2020 "The protection of health workers must be a priority."

As we join @GlblCtzn, @WHO and the millions of people worldwide staying #TogetherAtHome, meet two inspiring front-line health workers in #VietNam who are protecting mothers and babies from #COVID19: unf.pa/vnc



UNFPA Viet Nam and 8 others

Fig. 4. Example tweets discussing the safety of the local communities (low attention stage) and the safety of the frontline medical workers (high attention stage).

were manually confirmed by human coders. The consistency between human and machine is at 86.25%. Among these topics, two clusters of topics accounted for the largest number of tweets. Thus, we identified two sub-issue areas (i.e., health and economic issues) as sub-issue niches for further analysis.

In the whole issue niche (see Appendix D_a for details), most discussion topics were consistent throughout the two stages. A unique topic being discussed at the low attention stage was preparedness; whereas when attention was high, the humanitarian issue emerged to be a major topic.

Health was the most dominant sub-issue in the entire discussion. It covered pressing topics including public health, protection for frontline workers, protection for vulnerable populations (e.g., prisoners, homeless, and children), sounding alarms for mental health, and raising donations (see Appendix D_b). We divided the tweets on the COVID-19 health issue into the low ($N_{\text{tweets}} = 387$) and high attention stages ($N_{\text{tweets}} = 1,993$) and conducted topic modeling. The perplexity score revealed seven unique topics in low-attention stage and high-attention

stage (see Appendix D_b). While most topics stayed consistent across the two time periods, at the low-attention stage, a unique discussion topic emerged concerning information related to the health and safety of local communities. At the high-attention stage, the discussion about the safety of frontline medical workers emerged as an important topic (See Fig. 4 for example tweets). This may be due to the active efforts of advocacy NGOs (as indicated in ERGM results and will be discussed in the later sections).

The economic issue niche, the second prominent topic, covered topics such as economic stimulus funding, food distribution to fight hunger, and support for small businesses and local communities. Appendix D_b reports detailed findings. For the economic sub-issue niche, at the low attention stage, there were 157 tweets sent by NGOs related to the economic issue. The perplexity score suggested five topics. Similarly, researchers manually checked the accuracy of the topic assignments. At the high attention stage, there were 838 tweets, and the perplexity score suggested six topics were present. Food security, funding support, resources, and local community stayed consistent

Coalition on Homelessness (Seattle / King Co., WA)

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Public health info for kids about #coronavirus in #Spanish #Tagalog #English. Check out these Qs & As, tips. Talking w/ kids about facts is an important way to address their fears. (Adults could probably learn a thing or two as well!) Thanks @educationlab. @MarysPlaceWA @Hopelink

Seattle Times Education Lab () @educationlab · Mar 6, 2020 Kids are asking questions about #coronavirus in all languages, not just English. So we're answering them in Spanish seattletimes.com/education-lab/... and... (1/3) Show this thread

5:35 PM · Mar 6, 2020 · Twitter Web App



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Important info for Nonprofits: @SBAgov's section of the CARES Act applies to nonprofits, with an allocation of \$349 billion to keep workers at small businesses & nonprofits employed amid the economic downturn and the COVID-19 pandemic. Learn more:

@TSNE

CARES Act Application Information Urgent Information for Nonprofits Applying to the Paycheck P... This page provides an overview of the CARES Act loans available to nonprofits, a step-by-step guide to apply for the ... \Im tsne.org

2:06 PM · Apr 2, 2020 · Sprout Social

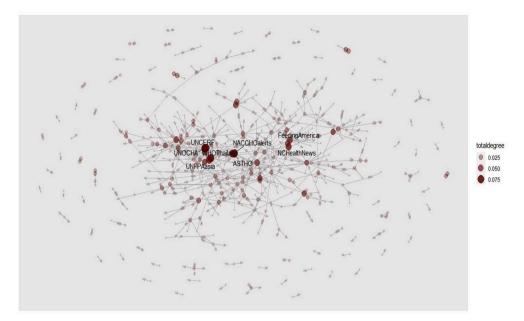
Fig. 5. Example tweets discussing education resources (low attention stage) and the survival of small businesses, nonprofits, and public policy and relief packages (high attention stage).

across two periods. In terms of topic changes, we found that education resources were a key topic when attention was relatively low and lost its salience later. When public attention increased, the survival of small businesses, nonprofits, and public policy and relief packages emerged a key topic (See Fig. 5 for example tweets).

So far, we have discussed our topic modeling results, next we present findings from our network analysis. H1 stated that more NGOs would participate in the COVID-19 discourse at the high attention stage than the low attention stage across the whole and sub-issue niches. We found that as public attention to the COVID-19 issue rose, the number of NGOs that participated in the COVID-19 conversations increased considerably across networks. At the low attention stage, the whole network consisted

of 533 NGOs connected by 873 ties (density = 0.004; see Fig. 6 Panel 1). At the high attention stage, the network grew to the size of 1,069 NGOs connected by 4,600 ties (density = 0.002; see Fig. 6 Panel 2). Similarly, in the health sub-issue networks, when public attention was low, there were 337 NGOs connected by 387 ties (density = 0.003; see Fig. 6 Panel 3). When attention was high, there were 780 NGOs connected by 1,993 ties (density = 0.002; see Fig. 6 Panel 4). In the economic sub-issue network, when public attention was low, there were 180 NGOs connected by 157 ties (density = 0.0041; see Fig. 6 Panel 5). When attention was high, for the economic issue network, there were 560 NGOs connected by 838 ties (density = 0.0018) (see Fig. 6 Panel 6). Thus, H1 was supported.

Panel 1: Whole issue network for 533 NGOs (T1)



Note: The darker the color and the larger the size of the nodes, the higher total degree centrality

of the nodes. Based on the normalized total degree centrality, NGOs with the total degree

of larger than 0.05 were labeled.

Fig. 6. Visualization of the four networks and nodes with highest total degree.

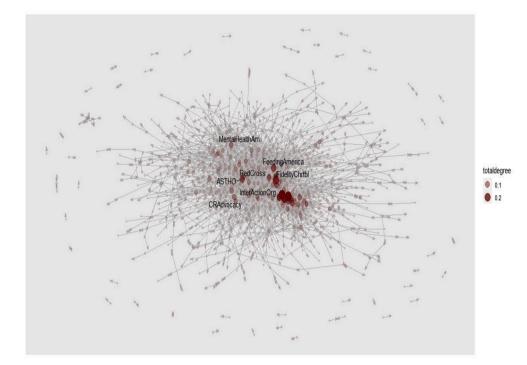
To understand factors shapring tie formation in the three sets of networks, we ran ERGMs (see Table 1 for ERGM results). Specifically, H2a and H2b examined niche partitioning at low and high attention stages. We used "specialists" as reference, and did not find support for the differential influence of generalists and specialists at low (Estimates = -0.109, p > .05) nor high (Estimates = 0.003, p > .05) issue attention stages in the whole networks (H2a & b were rejected). In the health networks, we did not find evidence that generalists were more active when attention was low (Estimates = -0.295, p > .05) (H2a was rejected), but we found that during the high-attention stage, specialists were significantly more active than generalists (Estimates = -0.147, p < .05). Thus, H2b was supported. Consistent with the case of the health network, in the economic sub-issue network, we did not find that generalists were more active when attention was low (Estimates = -0.177, p > .05) (H2a was rejected). We discovered that when attention was high, specialists were more active (Estimates = -0.350, p < .01) (H2b was supported). Overall, we did not find evidence that generalists were more active when attention was low across networks (H2a was rejected) but we found consistent and robust support for H2b in sub-issue networks.

RQ2 examined as the issue niche width evolves, how activities of NGOs with different service identities change in different niches. We found that NGOs' service identity was significantly associated with tie formation in all networks. We used "others" as the reference group. For the whole networks, when attention was low, we found that research NGOs (Estimates = 0.513, p < .01) and foundations (Estimates = 0.663, p < .05) were most active. Global NGOs were unlikely to initiate a conversation with other NGOs (Estimates = -1.107, p < .01). When attention was high, global NGOs continued to be inactive (Estimates = -1.001, p < .001). Foundations continued to be active (Estimates = 0.384, p < .01). Humanitarian NGOs (Estimates = 0.127, p < .01),

health NGOs (Estimates = 0.140, p < .01), and advocacy NGOs (Estimates = 0.199, p < .001) emerged to be significantly popular. For the health networks, at the low-attention stage, global NGOs (Estimates = -1.371, p < .05) and research NGOs (Estimates = -1.164, p < .05) were least active, whereas news NGOs were most popular (Estimates = 0.955, p < .001). At the high-attention stage, global NGOs continued to be inactive (Estimates = -1.399, p < .001) and advocacy NGOs became most active (Estimates = 0.201, p < .01). For the economic issue, when attention was high, global NGO were inactive (Estimates = -1.064, p < .01). Overall, the analysis showed that NGO community's tie formation patterns are similar in both sub-issue niches and are driven primarily by NGOs' service identities, which lend strong support for the reliability of our results.

RQ3 aimed to identify connections between the discourse and network. ERGM results and LDA results were compared to identify connections between shifts in discourse and network structure. For the whole networks, the model identified ten topics when attention was low. In addition to health and economic issues, other prominent issues included women, funding, and information. These patterns may be partly driven by the active engagement of research NGOs and foundations. When public attention was high, mental health, humanitarian, and advocacy became prominent topics, which may be associated with the significant activities of humanitarian NGOs, health NGOs, and advocacy NGOs. As such, it seems that the active participation of NGOs could bring new topics to the community conversation. Similarly, for the health sub-issue niche, we also identified that topics like safety of frontline medical workers and calling for support and solidarity emerged to be important topics when attention was high. This pattern might be associated with advocacy NGOs' popularity during that stage.

In summary, it is evident that the issue niche width plays a significant role in NGOs' network size. As issue niche increases, the number of



Panel 2: Whole issue network for 1,069 NGOs (T2)

Note: The darker the color and larger the size of the nodes, the higher total degree centrality of

the nodes. Based on the normalized total degree centrality, NGOs with the total degree of

larger than 0.08 were labeled.

Fig. 6. (continued).

NGOs participated in the COVID-19 whole issue and sub-issue discourse increases. Also, NGOs' issue identity affects tie formation across niches. Different types of NGOs appeared to be dominant in the whole issue and each sub-issue area as the issue niche evolved. Moreover, active NGOs were able to introduce new topics to the overall discussion. However, there was an important difference between results in the whole network and sub-issue networks: we found that specialists were more likely to stand out in the sub-issue networks than in the whole network.

4. Discussion

The COVID-19 pandemic poses severe and novel challenges to societies. Discourse about COVID-19 created new issue niches where NGOs identify COVID-19 related problems and form connections towards solving the problems (Oberg et al., 2017). Our study focuses on the co-evolution of NGOs' community networks and discourse on Twitter during the first half year of the pandemic outbreak in the U.S. This research design combines network modeling and automated textual analyses (Zou et al., 2020). Our analysis suggests that social media support the formation of topic-driven communities among NGOs around the U.S. NGOs' discourses help this organizational community make sense of the crisis and identify the most salient issues in need of action. Finally, NGOs that hold important network positions also propel topics to the center of community discourse. Each of these findings is elaborated below.

4.1. Social media and NGOs' topic-driven communities

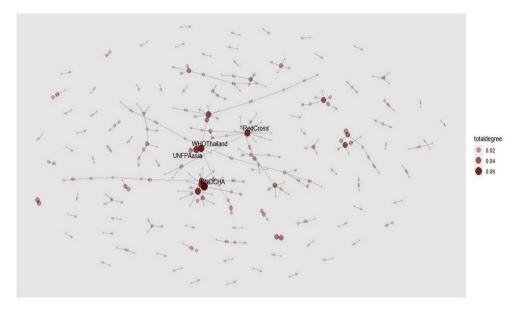
Our study showed that social media support the formation of

communities based on shared topics. Such topic-driven communities are especially important in times of crisis to help organizations' crisis sensemaking. Through our analysis, we observed that the majority of prominent discussion topics remained stable while a few new topics emerged as the issue evolved. This relatively stable discourse pattern allows many NGOs to stay engaged with other NGOs on similar topics over a period of time. Meanwhile, as different types of NGOs become prominent at different issue stages, new topics could be introduced to the prominent discourse. This pattern allows these communities to adjust their primary agenda as the crisis unfolds.

Additionally, we found that the health and economic sub-issue networks featured completely different discussion topics and involved quite different NGOs (Appendix C). These findings suggest that distinctive topic-driven communities have taken shape in the process of discourse. This finding confirms our expectation that during a major crisis, NGOs' community formation on social media is not driven by some elite NGOs who bring all NGOs to one topic, but rather reflect a topic-driven process where different topics attract different NGOs.

Moreover, we observed that as the issue evolved, changes in the discourse topics reflected that of network evolution. For instance, one of the key topics during the early stage was preparedness (Appendix D_a). This topic faded away when public attention intensified, and gave way to new topics such as advocacy and humanitarian aids. This pattern of change is also strikingly consistent with the network position changes associated with NGOs with different identities (recall that advocacy NGOs and humanitarian NGOs became prominent at the high attention stage). It is likely that as some NGOs with the most relevant expertise emerged as prominent actors in the community, they set the discourse agenda of the overall community and helped re-orient the community's

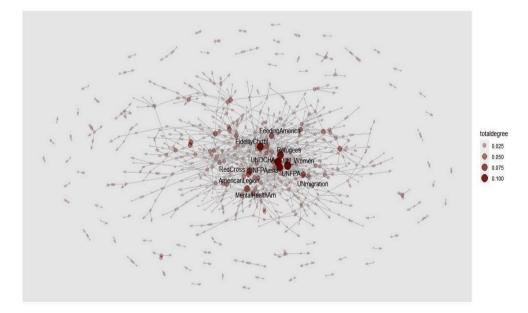
Panel 3: Health issue network for 337 NGOs (T1)



Note: The darker the color and larger the size of the nodes, the higher total degree centrality of

the nodes. Based on the normalized total degree centrality, NGOs with the total degree of larger than 0.05 were labeled.

Panel 4: Health issue network for 780 NGOs (T2)



Note: The darker the color and larger the size of the nodes, the higher total degree centrality of

the nodes. Based on the normalized total degree centrality, NGOs with the total degree of

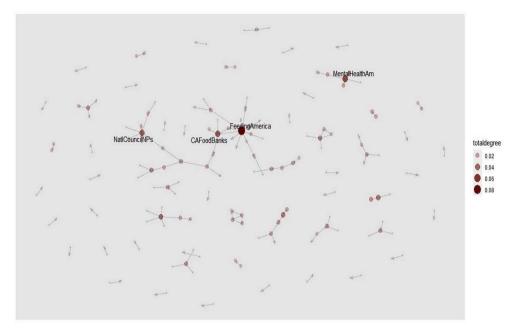
larger than 0.05 were labeled.

Fig. 6. (continued).

attention and actions.

Together, these findings suggest that social media support the formation of topic-driven communities that help US NGOs to identify pressing challenges and areas where they can step in and offer help. The consistency of discussion topics suggests that NGO communities have reached a consensus of major areas where their attention and actions

Panel 5 Economic issue network for 180 NGOs (T1)



Note: The darker the color and larger the size of the nodes, the higher total degree centrality of

the nodes. Based on the normalized total degree centrality, NGOs with the total degree of

larger than 0.03 were labeled.

Fig. 6. (continued).

were required. Our analysis also showed that NGOs' geographic locations or sizes no longer constrain their tie formation on social media. Finally, while the evolving discourse drives networks to take shape, the prominent actors and their relationships may also in turn influence the prominence of discussion topics.

4.2. Issue niche and NGO community network evolution

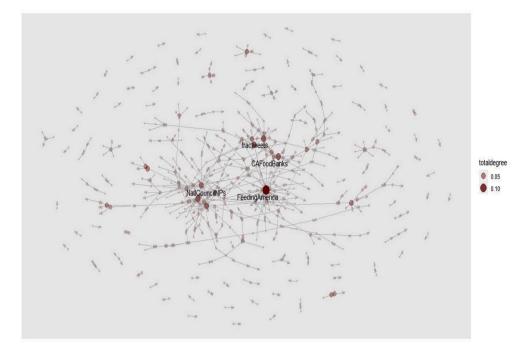
This study also illustrates that INT helps to explain tie formation patterns in topic-driven organizational communities (Yang, 2020). Our analysis showed that as public attention to this COVID-19 issue intensified, the number of NGOs discussing COVID-19 relief and related issues also drastically increased. The pattern was observed both in the whole issue network and two most prominent sub-issue networks (health and economic). Previous organizational ecology research suggests that as niche width increases, a niche could support more organizations and more interorganizational ties (Margolin et al., 2015). Our analysis shows that this theoretical prediction holds true in an issue niche and its representational networks on social media.

We further explored organizational tie formation patterns. We examined if niche partitioning drove tie formation patterns in the COVID-19 whole issue network and sub-issue networks. Our results show that NGOs with different service identities took spotlights by being active and popular at different issue stages and sub-issue areas. Specifically, results suggest that in the whole network, when public attention was low, the most active NGOs were research NGOs and foundations. This may be due to such organizations' access to new information. The activity of these organizations may also help the NGOs' community and their followers acquire early information and make sense of the pandemic and its impact. When public attention was high, in addition to foundations, humanitarian NGOs, and health NGOs, advocacy NGOs became significantly more active. This pattern could indicate that the organizational community shifted from information gathering to mobilization and taking actions. A similar pattern was found in the health and economic sub-issue networks, in which the most active NGOs during the early stage were news (for health sub-issue network) and research (for economic sub-issue network) NGOs. In contrast, when public attention intensified, the most popular NGOs were advocacy NGOs. Overall, this analysis shows that as more NGOs entered the issue niches and assumed different roles, NGOs with the most appropriate expertise at the moment emerged as popular actors in the community, contributing to niche partitioning. It is remarkable that the process took place quite swiftly in a completely novel issue niche through a seemingly autonomous discourse process. The process may also help the NGO community to prioritize attention and resources at different issue stages.

At the aggregated level, niche partitioning often means issue generalists and specialists collectively demonstrate different tie formation patterns (Monge et al., 2008; Pilny & Shumate, 2012). INT suggests that when public attention is low, generalists are preferred tie formation partners, whereas when public attention is high, specialists with the more relevant expertise will emerge as more active (Yang, 2020). Our analysis showed that although specialists had little advantage over generalists in the whole COVID issue-network, they became significantly more active in sub-issues at high attention stages. Our finding provides a nuanced understanding of how tie formation opportunities for generalists and specialists may change as issues evolve and issue niche changes. However, contrary to the theory, we did not find generalists showing any advantages at the low attention stage. One explanation is that COVID-19 is a novel issue. As NGOs just begin to populate this niche, generalist NGOs' role may not be well-formed yet for us to observe significant patterns.

Although previous studies generally found that organizational compatibility based on homophily drives tie formation among organizations (Margolin et al., 2015; Monge et al., 2008), our study did not find

Panel 6: Economic issue network for 560 NGOs



Note: The darker the color and larger the size of the nodes, the higher total degree centrality of

the nodes. Based on the normalized total degree centrality, NGOs with the total degree of

larger than 0.05 were labeled.

Fig. 6. (continued).

assortative or proximity homophily to be salient factors. It is likely that in the virtual space, NGOs' tie formations are less costly, and therefore, geolocation has less influence than in the offline world. The nature of this sample thus may limit the impact of homophily based on organizational ideologies.

4.3. Limitations and future research

This study does have a few limitations that can be addressed in future research. First, we primarily focused on NGOs' Twitter discourse and networks. Future studies could combine multiple data sources to examine the relationship between networks based on multiplex platforms because discussion about the COVID-19 likely permeates a wide array of media channels. For example, Lai and Fu (2021) analyzed how organizations' offline network diversities are associated with their online representational ties on both Facebook and Twitter. They found offline diversity positively correlates with network diversity on Facebook but negatively relates to that on Twitter. Future studies can explore a wide range of network features across platforms. Second, our sample mostly consists of NGOs with predominantly liberal or neutral ideologies (See Appendix E). This sample reflects the situation that conservative organizations may take a skeptical view of the pandemic. However, we should not assume conservative NGOs are silent during the pandemic. The interesting question is what they are discussing during this period and how do they make sense of the reality. Future studies may include a purposive sample of conservative NGOs and analyze their discourse and networks and compare the results with the current study to see how organizations with significant ideological differences may construct the issue differently. This finding may be especially relevant for dealing with politically polarized issues.

4.4. Conclusion

Overall, we found that as NGOs discussed the COVID-19 crisis and its social impact over time, distinctive organizational communities emerged around different topics. Moreover, social media use helped to remove geographical barriers and specialty constraints and allowed NGOs with different identities and backgrounds to come together. We also observed that tie formation patterns in NGO communities largely reflected theoretical predictions based on issue niche theory. Additional research is needed to further explore if and how NGO communities' relationship ties developed during the pandemic may influence their future operation.

Credit author statement

Yiqi Li: Conceptualization, Methodology, Software, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. Jieun Shin: Software, Investigation, Methodology, Resources, Data curation, Writing – original draft, Writing – review & editing. Jingyi Sun: Writing – original draft, Writing – review & editing, Data curation, Hye Min Kim: Writing – original draft, Writing – review & editing, Yan Qu: Writing – original draft, Writing – review & editing, Aimei Yang: Supervision, Conceptualization, Project administration, Methodology, Resources, Writing – original draft, Visualization, Writing – review & editing .

Author note

We do not have any known conflict of interest to disclose.

Table 1

ERGM estimation results.

	Economic Issue		Health Issue		Whole Network	
	Low Model 1	High Model 2	Low Model 3	High Model 4	Low Model 5	High Model 6
Structural features						
Edges	-2.587** (0.946)	-3.948*** (0.418)	-5.018*** (0.630)	-4.266*** (0.298)	-4.047*** (0.431)	-4.850*** (0.213)
Dwsp receiver	0.504*** (0.138)					
Desp receiver		-0.791*** (0.133)		-1.159*** (0.085)	-0.921*** (0.165)	-1.299*** (0.047)
Triadic closure			2.616*** (0.564)			
Mutual	2.233*** (0.626)	4.522*** (0.185)	4.032*** (0.280)		4.869*** (0.191)	
Outdegree1	0.706*** (0.171)	0.625*** (0.089)			0.653*** (0.092)	
Indegree0					3.411*** (0.280)	1.828*** (0.092)
Indegree1		2.166*** (0.205)			2.143*** (0.219)	
Indegree3						-1.212^{***} (0.139)
NGO Identity Types						
Research sender					0.513** (0.187)	
Global sender		-1.064** (0.364)	-1.371* (0.615)	-1.399*** (082)	-1.107** (0.388)	-1.001*** (0.171)
Foundation sender					0.663* (0.301)	0.384** (0.147)
Human rights receiver						0.127** (0.047)
Research receiver			-1.164* (0.508)			
Health receiver						0.140** (0.045)
Advocacy receiver				0.201** (0.067)		0.199*** (0.050)
News receiver			0.955*** (0.273)			
Research match	2.344** (0.788)		2.272** (0.778)			
Global match	. ,		2.027** (0.763)	1.508** (0.526)		
GenSpe sender (H2)	-0.177 (0.213)	-0.350** (0.117)	-0.295. (0.178)	-0.147* (0.067)	-0.109 (0.118)	0.003 (0.039)
GenSpe receiver	0.112 (0.183)	0.008 (0.069)	-0.010 (0.135)	-0.056 (0.059)	0.011 (0.077)	-0.027 (0.052)
Control						
Homophily(libral)	1.030 (1.039)	0.564 (0.535)	0.509 (0.899)	0.501 (0.755)	0.311 (1.179)	0.623 (0.414)
Homophily (neutral)	-0.918*** (0.277)	-0.210* (0.083)	0.136 (0.223)	0.011 (0.083)	-0.051 (0.131)	0.097 (0.071)
Proximity homophily (headquarter)	-0.451 (0.415)	-0.335. (0.173)	-0.054 (0.238)	-0.068 (0.129)	-0.504* (0.198)	-0.081 (0.094)
No. followers sender	-0.123* (0.050)	-0.006 (0.024)	-0.045 (0.035)	-0.027. (0.014)	-0.060* (0.024)	-0.038*** (0.011)
No. followers receiver	0.024 (0.044)	0.021 (0.015)	0.060 (0.028)	0.033** (0.013)	0.030. (0.016)	-0.038*** (0.011)
No. cases sender	-0.041 (0.057)	-0.051** (0.016)	-0.057 (0.043)	-0.003 (0.009)	0.008 (0.032)	0.002 (0.008)
No. cases receiver	-0.126** (0.045)	0.010 (0.010)	-0.007* (0.034)	-0.011 (0.008)	0.019 (0.020)	0.004 (0.006)
Unemployment rate sender	-0.046 (0.075)	-0.028. (0.016)	-0.164* (0.067)	-0.003 (0.009)	-0.067 (0.048)	-0.010 (0.008)
Unemployment rate receiver	0.118. (0.061)	0.564 (0.535)	-0.022 (0.042)	0.008 (0.009)	-0.004 (0.024)	0.012* (0.006)

Note: This is a converged model with good GoF. Goodness of fit information can be found in Appendix D. dwsp is short for Dyad-wise shared partners, and desp is short for Directed edgewise shared partners. Indegree 0, 1, 3 and Outdegree 1 were added to achieve better model fit, meaning adding statistics that equals the count of nodes with indegree of 0, 1 and 3, and outdegree of 1 (Hunter et al., 2008a).

* indicates significant effect. *p < .05, **p < .01, ***p < .001, . means marginally significant.

For NGOs' issue types indegree, outdegree and match, we only included significant, or marginally significant statistics in the model because otherwise the table would be too long. If not reported, no signature was significant.

Acknowledgments

The authors would like to thank Janet Fulk, Peter Monge, Lindsay Young, Wenlin Liu, Emilio Ferrara, Marlon Twyman II, and two anonymous reviewers for their feedback on the earlier manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2021.106838.

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