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Social Media and Emergency Services: Information Sharing about Cases of Missing Persons in Rural Sweden

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The aim of this article is to investigate the nature of information sharing in social media about missing persons by using social media data (mostly Twitter) and conventional media coverage (media archives), adopting a spatial perspective to this geographical information. By focusing on the cases of three people gone missing, we report on ways in which civil society establishes relational networks through social media to collectively support local searches and share information in rural Sweden. Geographical information systems and visualization techniques underlie the methodology of this study. Findings show that the geography of information sharing in social media about a missing person is not random, revealing a globally dispersed pattern across the country. Information sharing contains more emotional than informational content, hitting a peak of spread after a person is found deceased. This finding indicates that the value of information shared by social media as a problem-solving resource might have so far been overestimated in the process of finding missing persons. In addition, tweets show indications that voluntary organizations constitute a valuable resource in rural contexts but not without impact on the existing networks of stakeholders delivering emergency services. *Key Words:* digital networks, GIS, mapping, media archives, social media, tweets, volunteers.

New information and communication technologies are influencing emergency services in profound ways. Social digital networks such as Twitter and Facebook have become among the most popular sources for accessing emergency information (Lindsay 2011). Such a key role is reflected in studies on earthquakes, floods, hurricanes, terror attacks, forest fires, and social unrest, just to name a few (Goodchild and Glennon 2010; Mendoza, Poblete, and Castillo 2010; Shklovski et al. 2010; Meier 2011; Heverin and Zach 2012; Kim and Hastak 2018; Krutrök and Lindgren 2018). Martínez-Rojas, Pardo-Ferreira, and Rubio-Romero (2018) provided a systematic overview. Social media illustrate how people organize themselves to help others through “digital volunteerism” (Whittaker, McLennan, and Handmer 2015) and reflect, among other things, how major disruptions in the normal dynamics of the economic, cultural, social, or political life of large numbers of people take shape (Hagar 2011) when a catastrophe occurs.

Much less is known about the use of social media in calls for emergency services in cases when a person goes missing (but see, e.g., Solymosi, Petcu, and

Wilkinson 2020). These cases, although they might not represent major disruptions in society, such as hurricanes, they constitute a tragedy to those involved, especially in small communities. Currently, a call for a missing person (MP) often includes voluntary organizations specializing in searches that make use of social media. In these cases, Facebook and Twitter are often a source of information to those who look for confirmation and verification of specific information (Helsloot and Ruitenberg 2004), as well as a source of emotional comfort (Jasper 1998; Bosco 2007; Shklovski et al. 2010). Rather than focus on the analysis of massive databases from social media, in this study we instead find it more relevant to ask in an exploratory way how small subsets of the data, especially georeferenced social media information scraped from the Internet (see also Shelton et al. 2014), can potentially reveal the geographies of a range of social practices that might vary over time during emergency situations.

By focusing on three cases of people gone missing, we report on ways civil society operates in supporting local searches and sharing information. We

adopt a platial perspective to geographical information (e.g., Adams and McKenzie 2013; Elwood, Goodchild, and Sui 2013; Gao et al. 2013) that is gathered through social media exploring the nature of non- x,y location information. Using both qualitative and quantitative methods, we first uncover broad temporal and spatial patterns within these data and then reveal how the patterns reflect the lived experiences of the people creating them, using these three cases. We finalize the study by briefly looking at the role of voluntary organizations in searches and their relationship with emergency services, in particular in policing. We employ a relational approach to reconceptualize policing as a networked activity that goes beyond the idea of community and enrolls various actors in networks that flow between spaces (Yarwood 2015).

Thus, the aim of this study is to investigate the nature of information sharing about cases of missing persons in Sweden. We are particularly interested in reporting the nature of the communication (using social media, especially Twitter, and conventional media archives) between civil society and voluntary organizations aimed at supporting emergency services in cases of persons gone missing. Geographical information systems (GIS) and visualization techniques underlie the methodology of this study. We hope to obtain a better understanding of the ways in which voluntary organizations operate in cases of missing persons in relation to traditional emergency services, in particular the police in rural areas of Sweden. To achieve this goal, we focus on three cases of missing persons with a total of 1,104 tweets. This is done by doing the following:

1. Reporting the geographical and temporal distribution of followers of each case and their engagement with the content of MP posts on social media, particularly Twitter, and comparing with the number of articles in traditional media archives.
2. Adopting a platial approach to the information gathered in social media, first by taking distance from geometric spatial descriptions of information, evaluating the relational nature of the information, and examining what is being discussed on social media more closely in three different cases of MPs, so we can assess the nature of the posts (type of message and how it changes over time) and briefly report the relationship between conventional stakeholders of emergency services involved in the search and volunteers.

3. Employing a relational approach to emergency services (instead of insular, community contained) to reconceptualize policing in municipalities as a networked activity that enrolls various actors that produce different forms of actions, as expressed in these cases of MPs.

The novelty of this article is twofold. First, the article calls for a platial view of GIS and geographical information that is gathered through social media using non- x,y location information beyond urban environments. As our literature overview shows, much of social media analysis is, after all, “small data” analysis and limited in scope to the phenomena currently studied—as this study is an example. Second, the study focuses on three cases to explore the particular issues regarding rescue and emergency services supplied in communities in remote areas, in low-population-density contexts. The intention is to reveal possible links between civil society engagement in voluntary work with MP cases and police after the police reorganization in Sweden that led to a centralization of police services (Stassen and Ceccato 2019). We attempt to adopt a relational perspective to policing in which power and agency are distributed among different actors. In doing so, the study critically evaluates the added value of the use of social media in cases of MP emergencies, both in comparison with the coverage of traditional media (media archives) and in comparison with social media’s coverage of major disasters, such as hurricanes or riots.

Theoretical Background

Studies using data scraped from social media platforms are abundant in the field of disaster management. As the use of social media has become ubiquitous in everyday life, it has become an important factor in people’s response to and actions during times of emergency, especially because of the increased demand for reliable information (Procopio and Procopio 2007). We report shifts in approaches of studies devoted to the analysis of spatial and temporal patterns of social media data, analysis of the content within such data, and ways of assigning roles to producers of content within the context of digital volunteerism in which a more relational approach to action in policing is adopted in MP searches, beyond the local community.

Social Media Data and Emergency during Disasters: From Spatial to Platial

Much of the data generated online are geographically tagged. The kind of data ranges from volunteered geographic information (Goodchild 2007), such as the maps on openstreetmap.org and wikimapia.org to smartphones constantly tracking their users through Global Positioning System technology. This kind of “big data” has prompted what Hey (2009) called “the fourth paradigm” of scientific research, in which not only the size and scope of data have changed but also the speed at which one can access it. Also, many seemingly unrelated data sets can be analyzed and cross-referenced with meaningful results. All a researcher supposedly needs is enough computing power. These rather naive views have received critique, not least from geographers (e.g., Earle et al. 2010; Boyd and Crawford 2012), due to issues such as discrepancies in use by different demographics (Crutcher and Zook 2009), lack of validation, and false information (Goodchild and Glennon 2010). Kwan (2016) argued similarly that knowledge attained through analyzing big data might not reflect reality but rather the characteristics of the algorithms involved in retrieving and processing those data. These criticisms should not discount the importance of crowdsourced data in geographic research altogether (Miller 2010; Adams and McKenzie 2013). For instance, the study by Elwood, Goodchild, and Sui (2013) relates directly to the fourth paradigm and calls for a more platial view of geographical information, which this article considers in its use of non-*x,y* location information. The platial perspective takes distance from the legacy of geometric reference systems that includes coordinates, distances, topology, and directions and focuses instead on a perspective that is usually characterized by place names and descriptions as well as semantic relationships between places. Gao et al. (2013) suggested that because a platial perspective implies ambiguity and vagueness, there is an urgent need to formalize the semantic relationships of places.

Examples of the need for relational perspectives using social media data in major emergency conditions are reported in the international literature. For instance, Zou et al. (2018) analyzed the geographical distribution of Twitter use during Hurricane Sandy (2012) and found that although the ratio of tweets concerning the hurricane was highest in the areas

most affected, there were also outliers elsewhere because of the lack of exact location of tweets. These findings were corroborated by Shelton et al. (2014), who assessed the “data shadow”—“the imperfect representation of the world derived from the digital mediation of everyday life” (167)—of the same hurricane. The authors also showed that in areas around airports the ratio of tweets about the hurricane was much higher than expected, which means that social ties have a larger impact on Twitter activity than the geographical distance. These findings confirm what Gao et al. (2013) suggested, namely, that the connectivity and nearness of a place is context dependent and does not simply rely on a fixed distance. Therefore, platial perspectives that embrace the hierarchical structure and the connectivity of places are desirable in future studies. The next step, we argue, demands an understanding of temporality and semantics of the geographical information as it is discussed in what follows.

In cases of emergencies, the temporal patterns of tweets correspond quite closely to the evolution of the emergency (Guan and Chen 2014; Q. Huang and Xiao 2015). Wang, Ye, and Tsou (2016) reported that temporal patterns of Twitter activity follow the outbreak of wildfires in the United States and subsequently decline. Reuter, Heger, and Pipek (2013) described temporal patterns of Twitter use during an outbreak of tornadoes in the United States. Their findings show that although the number of tweets about tornadoes decreases steadily from the start of the emergency, the ratio of tweets expressing the need for help increases over time, which indicates the importance of evaluating the nature and content of the messages. In addition, Cheng and Wicks (2014) provided a comprehensive overview of tweets in the United Kingdom over time. In the early morning (1 a.m.–6 a.m.) few tweets are posted, and then there are a great many more in the morning (7 a.m.–1 p.m.). In the afternoon (2 p.m.–4 p.m.), the frequency drops a little, followed by a surge in the evening, when the most tweets are posted. They also found that this pattern changes on weekends, when tweets are most common in the afternoon and relatively few are sent in the evening. Li, Goodchild, and Xu (2013) found, similarly, that Twitter activity in the United States has two peaks during the day: 1 p.m. to 2 p.m. and 8 p.m. to 9 p.m. These peaks might be affected by emergencies or other disruptive events.

Social media is also used for collectively making sense of, and coping with, a disastrous event, which is done, for example, through emotional support, emotional venting, and positive thinking (Yan 2010), or to communicate a sign of life, confront and construct reality, and memorialize to move on (Tandoc and Takahashi 2017). Jurgens and Helsloot (2018) categorized the nature of support that social media users offer in emergencies in four domains: information gathering, information dissemination, collaborative problem solving, and coping. This can be further simplified according to Shklovski et al. (2010) into two types: *informational support*, especially important during a crisis, and *emotional support*, which includes people's own need to make sense of their experiences. This kind of emotional support is why hashtags such as #JeSuisCharlie arise or people place a country's flag above their profile picture on Facebook after terror attacks (#JeSuisCharlie was a hashtag and a logo adopted by supporters of freedom of speech after the 2015 shooting in which twelve people were killed at the offices of the French satirical weekly newspaper *Charlie Hebdo*). The slogan became one of the most popular news hashtags in Twitter history (Goldman and Pagliery 2015). These hashtags can also be associated with fear of attacks (Castro-Toledo, Gretenkort, and Esteve 2020). Many of these studies use sentiment analysis techniques—algorithms that can analyze the sentiment of a given text, for example, whether the opinion expressed is positive, negative, or neutral.

The use of emotional content is as important as informative support for expanding networks (Jasper 1998; Bosco 2007). An outpouring of emotional support can galvanize civil society's effort into providing support for families and the local community in distress (as is the case in other types of crises documented in scholarly writing; e.g., Bosco 2007). In one of the few studies exploring public engagement with MP appeals on Twitter, Solymosi, Petcu, and Wilkinson (2020) analyzed 1,008 tweets from the Greater Manchester Police between 2011 and 2018 to investigate what features of the tweet, the Twitter account, and the MP are associated with levels of retweeting. They found that having a clear strategy when sending tweets for MP appeals pays off. For instance, tweets using police custody images have lower retweet rates than those with regular photos, and tweets asking "Have you seen ... ?" with an explicit request to be retweeted engage more in the

form of retweets. These lessons could be used to develop guidance for police and perhaps other stakeholders involved in MP appeals.

Voluntary work in emergency services has been highly affected by social media. Whittaker, McLennan, and Handmer (2015) reviewed the ways in which volunteering during emergencies is changing, with specific emphasis on informal volunteerism—ordinary people devoting time and effort in times of crisis, without being affiliated with the emergency services or any formal organization. Examples of "digital volunteerism," as the authors call it, range from setting up Facebook groups, to posting pictures of lost items during a tornado in the United States, to mapping and translating distress messages from Haitians after the earthquake there in 2010. Starbird et al. (2010) distinguished among four kinds of information on Twitter during emergencies: generative, synthetic, derivative, and innovative. These types of information, they argued, are typical of different kinds of actors. Working from these distinctions, Reuter, Heger, and Pipek (2013) assigned roles to what they called "virtual volunteers," individuals who talked about events on Twitter during an outbreak of tornadoes in the United States, functioning as contributing assets in emergencies. These roles are the helper, the reporter, the retweeter, the repeater, and the reader. The *helper* is the person most easily identified as a volunteer, someone who is actively engaged in helping with the emergency. They send numerous tweets with original content. They make emergency appeals and provide advice for others who want to participate. The *reporter* is the person, or more likely the organization, that makes sure information enters Twitter. The *retweeter* does not produce original content but distributes important information to as many people as possible through many retweets. The *repeater* produces original information, but it is generally limited to a few topics that are repeated over and over again. The *reader* is the passive information consumer, not easily seen in the analysis but thought to be the most numerous. In summary, the analysis revealed that "every twitterer, who is particularly active within a crisis, can be matched to at least one of the categories" (Reuter, Heger, and Pipek 2013, 784). Overlaps between these roles in digital volunteerism are expected to be common.

The use of media coverage, such as digital or daily printed newspapers, as a reference for studying

emergency and policing services is not new. Previous researchers have suggested that newspaper articles can be useful in providing a *benchmark*, an independent record of events that often suffer from unreliable or discontinuous registers (Stassen and Ceccato 2020). Studies show that newspaper articles might underreport some types of events and overestimate others (Marsh 1991; Fine et al. 1998; Ghaffar, Hyder, and Bishai 2001). Reis (1999) showed that media coverage is not impartial and tends to favor particular topics, sources, and opinions. For emergency services, articles in daily print newspapers can reflect “mundane” calls for services such as filling potholes and other issues of poor urban infrastructure (Linders 2012) or in-depth reports of major disasters (Fu et al. 2012) or cases of MPs (e.g., MacAndrew et al. 2018). The international literature, however, lacks comparisons between, for example, frequency of articles in traditional and social media and how they indicate relational perspectives of place and actions beyond the boundaries of communities and actors.

Voluntary Organizations and Their Contributions to Policing: Relational Approach

In this section, we review the use of data from social media to reconceptualize policing in municipalities as a networked activity that enrolls various actors in actions during the search of cases of MP. Relational approaches focus on how networks of different actors affect change in particular places; these networks are not contained to individual communities (Murdoch 2006). As suggested by Yarwood (2015), relational approaches consider that power and agency are distributed between different actors in a network. The author reminded us that despite the fact that the search for MPs has become more and more a multiagency activity (with voluntary organizations playing an important role in it), the responsibility for locating them remains with the police. In what follows we report on studies focusing on volunteers’ role within policing.

The first group is comprised of volunteers and organizations engaged in issues that would otherwise be the responsibility of the police; these groups might actively work and collaborate with the police but are independent organizations. Some of these external local voluntary organizations have contributed to lower crime rates in their neighborhoods

(Friedman 1998; Slocum et al. 2013) and have been involved in the search for MPs (Yarwood 2015). The second group focuses on police volunteers—individuals who volunteer their time to the service of the police force doing a wide range of tasks, such as administrative work, traffic control, and patrols (Phillips 2013). Yet other studies show potential problems in the relationship between regular police and volunteers, in that the volunteers’ position within the organization is not clear, the police tend to undervalue them, and there is a distrust, mainly from police unions, about unpaid workers doing the job of the police (van Steden and Mehlbaum 2019).

The level of engagement of these voluntary organizations varies geographically. In the United Kingdom, for example, poor areas were suggested to have fewer active voluntary organizations overall (Clifford 2012). In addition, Fyfe and Milligan (2003) found in a study on voluntary organizations in Scotland that less deprived areas had more voluntary organizations. Other studies have shown differences between urban and rural areas. For instance, city dwellers are less likely to engage in voluntary activities than rural ones (Oliver 2000) or to feel that their individual contributions and engagement will make a difference (Remmer 2010). Yet other studies have found no clear connection between city size or population density and people’s willingness to help or volunteer (Hooghe and Botterman 2012).

In Sweden, voluntary policing has been depicted as a resource and a benefit for both the public and the police. Uhnöo and Löfstrand (2018) studied one state-sanctioned and one autonomous civic initiative to understand the role played by police–citizen partnerships in the establishment and legitimation of voluntary policing forms. They found a high degree of integration between police and volunteer work, to an extent that the division of labor and the accountability started to blur. More problematic have been signs of conflict between police and voluntary police. Uhnöo and Löfstrand (2018) illustrated that “the more effective and publicly visible the voluntary policing bodies were, the more pressure there was on the police to defend its legitimacy, ally itself with the volunteers and regulate the latter’s activities while holding them responsible for their actions” (41). Note that this evidence is based entirely on an analysis of 9,280 news media articles and not social media communication, and no geographical assessment within the country was performed.

Research Questions

From previous studies, we have observed that patterns of tweets of MPs are dependent on the location of the victim and follow a distance-decay pattern from the municipality of the MP (Shelton et al. 2014; Zou et al. 2018). By adopting a platial approach to the information gathered in social media, this study explores the nature of non- x,y location information associated with a Twitter account by stating this question: How can we characterize the spatial pattern of tweets for an MP?

The nature of social media data as a medium to study relatively small data sets in a mixed methods approach to spatial and nonspatial information is further investigated in this study. The international literature indicates that social media activity is expected to increase rapidly when someone goes missing and then slowly decrease, as it does with other types of major emergencies (Guan and Chen 2014; Q. Huang and Xiao 2015), and we expect to find both informational and emotional support expressed in the tweets concerning MPs (Shklovski et al. 2010). What does the temporal pattern of MP tweets look like? What is the most common content in MP tweets: informational or emotional?

Finally, by reconceptualising policing in municipalities as a networked activity that enrolls various actors that deliver different forms of actions, we aim at investigating which types of roles tweeters can have in MP appeals. Digital volunteers are to assume different roles on social media, with different ways of supporting the search operation; for instance, as helper, reporter, retweeter, repeater, or reader (Starbird et al. 2010; Reuter, Heger, and Pipek 2013). Finally, how do tweets depict the relationship between voluntary organizations in MP cases and the police in rural contexts? We expect to find evidence of cooperation between new digital volunteers and traditional (police) agents of emergency services but also signs of conflict (Uhnöo and Löfstrand 2018).

Study Area and Research Design

The study is divided into two parts. The first part provides a general explorative overview of post sharing across the country using Twitter data in relation to articles from media archives, whereas the last part focuses on the specifics of the three MP cases in

rural Sweden. Figure 1 illustrates the steps taken during the study.

Framing the Study Area

This research focuses on the use of social media during MP searches, particularly in more rural areas of Sweden. Sweden was chosen for several reasons. It is sparsely populated (twenty-two inhabitants per square kilometer), with rural and sparsely populated areas covering as much as 95 percent of the country. Of Sweden's 10.3 million inhabitants (Statistics Sweden 2021), about 2 million live in rural areas. Of these, 200,000 live in remote rural regions.

Missing People Sweden (MPS) is a voluntary organization, founded in 2012, with the purpose of finding missing MPs. Since its start, the organization has grown rapidly and is now active in all parts of Sweden, with regional chapters in all counties. MPS was chosen as a focus in this study because they are a well-established voluntary organization, with a high level of legitimacy in the eyes of both the public and emergency services, that works in partnership with the police across the country. MPS is also very active on social media platforms, where they regularly publicize cases of MPs in hopes of receiving information and help from the public.

Case Studies

Three cases of MPs were chosen for a more detailed analysis. The three case studies are all located in relatively rural, or sparsely populated, areas of Sweden (Figure 2).

The first case is Dante, a twelve-year-old boy with Down's syndrome, who went missing on 6 November 2018 when walking his dog in Falkenberg. The events following his disappearance were widely discussed and received a lot of attention in the national media. Thousands of people volunteered in the search, and when the police found his drowned body, on 9 November 2018, there was an outpouring of grief and support from around the country—the local football team even postponed their game out of respect. In this sense, Dante's case is an outlier, a national phenomenon that affected a substantial part of the population. Most cases of MPs, however, receive much less notice from the public. Two other cases that more closely follow the norm with respect to their impact on wider public awareness are also analyzed more

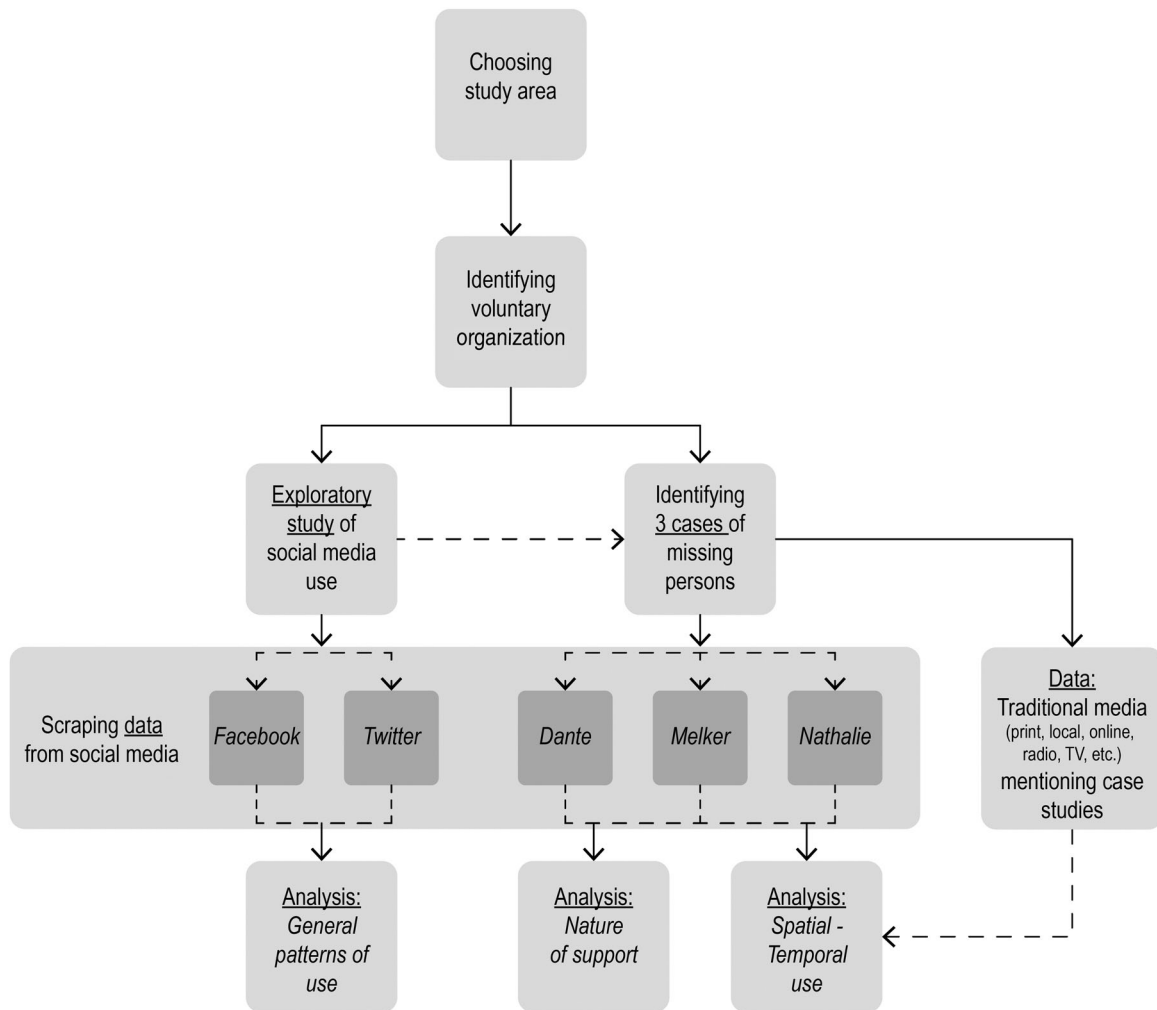


Figure 1. The methodology of the study.

closely: Melker and Nathalie. Melker, a twenty-year-old student, went missing near Sya, a small community near Linköping, on 16 September 2018. He was found dead, by volunteers from MPS, in the forest where he had committed suicide. Nathalie, age twenty-one, went missing near Eksjö in Småland. She, too, was found dead in the forest. All of these cases prompted large-scale search-and-rescue operations by the authorities. The police, military, coast guards, search dogs and their handlers, and volunteers, mostly from MPS, participated in the operations.

Data Collection and Preanalysis

This research builds mostly on analysis of data gathered through Web scraping and Web crawling, methods of automatically copying relevant data from Web pages, in this case the social media platform

Twitter (for a more detailed description of Web scraping and associated techniques, see Mahto and Singh 2016). We used the Google Chrome plug-in *web scraper* (<https://webscraper.io>) as the main tool for the data scraping process. This study makes use primarily of data scraped from Twitter, focusing on tweets mentioning the names of the MPs in the three case studies. The data sets contain information on the content of the tweets, the time they were published, and the locations from which they were sent, when possible. Graham, Hale, and Gaffney (2014) analyzed, among other things, the accuracy of geo-referencing tweets through different methods. Because only between 1 and 4 percent of tweets come with exact x,y coordinates, it is common within the literature to extract the location of the place people say they live, on their profiles, as a proxy for the location of their tweets. The findings of

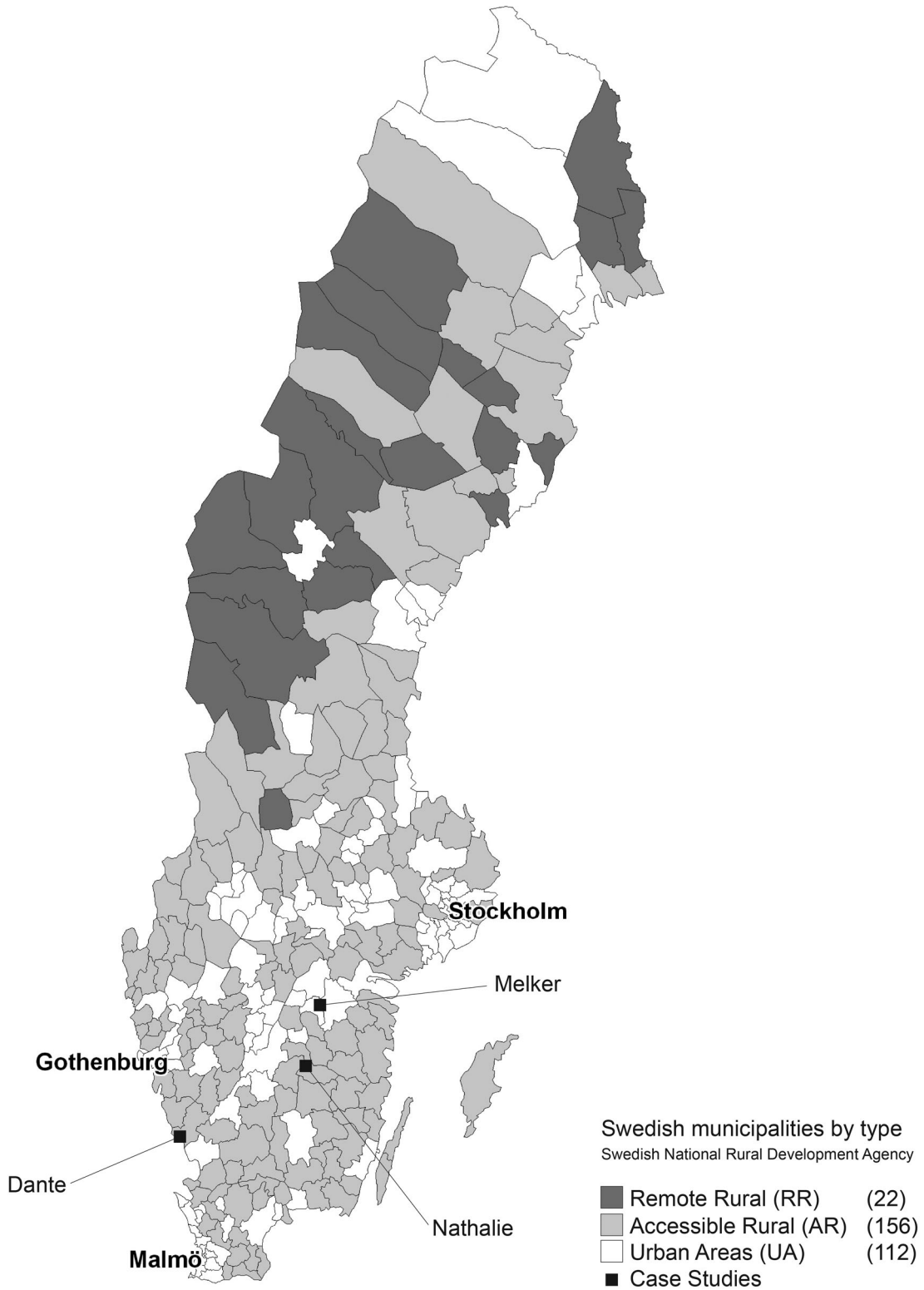


Figure 2. Locations of case studies and Swedish municipalities by type.

Graham, Hale, and Gaffney (2014) show that this method is accurate in around 54 percent of cases, and the method is employed in this study. This is not a great level of accuracy, which is actually what the Graham et al. study concluded, but for the purposes of this research, it is deemed sufficient, because this study looks at the spatial distribution of tweets on a regional scale rather than, for example, within a specific city.

In addition, most tweeters within the data set who disclosed information on their profiles concerning where they live stated the name of their city or municipality, which was converted into x,y-coordinates and assumed to be the location of the tweeter in this study. It is, however, entirely likely that some people are not in fact at the location they say that they are at the time of the tweet. Trying to control for this “inaccuracy” is a difficult task, and surely there will be some data points that are misrepresented in the data set. Because we are searching for general regional patterns, this should not constitute a major problem. We instead embrace this issue by taking distance from the typical spatial perspective based on geometric reference systems (based entirely on coordinates, distances, topology, and directions) and attempt to contribute to a more *patial* (Elwood, Goodchild, and Sui 2013; Gao et al. 2013) and especially relational approach to the phenomenon in this study, looking at place names and descriptions as well as semantic relationships between places (e.g., urban and rural areas).

For newspaper articles, a search for the names of the MPs from the case studies in the media database Retriever was conducted to compare activity on Twitter with other media. This resulted in a data set of the number of published news media articles (print, online news, radio, TV, local news, etc.) in Sweden, per day, for each case study. To get an accurate result and not get search hits for these names in unrelated articles, additional words—*missing*, *lost*, and *missing person*—were associated in the search query. To better understand the nature of support, an analysis of the content of the articles was conducted. In total, 707 articles were collected and reviewed for the three cases (Dante, 313; Nathalie, 373; Melker, 21).

Mapping Spatial and Temporal Patterns

Using GIS and illustration techniques, temporal and spatial dimensions of Twitter use during the three case studies were mapped. The temporal activity was mapped both hourly and daily. The tweets

that could be geolocated were mapped for each day. These locations were also analyzed using global and local indicators of spatial association in GIS to test whether or not the spatial pattern of tweets was random. We used global Moran’s *I* as a measure of the overall clustering of the data and the local measure to identify possible local clusters using GeoDa 1.8.16.4 (Anselin 2014). In cases of no global autocorrelation or no clustering, we can still find clusters at a local level using local spatial autocorrelation.

To further analyze the results of the mapping, comparisons are drawn between the daily use of Twitter and daily media activity, such as how many articles, news reports, and radio announcements were published in Sweden covering each case, per day. Post sharing of Facebook entries about these missing persons on the MPS Web site was also mapped by county (municipality was not available) in relation to the location of the police station. Tweets were collapsed by county and a ratio between the number of observed tweets compared with the expected counts of tweets was calculated based on population at risk (see, e.g., Haining 2011).

Maps and figures presented in the results are split into two parts: the overall temporal and spatial patterns for the whole of Sweden and then the three case studies of MPs.

Methods of Analysis

By analyzing the discussions around these cases on Twitter, the aim was to make clearer the nature of information sharing and support online, as well as the relations between the traditional stakeholders in emergency services and the volunteers. Whereas many studies in the literature make use of sentiment analysis techniques to get an understanding of the general mood of the textual content of Twitter data, our analysis was done in a qualitative, in-depth way. Our data set of tweets is sufficiently small so that each tweet can be read and categorized according to what kind of information it contains (informational = direct help in the MP search; emotional = psychological support; or both or other). In addition, to check whether people posting tweets performed different roles as virtual volunteers (see Reuter, Heger, and Pipek 2013), we adopted a more straightforward method of sifting through each Twitter user who could be characterized as tweeting informational support, as opposed

Table 1. Data description of the study

Type of data	Description	Date	Source	N	n Geotagged
Twitter data	All tweets mentioning “Dante” (between 6 November and 12 November 2018)	20 March 2019	Twitter.com	1,020	533
Twitter data	All tweets mentioning “Melker” (between 17 September and 23 September 2018)	2 April 2019	Twitter.com	17	12
Twitter data	All tweets mentioning “Nathalie” (between 15 December and 24 December 2018)	16 April 2019	Twitter.com	67	34
Media archives data	All published Swedish media mentioning “Dante” (between 0 November and 12 November 2018)	10 June 2019	Retriever	313	—
Media archives data	All published Swedish media mentioning “Melker” (between 17 September and 23 September 2018)	10 June 2019	Retriever	21	—
Media archives data	All published Swedish media mentioning “Nathalie” (between 15 December and 24 December 2018)	10 June 2019	Retriever	373	—
Twitter data	All tweets from Missing People Sweden’s official account	29 March 2019	Twitter.com	707	707
Facebook data	All Facebook posts on Missing People Sweden’s official page	21 March 2019	Facebook.com	52	52
Geographic data	Map of Sweden	7 December 2018	GSD-Maps of Sweden, lantmäteriet	—	—
Population data	Sweden—population by county	2018	Statistics Sweden (SCB)	—	—

to those who were merely emotionally supportive, in an attempt to search for the characteristics of one or several of the roles laid out by this study.

Results

The Content of Tweets in Three MP Cases

The Dante case accounts for the majority of tweets in the database, followed by Nathalie and finally Melker (Table 1). By collapsing all tweets into one database (total of 1,104 tweets), we noticed that 63 percent of tweets were characterized as emotional, 27 percent had informational content, 5 percent contained both, and 5 percent contained neither informational nor emotional content. Note that these figures are heavily skewed because the Dante case—the most widely known of these three—made up the majority of the data. When the cases were depicted separately (Figure 3), the ratio of emotional–informational support for each case

differed. In the cases of Nathalie and Melker, most of the tweets were characterized as having informational content. Both cases simply did not get the enormous emotional response that the Dante case received across Sweden.

Temporal Patterns of Tweets in Three MP Cases

Temporal patterns of information sharing via Twitter are similar for all three MP cases, with a peak taking place right after the missing person is found deceased. Figure 4 illustrates the temporal patterns of tweets, when differentiating between informational and emotional support. The daily proportion of tweets classified as containing mainly informational support decreases over time, whereas that of emotional tweets increases. Note that the time period of analysis is not exactly the same for all three MP cases.

When the temporal patterns of tweets (tweets over time) were compared with the number of

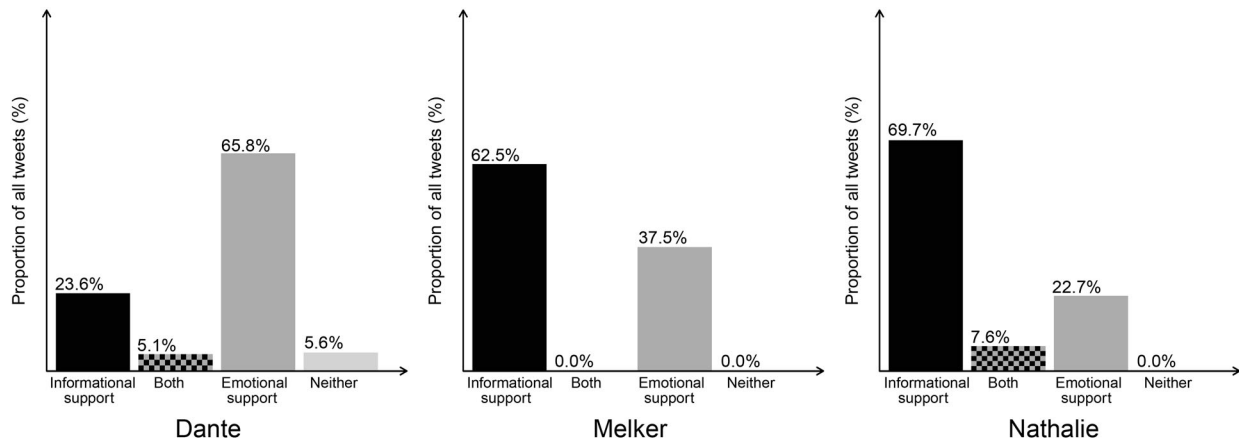


Figure 3. The proportion of tweets by content: informational, emotional, and both.

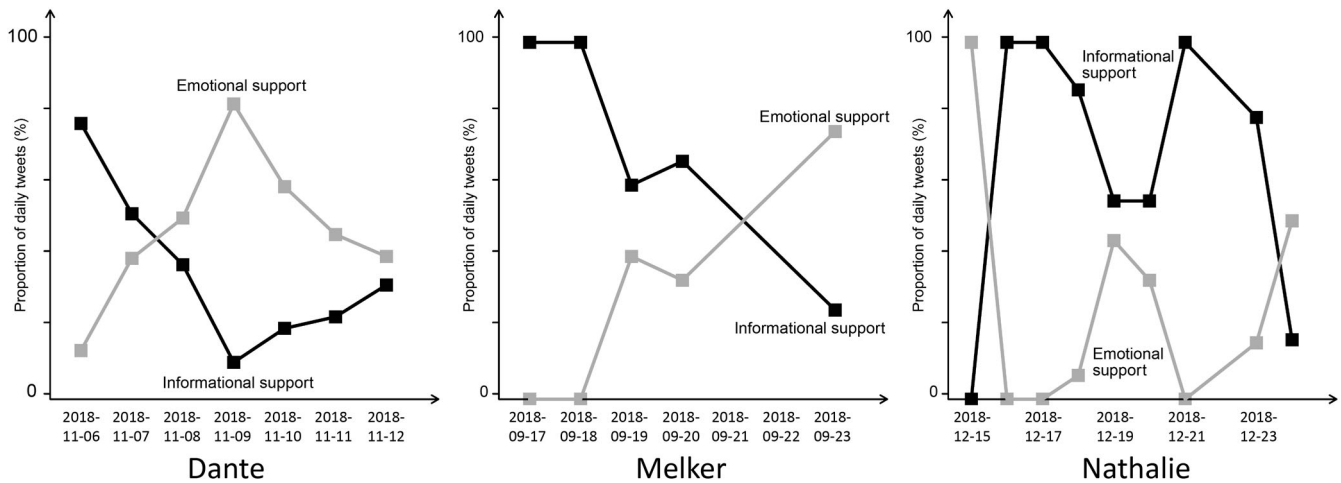


Figure 4. Temporal patterns of information sharing for three missing person cases.

articles published about each MP case in traditional media, they showed similar temporal trends. These similarities between activity of information sharing on Twitter and number of articles in media archives indicate interdependence between the two data sources. Figure 5 illustrates how tweets were mapped over time and space and according to their nature—informational, emotional, both, and others.

This is consistent for all three case studies, although the level of attention given by traditional media differed from case to case. The cases of Nathalie and Dante had almost the same amount of media coverage, whereas the activity on Twitter differed substantially between the two cases. In the case of Dante, most media coverage was carried out by national media (it became a national case), whereas the two other cases were mostly covered by local media.

Geography and Spatial Distribution of Tweets in Three MP Cases

When tweets were geocoded and mapped, we noticed that proximity to the location of the MP residence itself did not seem to have a strong effect on the geography of Twitter activity. For all MP cases, large cities such as Stockholm, Gothenburg, and Malmo also participated in the information sharing, especially when the person was found dead and the emotional content spread by social media. Tweets were either randomly distributed or followed a dispersed pattern for these three MP cases. Using global Moran's *I*, we tested for spatial randomness of tweets. (The null hypothesis states that the tweets are randomly distributed across Sweden and the spatial processes promoting the observed pattern of values are random.) Results reject the null hypothesis because we found a tendency of spatial dispersion for the global pattern of tweets for

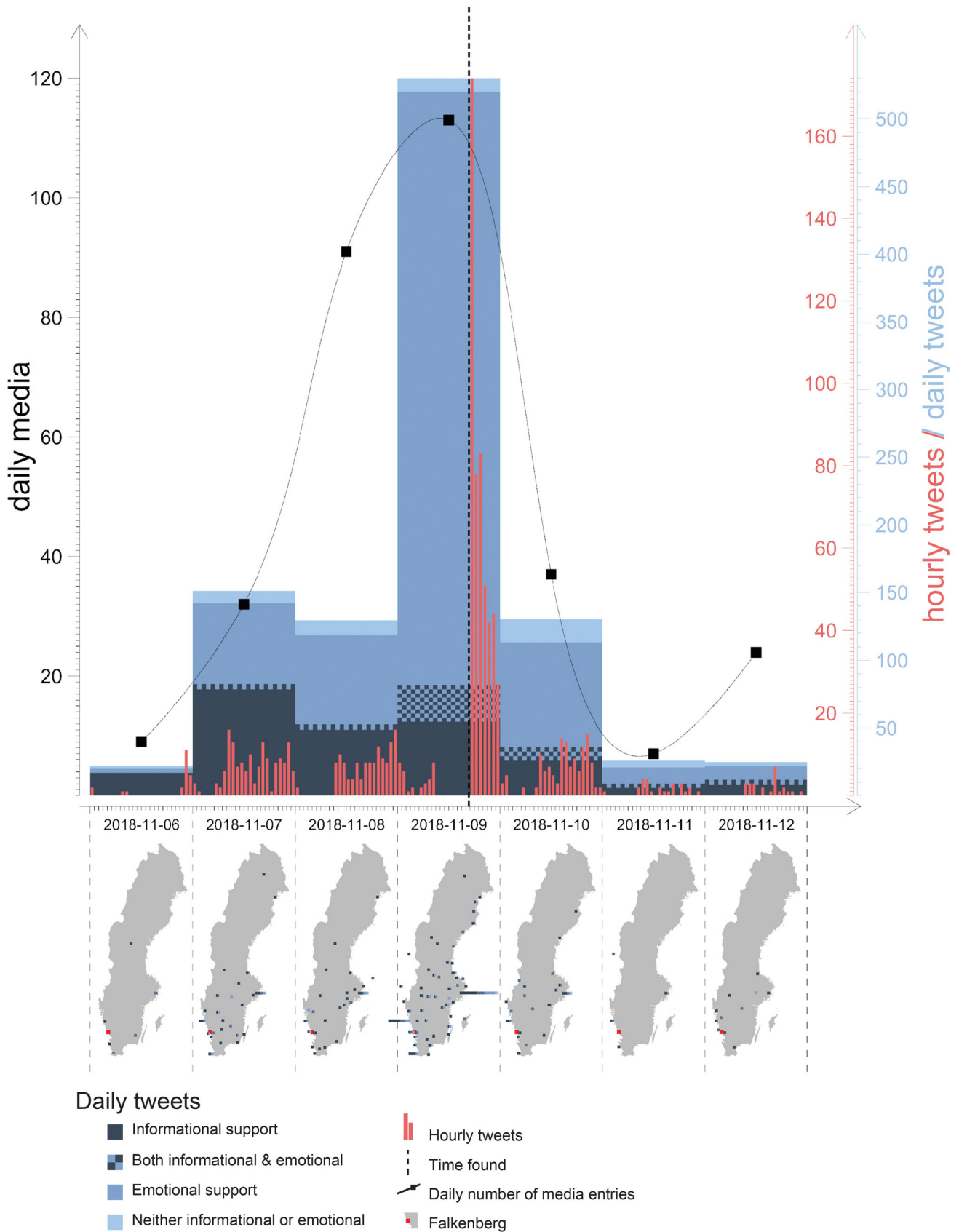


Figure 5. Temporal and spatial distribution of tweets: example “Dante-case.” Number of tweets and number of traditional media entries mentioning “Dante” between 6 November 2018 and 12 November 2018.

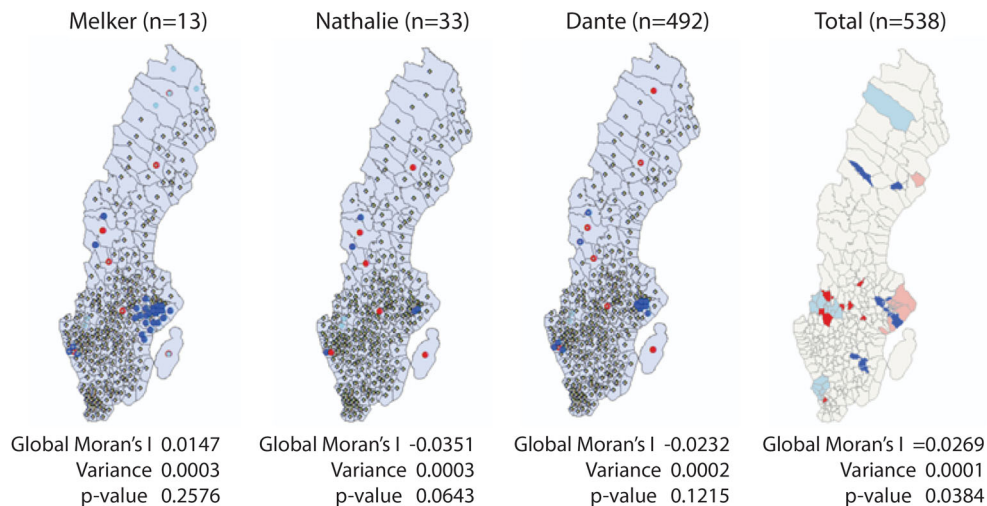


Figure 6. Maps of the location of tweets (gray circles), hotspots (red), cold spots (blue) for local clusters of tweets for each person and total and values of global Moran's I . Caution: The first set of tweets geocoded numbered fewer than 30.

the three cases of MP together (Moran's I was significant and negative, $p=0.04$), and similarly for the global distribution tweets in the Nathalie case. This means that global spatial distribution of high values and low values in the data set is more spatially dispersed than would be expected if underlying spatial processes were random, reflecting some type of competitive process (opposite of clustering). When the local Moran's I was tested, however, a few clusters appeared in nearly all maps (Figure 6).

The local Moran's I map for total tweets is shown on the right in Figure 6, by population of municipalities. The maps show dark red for the high-high clusters, dark blue for the low-low clusters, light blue for the low-high spatial outliers, and light red for the high-low spatial outliers. Note that these high-low values of tweets are composed of municipalities of Stockholm county (high), surrounded by smaller municipalities (low). Significant clusters of tweets do not appear where the MP resides or in big cities (compare the location of the case studies in Figure 2 and the geography of tweets in Figure 6; they are not the same) as initially expected. In Dante's case, for example, although the flow of tweets was relatively high where he lived and was highest in the largest Swedish cities of Stockholm, Gothenburg, and Malmö (see maps in Figure 5), only Gothenburg turns out to be a significant hotspot (Figure 6). The flow of tweets (and retweets) possibly follows where representatives of voluntary organizations in search of MPs are geographically located, some of them linked to regional Facebook pages (Figures 7A, 7B). When the population is

taken into account, note that the observed number of posts shared (retweets) is higher than expected in Sweden's northern counties for three case studies (Figure 7C).

The Role of Twitter Users in Three MP Cases

Actors on Twitter seem to assume roles on Twitter when sharing information about MP cases. Their roles are not as clear as might be expected, though. We were not able to identify the roles of the helper, reporter, retweeter, and repeater, as suggested by Reuter, Heger, and Pipek (2013). Looking at tweets that are characterized as informational, it becomes clear that there are reporters, Twitter users who generate information and are retweeted several times per day. The reporters are, almost exclusively, established media organizations, sometimes freelancers but linked to *Aftonbladet* and *Expressen*, the two biggest daily tabloids in Sweden, and those most active and most retweeted in cases of MPs. There are also helpers, as described by Reuter, Heger, and Pipek (2013), who are actively trying to support the search and who share valuable information on social media. These were not found in the three MP cases. Some volunteers who were involved in the search for the missing persons did write about it on Twitter, but their tweets could hardly be described as informational, nor were they retweeted by others. Retweeters are quite plentiful but not in the same sense as in natural disasters, for which Reuter, Heger, and Pipek (2013) reported that some of them make an effort to collect and redistribute lots of

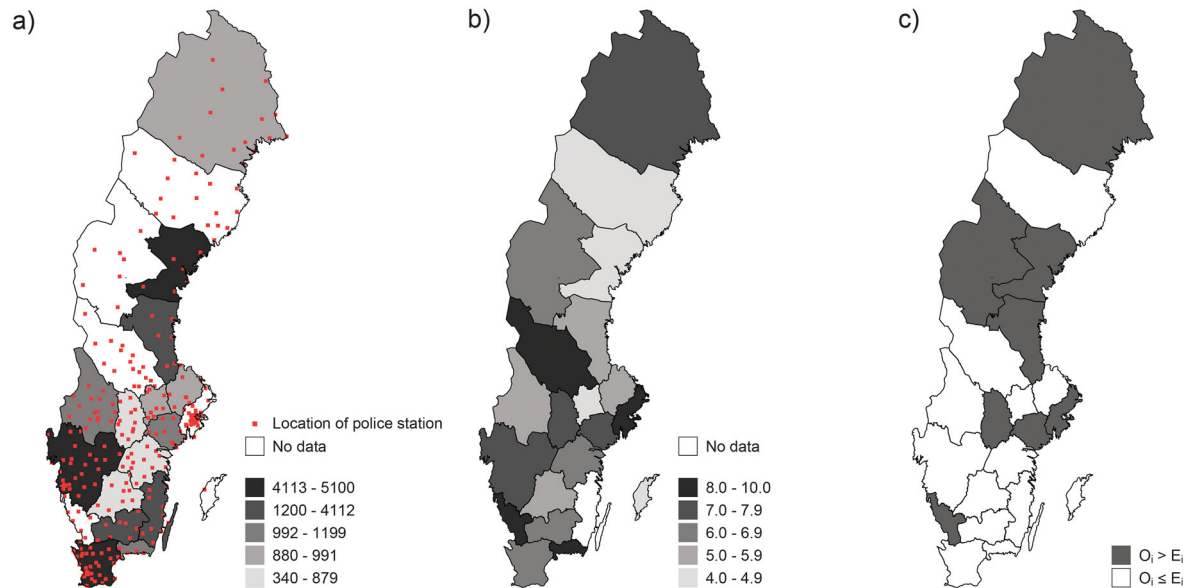


Figure 7. (A) The number of people who follow each regional Facebook page of MPS. The red dots represent all locations of police stations in Sweden. (B) The frequency of post sharing (retweets) by county: how many people, on average, share tweets MPS posted in the different regions in Sweden. (C) Counties where the observed number of posts shared (retweets) are higher than expected by county, tweets for the three case studies only. MPS = Missing People Sweden.

information. Our data set contains few people who published more than three or four tweets during these events, so nobody seems to fit the description of a truly dedicated retweeter. The same goes for the repeater, someone pushing one agenda or having one message that he or she wants to emphasize. People with this role, in cases of MPs, could be someone publishing tweets every day reminding people to show up for the search operation. There were people who posted such tweets but not with sufficiently repeated frequency to be called repeaters.

The Nature of Tweets in Three MP Cases

Although often contrary to the views of authorities, individuals and communities show a great deal of resilience and coordination in the aftermath of disastrous events (Jurgens and Helsloot 2018). Quarantelli (1986) argued, “If disasters unleash anything it is not the criminal in us, but the altruistic” (5). During and after disasters it is necessary to solve problems, and social media helps people gather to solve problems collectively (Dufty 2012; Scanlon, Helsloot, and Groenendaal 2014). The vast amounts of data that arise can be received and disseminated by many users, making it possible to solve problems on a collective scale (Palen and Vieweg 2008). The

possible downside of this kind of collective problem solving, as Hammon and Hippner (2012) pointed out, is that those involved might not share the most valuable or accurate information. To investigate the nature of the tweets between volunteers and the search team in these three rural contexts, an in-depth analysis of threads was executed.

Some tweets, such as the ones reported next, were able to reveal how the police and the organizations that help in the search operations are appreciated by individuals in the local community. This case gathered more than 3,000 volunteers organized by Missing People.

Today’s insight: only after I was involved today and searched for #Dante did I understand what it really is like, what you read about and listen to the news. What a force in all volunteers! Shine from flashlights and reflective vests everywhere. May he be found soon!

Having my own twelve-year-old with Down’s syndrome today gives me pain in my belly. Thoughts go to Dante’s family of course, and gratitude to all who seek, police, Missing People, military and volunteers. Thanks. #Dante

R.I.P purple Dante. Well done by the police and MP. Now it remains for the police to find out what really happened.

Other tweets are more critical about the search operations and police strategies.

Searched for missing Dante yesterday. Of the 7.5 hours during the evening/night, we searched actively only 2 hours. The remaining time was spent waiting. On maps. How is it possible with such lousy logistics @polisen_halland and @MPSweden? ? Totally demoralizing.

Naive "Police": Search your cars. Why? Dante is of course kidnapped.

Get real FFS [Fire Fighting Systems] Sweden - Please!

In the case of Dante, specifically, there were some tweets showing distrust and outright disdain for the police. These tweets should probably be viewed as a reference to a previous homicide caused by the police just before Dante went missing (when a teenager with Down's syndrome was mistakenly shot and killed by the police in Stockholm). Although the event happened in the capital of Sweden, these tweets show how the police were demonized by locals during the search of the missing boy.

I hope Dante with Down's syndrome is found by the volunteer force and not the police.

Hope someone finds Dante before the police do, so he doesn't get shot dead.

Hope the police find Dante and do not shoot him.

Other tweets indicate some friction between the actors involved in the search. The following tweet highlights the value of voluntary organizations in relation to the police.

Police reduce search efforts to find Melker - but Missing People refuses to give up.

Although these messages fail in showing evidence of potential conflicts between the police and voluntary organizations, these tweets reflect how civil society is trying to come to terms with some degree of unpreparedness of the traditional emergency services in cases of MP searches in Sweden. At the same time, these tweets also reveal potential among volunteers, either by posts sharing information via social media or working directly on the searches.

Discussion

In this study we focused on the analysis of the nature of communication via social media between civil society and voluntary organizations in supporting emergency services in three cases of MPs in Sweden.

First, although we expected to find both informational and emotional support expressed in the tweets concerning MPs (Shklovski et al. 2010), we found that 63 percent of the tweets shared in the three cases of MPs were of an emotional character. For these cases, tweets intended to support the search were limited. Messages of condolence and tweets providing psychological comfort to followers after the person was found dead are common, but messages showing anger toward the situation or emergency services are also common among those containing emotional content. In addition, as previous studies indicated (for a review, see Bosco 2007), this emotional content is essential to create bonds between individuals, sometimes geographically far apart, to support them in a moment of distress and allow them to find common grounds (Jasper 1998). These emotional expressions are often linked to a place (e.g., where the MP disappeared) that helps them construct new connections, even though such connections might be less intense and unfamiliar as time passes by. For MPS, the spatial connection to a place in hashtags #Dante and @Falkenberg is strategic to the long-term mobilization of the group as voluntary organization.

We conclude that MP tweets do not share similarities with other types of tweets on major emergency events, in particular natural disasters, as they are reported in the international literature and as far as we compared tweets devoted to problem solving. When a tweet is informational, as in 27 percent of cases, it often reproduces news from traditional media, which indicates a strong interdependence between conventional and social media channels. To date the potential value of information shared by social media in the process of finding MPs might have been overestimated; at the least, further investigation is needed. Therefore, differences in the emotional and informative discourses of the police and those from members of voluntary organizations should be further investigated.

As for the temporal pattern, our findings show that the maximum activity of tweeted messages happened after the MP was found deceased, when people started sharing messages of comfort. These findings go against the pattern found for major natural disasters (S. C. L. Huang 2012; Guan and Chen 2014; Wang, Ye, and Tsou 2016). Reuter, Heger, and Pipek (2013), however, also found that although the number of tweets regarding tornadoes decreased

steadily from the beginning of the emergency, the ratio of tweets expressing the need for help increased over time.

As for the spatial pattern, the global pattern is not random and tends to show indications of dispersion. Locally, some concentrations are found, but the sharing patterns of tweets concerning MPs seem to be less dependent on the location of the victim than we initially expected (see, e.g., Shelton et al. 2014; Zou et al. 2018). For all case studies, although the flow of tweets was concentrated in the southern parts of Sweden (where the MPs resided), the significant clusters appeared to be scattered across the country. This is partially explained by the fact that our cases are located in smaller municipalities in sparsely populated regions of Sweden, far from the three most populous Swedish municipalities. When the police or voluntary organizations share tweets, the engagement happens in a dispersed way and does not necessarily follow a distance decay of the location of the victim. The case of Dante shows evidence that the profile of the MP fundamentally determines the attention in both traditional and social media in different platforms (Figures 5 and 7). Another interpretation for this spatial dispersion is related to the emotional content of the messages. According to Bosco (2007), “The mobilisation of reciprocal emotions helps build and sustain both local and geographical dispersed individual’s networks through physical and virtual proximity” (557).

Findings also show that “digital volunteers” assume different roles when sharing posts, using different strategies when supporting the search operation. For the three cases studied in this analysis, we were not able to find examples of all types of roles indicated by the literature (e.g., Starbird et al. 2010; Reuter, Heger, and Pipek 2013). Because we were particularly interested in the role of voluntary organizations in the search process, we found several examples of retweeters and repeaters, when post sharing was centrally distributed through a network of followers, by a Facebook page or from MPS or a conventional newspaper, for instance.

Volunteers can be perceived by emergency services as both a help and a hindrance in these situations (Barsky et al. 2007), given volunteers’ varied competencies, skills, and intentions (Kendra and Wachtendorf 2001). Tweets reveal a vast number of examples of good cooperation between police and the voluntary sector as well as other agents of emergency

services in MP searches. We also found, however, as suggested by Jurgens and Helsloot (2018):

[T]he ability of social media to connect people through time and space enhances collaborative problem-solving and citizens’ ability to make sense of the situation and cope with it. And yet, authorities by and large find it troublesome to get used to this new reality. (79)

This was indicated by a number of tweets reported in this study about people’s perceptions of police unpreparedness in cases of MP search and people’s more positive views about the support provided by voluntary organizations. This finding is not new and was already pointed out by Uhnöo and Löfstrand (2018) in Sweden and in the UK context by Yarwood (2005). Yet, our findings provide evidence from MP cases in rural contexts where police might not have as large a presence as in cities and where volunteerism is part of the social fabric of the community, a finding that was missing from the current literature. What we know so far is that, although the country has a relatively long tradition as a welfare state, the share of the economy as well as the share of the population engaged in nonprofit activity is on the same level as comparable European countries, like Germany, but Swedish organizations are thought to work in different sectors (Lundström 2001). As suggested by Barsky et al. (2007), a better utilization of volunteers constitutes an opportunity for the survival of rural communities that merits specific efforts and continued research.

Conclusions and Recommendations

The exploratory analysis presented here reveals several surprises. Even though our three case studies do not present extensive insight into massive data-sharing databases in social media, we believe that this analysis has allowed us to articulate several key concluding points that should inform any similar analyses in the future.

First, when looking at particular cases of MPs, we noticed that post sharing hit the highest levels after the subject was found, not at the beginning or during the search as initially expected and as happens in major emergencies, such as natural disasters. This finding is certainly related to the nature of the messages and the profile of the case under study. Information sharing contains more emotional than informational content, hitting a peak of spread after a

person is found deceased. One interpretation of these findings is that the potential value of information shared by social media might have thus far been overestimated in the process of finding MPs. Another interpretation is that emotional content of these messages plays an important role for those involved in the search process but also in the maintenance of the voluntary organizations in supporting police work. This process of framing emotions facilitates networks of coalition that perform different roles in the collective search and helps galvanize civil society's effort in providing support for the local community. These emotions help people to construct new connections, and even though such connections might not be local, their spatial reach is strategically interesting for the long-term mobilization of the organization. This is clear when the spread of information in this study does not show a clear distance decay pattern from where the person went missing, revealing instead a dispersed geographic pattern.

Second, results show that information sharing in social media about MPs does not happen at random across the country, revealing a dispersed geographic pattern outside large cities after data entries were standardized by resident population. This dispersed pattern might be related to the dominant number of emotional messages, pictures, and hashtags (as opposed to informational) associated with a particular case and place, which could be of more interest to locals in the community involved in the search. The implication of these results for research and policy is not completely clear, but we can agree with Shelton et al. (2014), who warned against unduly elevating the use of spatial concentrations of social media activity in cases of emergency to being equivalent to areas in need of relief. They suggested that this can lead to an oversimplification of the ways that social media is used in emergencies and also potentially reinforce offline social inequalities ("disconnected" actors do not appear on the map, and their needs are excluded). This study has used searches of MPs depicted in social media as an example of how relational approaches can be used to better understand the work done by rural policing together with voluntary organizations.

Third, information shared about these three MP cases indicates that voluntary organizations can be a valuable resource in MP searches but not without an impact on the existing networks of traditional stakeholders delivering emergency services, such as the

police. A better utilization of volunteers as well as better use of the information shared in the search for MPs demand continued research. Future research could further investigate whether these current findings hold for large amounts of data on MPs from social media. In particular, we need to know more about the preparedness of the volunteer sector in relation to the police. In many countries police forces have entered into formal agreements with volunteer teams to provide search and rescue services in rural places. Interviews and perhaps more data would allow us to investigate the roles of stakeholders sharing information in MP searches and why stakeholders differ from those engaged in natural disasters, for example, which was not possible in this study due to the limited sample.

Despite the aforementioned limitations, we believe this study has contributed to the discipline by showing how small subsets of data (especially georeferenced social media information, scraped from the Internet) can be useful to reveal essential parts of the nature of the data in MP searches in the Swedish rural context, highlighting voluntary work in policing. We have also shown the importance of a mixed methods approach to understanding small sets of social media data, by combining graphs and maps as well as in-depth analysis of the contents of the tweets. We agree with Martin and Schuurman (2020), who stated that "qualitative GIS is more than a set of methods, approaches, or practices. It is rooted in mixed methods and pragmatism for accomplishing novel research" (1347). This study constitutes the first step in providing a better foundation for future analyses of geosocial media data in MP searches in the Swedish rural context.

Finally, this study contributes to a platial perspective to geographical information, by taking distance from the legacy of geometric reference systems and instead focusing on a perspective that is usually characterized by place names and descriptions as well as semantic relationships between places and people that create a new meaning. This perspective is not without problems, however, and demands new ways to formalize the vagueness of semantic relationships of places. There is a need to better understand the forms of knowledge and social connection from which individuals and groups are generating information (when using social media) and their implications for the data.

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