Crisis Management through Twitter: The Case of the Barcelona Attacks

Abstract

This article explores how the Government of Catalonia managed the emergency scenario during terrorists attacks of August 2017 (from 17th to 22nd) in Barcelona. Twitter was used for public services, Mossos d'Esquadra (the police force of Catalonia) and the Government of Catalonia Civil Defence, as an essential tool to broadcast information, secure people's security and drive the investigation. We gathered the network of Twitter posts and interactions, with tens of thousands of users, who helped spreading the information, and applied a social network analysis (SNA) methodology to conclude how those users contribute on the crisis management. In this investigation, we have focused on two questions: How does information diffusion spread during this crisis? And who are the actors that contribute to the expansion? This article aims to inform and explore how public services can use social media to handle crisis of any kind, taking advantage of citizens for spreading information that could contribute to a safer and quicker crisis resolution.

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Crisis management through social media is an emerging research field. In the last decade, several studies have demonstrated the value of these tools –i.e., social media– for establishing clear communication channels in emergency crisis. Twitter is the social media tool that best fits in this scenario because it allows a spokesperson (usually public services) to post a message that can became viral in a few minutes, reaching large audiences thanks to users retweets (Golder, 2010). This characteristic of Twitter –i.e., the possibility for broad and massive diffusion of information– is the main difference with other social networks, more focused on posting messages for people's more restricted own graph of contacts. Retweet is the key for fast information diffusion inside Twitter.

Twitter describes itself as an information-focused network and unlike other social media platforms, most of the users logging into Twitter are seeking for news on the site in opposition to Facebook or Instagram where users find news when they are doing other things (Pew Research Center, 2016). This characteristic makes Twitter a relevant source channel for information diffusion by reaching key stakeholders, such as: media outlets, official public and private institutions and opinion leaders as athletes or public officers, that help spreading messages. As studies suggest (Bakshy, Rosenn, Marlow, & Adamic, 2012) friends activity in social media influence ours, and by imitation we extend the reach of original and verified information, as well as unfortunately for fake news.

Previous research on crisis management through social media can be divided in two main categories. On the one hand, stand those focused in general crisis management (Lindsay, 2011); on the other, those that have a one-event approach, for natural crisis such as Katrina hurricane (Garnett & Kouzmin, 2007) or the Zika virus expansion (Hagen, Keller, Neely, DePaula, & Robert-Cooperman, 2017) or man-made crisis, such as the attacks in a Mall in Kenya (Simon, Goldberg, Aharonson-Daniel, Leykin, & Adini, 2014), the Boston Marathon attacks (Buntain, Golbeck, Liu, & Lafree, 2016), or the Brussels attacks (Mirbabaie & Zapatka, 2017).

This research is focused on a one-event crisis of a man-made source: the Barcelona (terrorist) attacks. In comparison to other man-made attacks, the Barcelona attacks crisis was at work (or in operation) for a longer period of time: during 5 days the emergency state was active, which makes it singular for this kind of crisis, most of this emergencies situations last for one or two days. Since the first tweet was published, the broad conversation unfolded mainly on Twitter, relegating mass media channels to a secondary stage of attention. Public services where the main actors using this channel not only for communication aims, but also for research purposes, asking for help on the on-going investigation.[1]

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[1] Barcelona is the main geographical area of this crisis. Catalan public services have a broad expertise in crisis management with Twitter, since March 10th, 2010, when a heavy snowfall affected Catalonia, leaving many habitants without basic services (thousands of homes were left without light supply) and many citizens hanging on roads all over the territory. Radio fm and Twitter (with the creation of @emergenciescat) became the two main information sources. This action had a positive impact on society, people discovered how fast information runs inside Twitter, and the number of Twitter users in Catalonia increased significantly. Since that day, Twitter had an important role in the resolution of crisis scenarios, like Empordà forests fires in July of 2012, floods in Val d'Aran and high winds in 2014, snowfalls and a chemical accident in Igualada in 2015 (Government of Catalonia, 2017), becoming the first place where citizen and media look for official indications and statements.

Other research has shown the positive effect of citizen engaging and cooperating with public services in crisis management extending the reach of information by retweeting from their personal accounts (Pervin, Takeda, & Toriumi, 2014). Empowered people play an important role in emergency scenarios, public services now consider citizenship as a key actor for spreading information into different communities that could contribute to a quicker and safer crisis resolution. Social network amplification has proved to reach a wider range of citizens communities than traditional broadcast media in emergency scenarios efficiently (Hagen et al., 2017; Mirbabaie & Zapatka, 2017).

One way to explore communication through Twitter in crisis scenarios is by tracking the path information follows since it is published by one account until it reaches its audience. In this piece of research we explore first **how information diffusion spread while Barcelona was under an emergency alert (RQ1)**, investigating the impact of user-roles in information diffusion phenomena. Collecting tweets and constructing the social network of information diffusion, build with retweets, we identify communities that naturally emerged within the conversation. These communities can be identified because people are more inclined to communicate with others who hold similar interests forming clusters of users (Barberá, Jost, Nagler, Tucker, & Bonneau, 2015).

People sharing information and communities of interest they spontaneously knit, are the key component of information diffusion on social media. To optimize future crisis management through Twitter we want to discover **who are the actors that contributed to the expansion** and **what role they played in information diffusion (RQ2)**. Users who participate in online conversation have a different level of influence, engaging influencers is crucial for the diffusion. Exploring who these users are, and how they are, are essential steps for mapping the ethnography of conversations.

In this investigation, we follow two different approaches. The first one used in previous emergency management studies (Mirbabaie & Zapatka, 2017; Pervin et al., 2014) ranks influential actors in social networks based on three main attributes: popularity, authority, and connectivity. The other approach used on online protests (González-Bailón, Borge-Holthoefer, & Moreno, 2013) sorts users in four categories based on their activity into the conversation: influential, hidden influential, broadcasters and common users. These rankings describe the function of each user in crisis resolution, and help to respond to the following sub-questions within RQ2: **who are the most popular actors within the attacks conversation? Who are considered the most authoritative actors within the conversation? And which actors are most effective at connecting disparate communities?**

One last point to be considered in this research is the language of information. Public services accounts of this study usually tweet in Catalan and from time to time in Spanish, the two official languages of the area. Considering Barcelona, and especially La Rambla, two of the most visited international traveller's destinations with its peak on August, the probability of people injured from other countries was very high. The range of people interested in the status of the emergency was never seen in any previous emergency in Barcelona, for the first time since the Olympic Games

(1992) and becoming an international travel destination, Barcelona suffered a terrorist attack. Furthermore, since media and other public services, and visitors' relatives and acquaintances seeked for information on social media, editors of official accounts considered informing in other languages. Hence, tweets containing important information were posted both in Catalan and Spanish, and in English and some in French. We evaluate the interactions rate of tweets for each language to measure the impact in reach of a multilingual approach in emergency scenarios.

Barcelona terrorist attack

On the afternoon of 17 August 2017, Barcelona suffered a harsh terrorist attack; terrorists drove a van into pedestrians on La Rambla in Barcelona (16:56h), killing 13 people and injuring at least 130 others, one of whom died 10 days later. Four minutes after the attack first messages appeared on Twitter asking public services for the situation on La Rambla and conversation about attacks grew on few minutes (see figure 1, tweets per hour). Public services leading the emergency immediately inform the crisis status on Twitter, pointing this social media tool as the primary source of information. At 18.50 the investigation confirms the terrorist origin of the accident and activated the terrorist protocol. This first hours had a huge number of tweets related to the emergency, tweets with a highest reach were those by official public services, that were playing a key role under a lot of pressure. The type of content published by public services was the standard for this cases: broadcasting information, broadcasting warnings, fighting rumours, encourage behaviour, appeal for information and emotional sense-making (Ehnis & Bunker, 2013).

Nine hours after the Barcelona attack (18th August at 1.00am), five men thought to be members of the same terrorist cell drove into pedestrians in nearby Cambrils, killing one woman and injuring six others. All five attackers were shot and killed by police. Due to the hour of this attack the impact on conversation was delayed until next morning when most people waked and knew about it. For the following days conversation was still active, several suspects were arrested on these days and the investigation drove to one last suspect. Until 21st of August when police used Twitter to asked for collaboration to find out the last suspect. On this morning images of the suspect were tweeted, several users reach public services giving valid information about him and finally the police caught up with the main suspect in Subirats, a village near Barcelona. He was wearing a fake suicide vest and shouted "Allahu Akbar" before police shot and killed him. During these days, the Government of Catalonia, especially through Mossos d'Esquadra (the police force of Catalonia) lead and coordinate the operations, receiving many worldwide congratulations and acknowledgments for the crisis management.
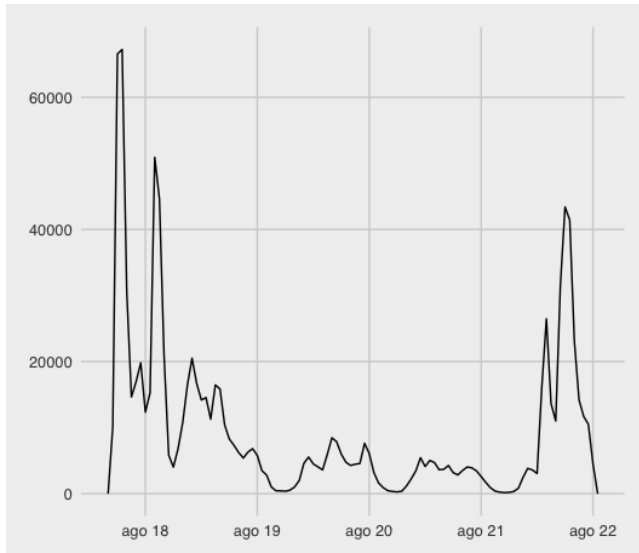
Figure 1. Tweets per hour

Methodology

Data analysed in this study was gathered from the public Twitter search API starting on 17th at 16:50h until 22nd of August 2017. Twitter search api is focused on relevance and not on completeness, which means that some Tweets and users may be missing from search results. We mitigated this risk executing multiple queries and comparing results to find out missing tweets. Considering the huge volume of tweets involved in the conversation related to the Barcelona attacks, we limit data collection on the conversation around the two main accounts providing information: Mossos d'Esquadra (@mossos) and Government of Catalonia Civil Defence (@emergenciescat). Both public services operated in a coordinated manner to oversee the safety of people in this area, and are clearly recognized as official spokesperson.

During the attacks, most of the conversation was not tagged under any predominant hashtag or set of hashtags, many words rise into trending topics in different languages, that is the reason we focused in this article on the conversation generated around public services accounts leading the investigation. Other research (Mirbabaie & Zapatka, 2017) gather the tweets querying the name of the city where the attacks took place but Barcelona have too many conversations with none relation to the attack, especially about FC Barcelona football team. These tweets could have distorted data with non-related information and alter findings.

With these assumptions, we gather a complete graph of unfiltered 1,8280,540 tweets mentioning or retweeting @mossos or @emergenciescat from 303,257 different nodes (each one represents a different Twitter user) composing a direct graph with 419,436 edges, drawing a relation between the users caused by retweets.

Technology used in this research study includes Python for data gathering, R for data cleaning and observation, and Gephi for graph operations.

Findings

Using modularity class, a community detection algorithm embedded on Gephi (Bastian, Heymann, & Jacomy, 2009), we calculate the number of communities that emerged on the Twitter conversation network we gathered. Each community is formed by a cluster of users who interact with each other. Due to the amount of communities (7,587) detected with algorithm standard resolution 1, we set its value to 1,000, this action decreases the number of communities to 748, each of them with a unique id.

Ranking those communities by the number of tweets assigned we found most of them are small clusters composed by less than 20,000 tweets. While public services were working on a fast resolution, Twitter communities emerged, helping spread official information. We analysed these communities and named them with a random number. The biggest community (#0), with 274,053 tweets, 27% of the total tweets analysed, was generated by those actors thanking public services for their job during the crisis; the most retweeted tweet was one by Oriol Junqueras (@junqueras), the vice-president of the Catalan Government. This is the central community and by far the one with more users. In second place, there is #702 community, which emerged when Mossos caught up the last suspect in Subirats. This community shares topic with #701. The difference between these two communities is the language they use: whereas in #702 the conversation is mainly in Spanish in #701 it is mostly in Catalan. Communities #63 and #103 emerged around Spanish public services, @policia (official Spanish Police account) and @emergencias112, a Spanish information channel managed by volunteers. They were especially relevant during the first hours of the crisis, when the cause of the accident was still unknown, and Mossos were starting the investigation.

Table 1. Content Analysis of communities

Category	Most retweeted tweet (author)	# of Tweets (%)
0	No ens cansarem d'agrair la feina dels @mossos, @emergenciescat i policies locals. (junqueras)	274,053 (27%)
702	Confirmamos que la persona abatida en el incidente de #Subirats es Younes Abouyaaqoub, autor del atentado terrorista en #Barcelona (mossos)	22,415 (2%)
63	No informes de los lugares donde están los @mossos por redes sociales. Deja a la policía hacer su trabajo. No informes sobre controles. (Emergencias112)	20,276 (2%)
701	Confirmem que la persona abatuda a l'incident de #Subirats és Younes Abouyaaqoub, autor de l'atemptat terrorista a #Barcelona (mossos)	14,877 (1%)
103	Si necesitas información sobre atropello en #Ramblas, @emergenciescat habilita el teléfono +34932142124 Y si tienes info 112, 091 062 (policia)	11,910 (1%)

Actors in Modularity Class #0 form the main community in this conversation. In this community, most users involved were active for a longest time and they generated the highest number of tweets. In Figure 2 we can see how the retweet ratio for these tweets is the lowest among top communities, due to the large number of tweets in this category. When the crisis finished, and even during the investigation many people had the need to thank public services openly for the management of the emergency, most of these messages were published by common users accounts, those located on the 4th quadrant in Figure 3. We have also identified the emergence of language-oriented clusters. Communities #702 and #701 simultaneously form two different tweets confirming the main suspect was caught, one in Catalan and the other Spanish. In Figure 2 we can see how the conversation in Spanish around the capture of one of the suspects (#702) had the greatest retweet ratio, much higher than the same conversation in Catalan (#701). However, most of the content generated around the largest community (#0) was written in Catalan, while the rest of communities had other predominant languages.
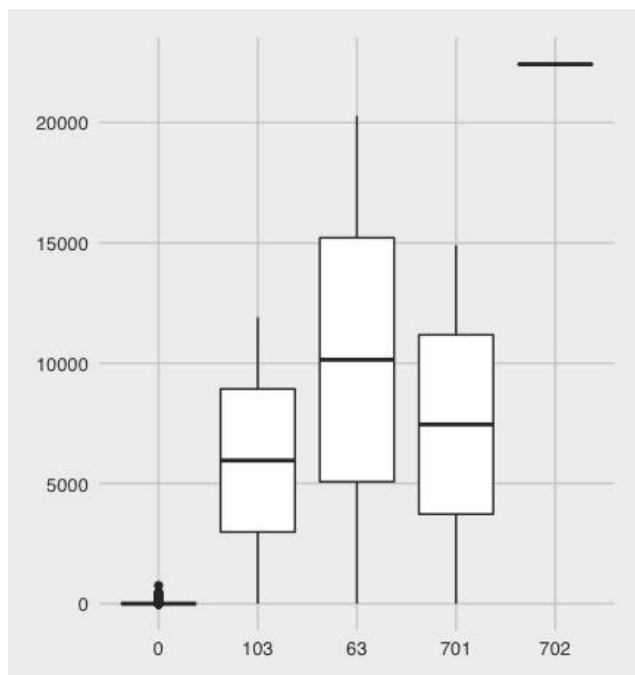

Figure 2. Retweets per community

The pace by which information diffusion is disseminated depends on the influence of the users who share it. Based on users' position in the social network, and using Gephi and their embedded functions, we could easily estimate the influence of each node composing the social network, as other studies have done before (Hagen et al., 2017). We rank users by three key attributes: popularity, authority and connectivity.

Eigenvector Centrality is the first attribute we analyse; it measures user's power to spread information according to the number of connections and the connections of these connections. These users are

also known as amplifiers, because they have a lot of users retweeting their tweets, and used to have a loyal wide audience. The top accounts by Eigenvector are @mossos and @emergenciescat by far, obviously because the conversation we are exploring is built around these two accounts. We can also see how official Spanish public services such as @policia or @guardiacivil also play an important role as starters, probably for those people not living in Catalonia. What it is not so usual is to find out citizens among starters, in this case some users with a niche audience appear as relevant sources. Looking at what they tweeted, we find that they re-posted as new messages information provided by official accounts. They helped spread information, but audience had to visit official channels to fast check information.

Table 2. The Top Ten with High Eigenvector Centrality

Username	Eigenvector Centrality	Description of the Account
mossos	1.00	Police of Catalonia official account
emergenciescat	0.35	Government of Catalonia Civil Defence
policia	0.11	Spanish Police official account
emergencias112	0.10	Spanish emergency information. Volunteers
auronplay	0.06	Youtuber
guardiacivil	0.04	Law enforcement agency in Spain official account
berlustinho	0.03	Communication consultant
gabrielrufian	0.03	Catalan politician and activist
momentses	0.03	Twitter Moments official account
joanqueralt	0.02	Catalan lawyer and publicist

PageRank is an algorithm that ranks the influence of a node in a social network by counting the number of connections directing to one node and giving influence based on its own score. These users are good information sources and they usually provide trustily original information. Most of the accounts on the top list by PageRank are official institutional accounts and Home Affairs Ministers of Catalonia and Spain. Catalan public services lead the emergency resolution and manage to secure citizens, and they were also recognized as the most authoritative sources on Twitter.

Table 3. The Top Ten with High PageRank Value

Username	PageRank Value	Description of the Account
mossos	0.126	Police of Catalonia official account
emergenciescat	0.088	Government of Catalonia Civil Defence official
justiciacat	0.065	Ministry of Justice
quimforn	0.029	Catalan Home Affairs Minister
emergencias112	0.008	Spanish emergency information. Volunteers
policia	0.006	Spanish Police official account
interiorcat	0.005	Ministry of Home Affairs
tv3cat	0.005	Tv channel of Catalan public broadcaster
auronplay	0.003	Youtuber
zoidoji	0.002	Spanish Home Affairs Minister

Betweenness centrality, also known as boundary spanners, are relevant users because they have the power to connect distant communities. It measures how often a node lies on the shortest paths within the whole network. They are also known as transmitters for their ability to distribute information into diverse clusters, connecting them and strengthening information diffusion. Identifying users by this attribute we found out that broadcast media channels and journalist played an important role connecting diverse communities on Twitter.

Table 4. The Top Ten with High Betweenness Centrality

Username	Betweenness Centrality	Description of the Account
324cat	.099	Information channel of Catalan public broadcaster
quimforn	.098	Government of Catalonia Civil Defence
tv3cat	.098	Tv channel of Catalan public broadcaster
mossos	.098	Police of Catalonia official account
martabelles33	.075	Journalist on Catalan public broadcaster
catalunyaradio	.075	Radio channel of Catalan public broadcaster
pepsina_mataro	.074	User created March 2010
xaviersolert	.036	User created September 2010
rsuarez4	.034	User created October 2012
jm_clavero	.034	User created September 2016

Most of the most influential users are public services accounts, celebrities, politics or media outlets with a huge audience, but especially for Betweenness unknown users appeared on the top ten. To

extend our vision on those users forming part of our network we classified users using a methodology used for online protest conversation (González-Bailón et al., 2013), mapping users considering their position on the network in terms of interactions (messages received/messages sent) and audience (user following/followers).

In Figure 3 there is a representation of this distribution, with interactions ratio on the vertical axis and audience ratio on the horizontal one. Users are divided in four categories: influential, hidden influentials, broadcasters and common. The color of the bins is proportional to the number of users who fall in the binned area.
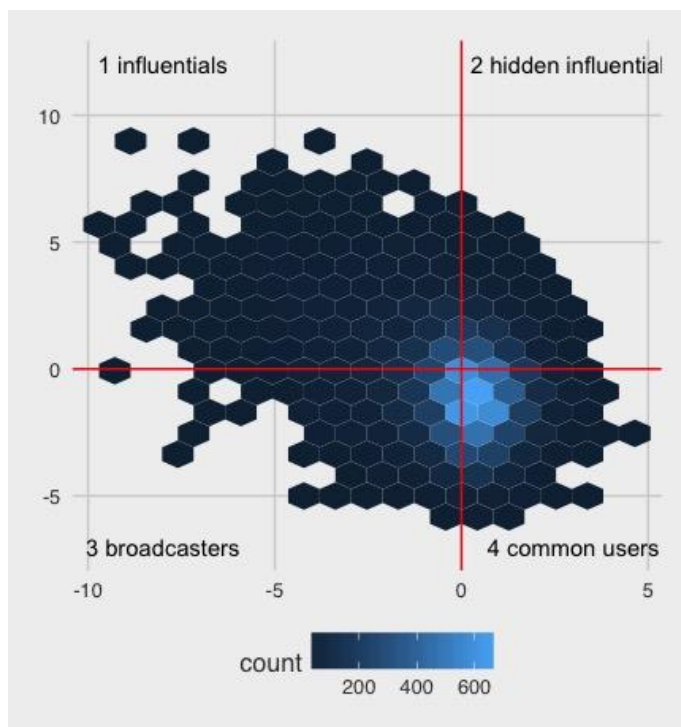

Figure 3. Distribution of users according to network position and message activity

Most of the users identified with a key role in information diffusion in this crisis scenario fall into the upper-left quadrant (1). These are the so-called influentials, public services, celebrities, politics and media outlets used to have big eager to interact with their followers community. They are well known as reliable sources and play a key role in publishing new information. Common users is the category with most social network users, and also play an important role on information diffusion. As other studies found out before (González-Bailón et al., 2013), users with low followers ratio and low engagement are the typology with a greater activity on the conversation. These common users were essential as transmitters, connecting different communities and increasing the reach of those messages published by influentials.

Conclusions

This article explores the role of citizens on information diffusion for crisis resolution. The emergency situation caused by Barcelona terrorist attacks was handled since the first minutes on Twitter, where public services looked for the cooperation of citizens, and they responded with their personal Twitter accounts helping to spread information that finally leaded to find the last suspect.

Public services confronting crisis should consider people an essential resource for emergency resolution, and social media as useful communication channel to coordinate operations. Citizens have a capillary knowledge of the society that allows diffusing information into micro-communities unreachable for public services, and the ability to connect these clusters, transferring information between them.

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