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User roles for emergency management in social media: Understanding actors' behavior during the 2018 Majorca Island flash floods



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ARTICLE INFO

Keywords:

Crisis communication
Emergency management
Social media
Audiences
User roles
Twitter
Spain

ABSTRACT

Social media assemble multiple users' interactions across singular events. Authorities need to navigate this diversity to effectively communicate and promote collaborative strategies. During emergency situations, discerning “who is there” is even more important for authorities, as this tracing process can save lives reaching the appropriate targets. This article contributes to this problem during emergency situations by proposing a user role taxonomy. We argue that focusing on functional behaviors could bypass the complexity of defining audiences during critical events. We test our framework using data from the 2018 flash floods in Sant Llorenç, Majorca island (Spain). Results show a diverse set of audience roles that emerge during crisis and post-crisis stages. We also identify the inclination of actors to represent certain roles and not others. Our findings contribute to understand crisis development models, and also crisis coordination configurations, such as the four-channel model or the network coordination perspective. Practical implications for public managers vary from improving coordination to influence audience's behavior during crises.

1. Introduction

Public managers use social media during crises to foster two-way communications with different types of actors. Social media and emergency management literature conceptualize these actors as “stakeholders”, “citizens” or “audiences”, whereas it is not completely clear who are the participants during these emergency situations and the role they play during the crises (Gascó, Bayerl, Deneff, & Akhgar, 2017; Panagiotopoulos, Bowen, & Brooker, 2017; Song, Kim, Kim, & Jung, 2015; Yildiz & Demirhan, 2016). Moreover, authorities can also become “audience” of the content created by other users (González-Bailón, Borge-Holthoefer, & Moreno, 2013; Reuter, Heger, & Pipek, 2013; Wukich, Hu, & Siciliano, 2019), which makes active listening essential to improve the understanding of information flows. These problems manifest particularly on popular applications such as Twitter where different audiences interact on the same platform and during the same situation (De Widt & Panagiotopoulos, 2018; Marwick & Boyd, 2011; Spence, Lachlan, Lin, & del Greco, 2015). These facts add complexity during the management of crises, possibly hindering effective communicative and participatory practices, regarding that some authorities wouldn't be able to direct their messages to the appropriate targets.

This article contributes to understanding the problem of social media “audiencing” during crises and it proposes a user role taxonomy.

With social media “audiencing” we refer to the public performance of belonging to the distributed audience for a concrete event (Highfield, Harrington, & Bruns, 2013). We argue that if authorities need to appropriately interact with different audiences during a crisis situation (Marwick & Boyd, 2011; Shwartz-Asher, Chun, & Adam, 2017; Spence et al., 2015), it will be of paramount importance to define an early starting point based on characteristics of different groups of actors and phases in the crisis. One of the possibilities could be to explore how these actors behave according to how they use the functionalities of the platform (i.e., sharing or replying) (González-Bailón et al., 2013; Reuter et al., 2013; Tinati, Carr, Hall, & Bentwood, 2012). Thus, a user role taxonomy operates as a heuristic mechanism bypassing the complex question of “who's there?” by focusing on “who's doing what?”. We initially built on Congosto (2018) user role taxonomy, reinterpreting this approach with the lenses of social media and emergency management literature.

To empirically test this initial approach, we analyzed the community of actors that interacted during the 2018 Sant Llorenç flash floods in Majorca island (Spain) using the *Twitter* hashtag #SantLlorenç. The research question that has guided our article is: *During an emergency situation (e.g. Majorca flash floods), how do different actors behave on Twitter, according to the displayed functionalities of this social media platform?* Our work was intended to automatically apply a user role

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<https://doi.org/10.1016/j.giq.2020.101521>

Received 16 December 2019; Received in revised form 22 July 2020; Accepted 28 July 2020

Available online 02 September 2020

0740-624X/ © 2020 Published by Elsevier Inc.

taxonomy to this particular crisis, whereas we manually classified the actors regarding to their nature (citizens, authorities, NGOs, news media, etc.). Also, we have filtered data from the crisis-response and post-crisis stages using the three-stage crisis development model (Coombs, 2012) and Social Network Analysis (SNA). By applying this approach, we mapped how functional roles can vary according to the type of actors and the stage of the crisis. Our goal has been to use these learnings to make the initial typology evolve into a more specific user role taxonomy focused on using Twitter for communication during crises.

This article aims to contribute to different theoretical and practical grounds. First, this study debates social media and emergency management literature by addressing the problem of “audiencing” with a functional user role perspective. This point of view could be important to apply certain communication during crisis theories in social media, such as the development of “staged” models, and specifically the three-stage model (Coombs, 2012). Accordingly, our user role perspective is applied to comprehend how the behavior of social media users' changes depending on the stage of the crisis and the primary role/function of them. Our study also contributes to communication and emergency response theories, such as the “network perspective” (Tierney & Trainor, 2003) and the “four-channel model” (Pechta, Brandenburg, & Seeger, 2010). Particularly, this study highlights audiences for information delivery and coordination tasks. Our user role taxonomy supports these approaches by providing a framework to gauge different groups of users, and to understand how to take advantage of the online capabilities for each group. Our work is a response to the need of studies on users' behavior through platform mechanisms, as it has been pointed out in recent literature reviews on social media and government (Medaglia & Zheng, 2017). On the practical side, our role taxonomy can improve the dissemination of situational information and early warnings by emergency managers. In particular, this article could help practitioners to understand the evolution through different stages of crises and how social media are used by different groups of actors. Finally, authorities might use these results to foster users' behavior in a pre-defined direction (Baldwin, Cave, & Lodge, 2012).

The remainder of the article is as follows. The second section of the article discusses the conceptual foundations of the study and presents the user role taxonomy inspiring our study, but also reinterpreting this taxonomy with social media and emergency management literature. Then, the third section presents our research case and methods with a special emphasis on data collection, classification, and analysis. The fourth section displays the results regarding the evolution of crisis response and post-crisis during Majorca flash floods. Finally, we present our findings, using what we have learned from the case to advance into a more unique user role approach. We also present some practical implications for practitioners. Our conclusion expresses some limitations and possible avenues for future research.

2. Conceptual framework

This section presents the conceptual foundations of this study. First, we explain in more detail the problem of social media audiences and its particular implications for emergency management. Second, we explore user role taxonomies as a possible solution to other social media and emergency management perspectives. Then, we present as an initial approach the Congosto (2018) user role taxonomy (in *Twitter*), reinterpreting it according to social media and emergency management and communication during crisis literature. Finally, we formulate some assumptions based on crisis response and post-crisis stages.

2.1. Social media audiences during emergency situations

Although the dissemination of messages in social media platforms can potentially reach to “unlimited” public(s), some authorities choose to talk to specific groups in order to augment their communication

impact. In general, they usually extract “clues” about the profiles of people who follow or interact with them (Highfield et al., 2013; Marwick & Boyd, 2011). In that process, they “imagine” their “audience” to embrace one communication and interaction style or another (Marwick & Boyd, 2011). However, social media platforms, mostly *Twitter*, usually experience a contextual break down. To say it in other words, the use of a specific hashtag can put on the same conversation different types of actors (Choi & Park, 2014; González-Bailón et al., 2013; Highfield et al., 2013), and the use of the retweet mechanism can spread the message out of its initial devised context. Thus, authorities are forced to navigate multiple audiences, pursuing a complicated balanced between the networked nature of this type of media and the need to categorize audiences (Marwick & Boyd, 2011). Creating and active “many-to-many network” where roles of producers and consumers are blurred (Marwick & Boyd, 2011).

As with other actors, authorities are not sure about their real audience compositions and behavior. They make assumptions about who the actors they listen and write to are and how they could be reached to spread their messages more efficiently (Mergel, 2013a; Panagiotopoulos et al., 2017). Hence, knowing more about “who is there?” can be key for defining goals, contents and measurement systems (Picazo-Vela, Gutiérrez-Martínez, & Luna-Reyes, 2012), to promote participation and engagement (Bonsón, Royo, & Ratkai, 2015), drive innovation (Mergel, 2013b; Criado, Sandoval-Almazan, & Gil-García, 2013) and help policy-makers to gain valuable insights (Panagiotopoulos et al., 2017; Williams et al., 2018), among other benefits. Despite the importance that this process of audiences' classification might entail in the study of social media, public sector scholars need to foster the attention to understand audience composition and their behaviors (Mergel, 2013b; Panagiotopoulos et al., 2017). In some cases, audience mapping has been carried out using vague or generic groupings (Bonsón et al., 2015; Colineau, Paris, & Vander Linden, 2012; Mahler & Regan, 2011). In other cases, they have not provided relevant information about the expected behavior towards agents of the public sector, with some noticeable exceptions (Shwartz-Asher et al., 2017; Wukich et al., 2019).

During emergency management the identification of multiple audiences is an essential aspect for emergency response. According to the four-channel of communication model (Pechta et al., 2010), it is central the positioning of the public as “participants” of a network (Sellnow & Seeger, 2013). This model identifies different links between audiences, including authorities, non-governmental organizations, citizens, news media, and private companies (Sellnow & Seeger, 2013). Authorities' audiences become both sources and consumers, and as such, it is important to seize the dynamic relations between different user behaviors, platforms and communicative elements (Sellnow & Seeger, 2013). The network perspective for disaster response coordination (Tierney & Trainor, 2003), also recognizes the importance of the emergence of certain groups within the scope of a particular disaster in unique and flexible structures. Nonetheless, how can we understand this diversity of participants during crises?

Social media and emergency management literature have stated different answers to this question based on the types of information handled by the participants during the process. A good starting point is the recent literature review of Reuter and Kaufhold (2018). These authors advance some answers regarding audiences' treatment in social media and emergency management. Depending on the sender and the recipient we can catalog different information flows ranging from citizens to citizens, citizens to authorities, authorities to citizens and between authorities (Reuter & Kaufhold, 2018). Besides, we can study the configuration of actors depending on information sources (Olteanu, Vieweg, & Castillo, 2015) ranging from primary (eyewitnesses), secondary or tertiary (news media, outsiders), as well as aggregate sources (governmental, non-governmental, business...). Other authors approach to audiences studying social media roles more specifically, indicating the suitability of this perspective for the analysis of crises

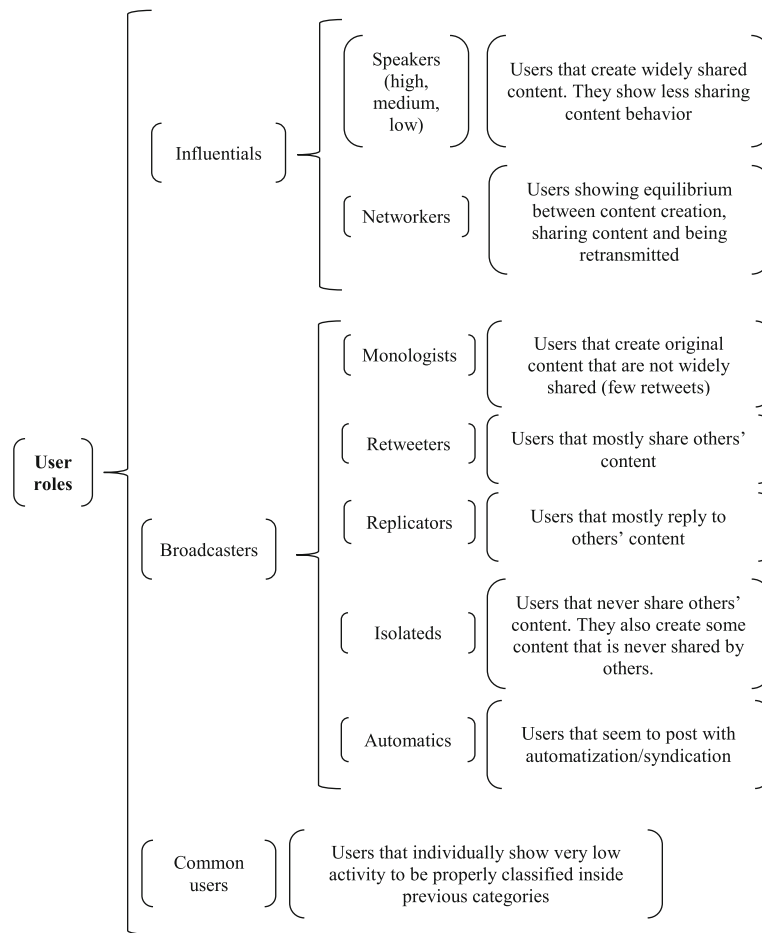


Fig. 1. Using Congosto (2018) user role taxonomy as a starting point for studying social media interactions during crisis.

management (Bergstrand, Landgren, & Green, 2013; Reuter et al., 2013). Therefore, our contribution will reflect on this last perspective.

2.2. Functional user role perspective to understanding actors' behavior on Twitter

User roles denote the composition of audiences and conversational sources in social media. In opposition to previous social media functionality models, scholars using user role taxonomies suggest that there is no single type of user creating or responding to different stimuli, but a variety of them (Shwartz-Asher et al., 2017). The interest of user role taxonomies is based on the fact that they can contribute to the systematization of user variability (Congosto, 2018). Hence, the study of user categories based on certain characteristics of the audiences could facilitate our understanding in relation to certain events (González-Bailón et al., 2013). In studies about social media and the public sector this type of classifications and attention to user behavior are uncommon (Medaglia & Zheng, 2017; Shwartz-Asher et al., 2017). Studies about social media and emergencies have published role taxonomies, taking different perspectives depending on their focus on citizens or authorities, or their relationship with the physical or virtual spaces (Reuter & Kaufhold, 2018).

These types of classifications have been linked to the types of information and some platform functionalities. Reuter et al. (2013) identified several user categories that can be applied for emergency management in Twitter based on information patterns: a) helpers, that is, users involved in supportive actions that are often retweeted and that publish a lot of tweets; b) reporters, generators of information that are often retweeted; c) retweeters, information distributors that retweet

intensely; d) repeaters, that is, actors that spread a message by publishing several tweets; and finally e) readers, users that develop a more passive role.

Other authors have described taxonomies more focused on authorities. Bergstrand et al. (2013) categorized actors depending on existing profiles that bestow information with a unidirectional perspective, distribute information and retweet authorities, or disseminate opinions and self-expression. The most recent work of Wukich et al. (2019) has defined social media communication patterns of bridging and bonding. This work presents a model of brokerage behavior, which also takes into account public, nonprofit and for-profit organizations, including: a) coordinators, who facilitate information flows between actors; b) consultants, profiles that link two actors from different organizations than the consultant's; c) representatives, receivers of information from their group, and senders of information to other groups; d) gatekeepers, which receive information from other groups, filtering and promoting this information inside their own group; and e) liaisons, that create a link within a receiver group who gets the information from an external actor, spreading this information to a different group.

Following the state-of-the-art, we argue that other contributions can be developed within this research field. On the one hand, role patterns have served to an individual research interest or unit of analysis (Reuter & Kaufhold, 2018). Since it seems very challenging to infer the diversity of users who can interact on Twitter, it deserves attention to explore new mechanisms to understand the composition of these audiences, regarding to the information and their behavioral virtual responses. On the other hand, other interesting aspects can be drawn discerning which and how users virtually participate in these emergency situations through functional behaviors. Our study is intended to examine the

relationships between these roles, crisis phases and types of actors (e.g., authorities, NGOs, citizens, politicians, news media, etc.). These ideas are expanded in the following sub-section.

2.3. Twitter user role taxonomy for emergency management

This study suggests a reinterpretation on one of the most recent user roles taxonomies in *Twitter* studies. The taxonomy proposed by Congosto (2018) and hosted by her *Twitter* analytical framework “t-hoarder” (Congosto, Basanta-Val, & Sanchez-Fernandez, 2017) operates here as a starting point for studying audiences' configurations and behaviors during crises. From there, we have initially reinterpreted the original categories according to early role taxonomies contributions applied to emergencies (Reuter et al., 2013; Wukich et al., 2019), network studies (González-Bailón et al., 2013), and other social media and communication during crises research. Then, we test this typology (Fig. 1) using data from a concrete event, which helped us to evolve the taxonomy into a more unique approach.

This taxonomy classifies the roles of actors according to general dimensions based on their contrasting behaviors during the process of crisis. *Influential* actors are users with great capacity to be disseminated (that is, they are highly retweeted). Under this category, we have two possible roles: *speaker* and *networker*. Unlike *influentials*, *broadcasters* are users who stand out for the density of their posting activity. Depending on how the behavior towards that content is, they can be classified into *monologists*, *retweeters*, *replicators*, *isolateds* and *automatics*. Finally, *common users* are those actors for whom we do not have enough information to classify in relation to the previous categories, as they show very few behavioral traits to be placed in any of them. In the following paragraphs we explain each of these categories, and we begin to reinterpret them using literature on social media and crisis communication.

2.3.1. Speakers

Speakers are actors being highly retransmitted through retweets. These actors create posts that are widely shared, because their accounts have high numbers of followers (*influentials*, following González-Bailón et al., 2013 classification). It could also be possible to find users with small communities in this category, because some of their content is addressed as highly original by their communities during an existing event, which can happen in the case of first responders or witnesses (*hidden-influentials*, following González-Bailón et al., 2013). This category could also partially correspond with what Reuter et al. (2013) called *reporters*, a type of user that makes sure information enters the virtual realm during an emergency situation.

During crises, authorities heavily rely on push strategies to provide emergency information to citizens. This information varies considerably (Wukich, 2016), ranging from protective messages to reduce exposure to risks (Lindell & Perry, 2012), messages providing situational information (such as data on damage or casualties, reports about incidents or changing conditions...) (Hughes, Lise, Leysia, & Kenneth, 2014), information about operations in progress (Hughes et al., 2014), or messages to report misinformation and false rumors. Authorities are considered as trusted sources (Wukich & Mergel, 2015), and some citizens are willing to share their content if they think this action can help (Chatfield, Scholl, & Brajawidagda, 2013; Lin, Lachlan, & Spence, 2016).

On the other side, some citizens and NGOs should be considered as first responders during crisis situation. Some of them nurture authorities and news media with information about what is taking place in real time, sometimes reaching great audience and strengthening situational awareness (Song et al., 2015; Spence et al., 2015). However, many times, citizens post opinions and feelings more than objective information (Yuan & Gascó, 2018). They provide information barely adding value for authorities. On the other side, NGOs often appear as relevant actors (Hughes & Tapia, 2015), operating as aid organizers or

coordinating actors (Yildiz & Demirhan, 2016). During initial recovery, celebrities, prominent citizens, or politicians and political parties will be expected to join the conversation (Anikeeva, Steenkamp, & Arbon, 2015). Also, it is expected that news media will play a role, as they are broadcasters of information usually having large pre-established social media communities. News media might be one of the key types of users, during and after disasters, providing realistic, objective, and non-promotional information (Ghassabi & Zare-Farashbandi, 2015).

2.3.2. Networkers

Networkers display an equilibrium between creating content, retweeting, and being retweeted. They are polyvalent users which are highly involved during a crisis situation, retweeting information from official sources, offering emotional support, participating in virtual actions of volunteers during the catastrophe, etc. They resemble on Reuter et al.'s (2013) category of *helpers*, users who are less prone to information processing, but more involved on communication, interacting with other users and coordinating certain help activities.

During crisis response, a phase usually focused on situational information (Wukich, 2016), we should expect some pro-active news media to be quite present. This is so because on early stages, when they will not only create content, but they will probably pull some information from first responders, and retweet authorities that provide key information about the current situation (Spence et al., 2015), therefore generating widespread dissemination. We will also find some emergency agencies and some citizens to be *networkers* alike, with similar features of these presented above.

2.3.3. Monologists

Monologists might post tweets and even perform retweeting practices. In one case or another, the contents they produce do not receive much attention (they have very few retweets). They are similar to the category that Reuter et al. (2013) named *repeaters*. They repeat messages again and again, as they try to draw attention in their content. Usually, they do not succeed, and the dissemination of their messages is limited. In fact, a *monologist* who is successful with his/her messages could become a *speaker*.

In this category one would expect to find some citizens and local media with limited communities of followers. The literature has found that what citizens post could be important regarding to the notion of usefulness (Gascó et al., 2017; Yildiz & Demirhan, 2016; Yuan & Gascó, 2018). Local newspapers and local journalists could be describing the events with detailed knowledge but having little impact due to the fact they do not have strong social media communities, or the lack of awareness about their condition as trusted media, based on their local nature.

2.3.4. Retweeters

Retweeters are social media users who massively use the retweet function. It resembles the role of *retweeter* from the categorization of Reuter et al. (2013), and to some extent they act as *coordinators* in the classification of Wukich et al. (2019), who behave facilitating information flows. As retweet is a widely used mechanism, we expect to see most citizens using it across all crisis phases, as a way to foster the capabilities of authorities to communicate (Lin et al., 2016). One single exception to this could be authorities themselves: if authorities retweet, they will only share information from trusted sources, such as other emergency agencies (Wukich & Mergel, 2015). As *retweeters* are one of the main responsible for content propagation with *networkers*, authorities will have to target them not only for reaching more audience, but for controlling misinformation (Wukich, 2015).

Retweeters convey one of the key roles for message propagation. They have potential to be part of a co-production network strategy in terms of communication and widespread. For example, Chatfield et al. (2013) illustrated how citizens and organizations retweeting tsunami early warnings made possible for the Indonesian Agency for

Meteorology, Climatology and Geophysics (BMKG) to reach people with alerts in a more agile and efficient way. Thanks to people willing to collaborate, the overall service capacity of BMKG increased beyond its potential limits, if they had only used their own resources (Chatfield et al., 2013).

2.3.5. Replicators

Replicators are users who have more replies to tweets than original tweets during actual events. They are users willing to actively participate in a conversation, not only by sharing official content, but also engaging with it. During an emergency situation we expect to find some citizens, NGOs, and organizations playing this role. On the one hand, citizens will extensively use replies to voice concerns, respond to information pulled from authorities, and reveal subjective feelings (Wukich & Mergel, 2015). They could also use replies to pursue accountability (Gascó et al., 2017). On the other hand, some authorities can also use the reply function, for example, to respond to false rumors, clarify information, or gather data from citizens and organizations (Panagiotopoulos, Bigdeli, & Sams, 2014). Nevertheless, *replicators* are expected to represent a shorter group in comparison to *retweeters*.

2.3.6. Isolateds

Unlike *monologists*, *isolateds* are not willing to propagate information. They publish less tweets than *monologists*, and they do not have any remarkable impact (unlike *monologist* – which are capable of getting a few retweets – they don't get any). They are out of the conversation, although they are actually part of it (e.g. they have used the hashtags in operation during the crises). They have less relevance than *monologists* in terms of dissemination. Respecting this scenario, we hope to find some citizens – although very few – since people usually express interest in helping with message propagation (Chatfield et al., 2013; Lin et al., 2016; Panagiotopoulos et al., 2014).

2.3.7. Automatics

In some cases, users display no human behavior because they have been automatized. This situation appears, for example, by using aggregators or syndication to post content from external sources. This type of users has increased over the last years within the social media platform *Twitter*. During emergency situations, some studies have stated that the existence of this kind of accounts could be somehow related to publication of misinformation across all crisis phases (Reuter, Kaufhold, & Steinfort, 2017). If *automatics* exert a distinctive role during the process, authorities need to quickly monitor them to verify if their activity is aligned with real facts or, on the contrary, they are endangering response management.

2.3.8. Common users

There are lot of users which are not easy to classify. This is so because – in relation to a certain event – they do not show sufficient traits to be placed in any of the previous categories. To solve this, Congosto (2018) generated the category of *common users*. This category refers to the fact that a large number of users during a certain event participate in a very testimonial way. For example, they only send one retweet, something that it is not sufficient to make them neither *retweeters*, nor even *isolateds*. *Common users* may not be relevant in a conversation. However, during a certain event, they may have what González-Bailón et al. (2013) called the “power of numbers”: massively grouped around one actor, they can contribute to high levels of retransmission.

During emergency situations, it is likely that we will find as *common users* mostly citizens who were part of other communities and who at one point retweeted a single post. This can usually be because it just appeared on their timeline and it was from an entity, they well-know or follow. And they retweeted it without showing much more interest in the specific event. For example, we should find here a big part of fan-bases in case certain celebrities are echoing the crisis. Celebrities are citizens probably not directly related to the emergency situation and

they not usually post critical information. Thus, if *common users'* numbers are high, concentrate around actors not directly related to the event and join forces with *retweeters*, they could potentially distort network conversational dynamics (Highfield et al., 2013) and hide relevant information if they are numerous and bigger in comparison, for example, with authorities' communities. In this article, as they should not show sufficient behavioral traits, we are studying *common users* only as part of our visualization analysis and role distribution.

2.4. Crisis stages and user roles

The variability of these roles during the evolution of phases in the crisis is another dimension of interest in our study. Looking at how actors and behaviors evolve during the different stages of one crisis might help to understand the crisis itself. This could support scholars studying specific events and authorities managing transitions and coordination among different groups of agents involved in the mitigation of the emergency. Literature of communication during emergencies presents different theories about the development of crisis, including the three-stage model, the four-stage cycle, or the six-stage frequency of failure, among others (Sellnow & Seeger, 2013). In this article we focus on the three-stage model of crisis development (Coombs, 2012), due to its simplicity and its approach to specific-stage related features (this taxonomy could also be applied to other models).

This model divides crisis phases into three categories: pre-crisis, crisis and post-crisis. (1) In the pre-crisis stage, we are in an incubation state, in which the authorities must prepare to mitigate any eventuality. (2) The crisis stage begins with a trigger event: this event may have suddenly appeared or may have been silently growing during time. As Sellnow and Seeger (2013) comment, during this stage the greatest damage is usually inflicted, and more extreme mitigation and containment responses are put in place by the authorities. During this stage, authorities will sometimes be overwhelmed by the threats. (3) Finally, the post-crisis initiates a process of recovery and return to the normal.

Certainly, it is initially difficult to ascertain where and how variations can occur without repeatedly testing this typology. However, some previous assumptions can be made regarding user roles. For example, the response phase is typically saturated with protective messages and situational information (Wukich, 2016), and implies more critical and collaborative actions, especially through the amplification of messages (Chatfield & Reddick, 2018). We expect to find prevalence of eyewitnesses and affected citizens acting as *speakers* across high to low positions, much lesser numbers of *replicators*, and noticeable activity from *networkers*, especially when the end of the crisis response is at stage.

The post-crisis phase is more focused on resource provision and crowdsourcing of ideas and knowledge (Wukich, 2016). As this type usually implies a greater collaborative action with higher interactions with individuals and civil society organizations (Chatfield & Reddick, 2018) (one of the most iconic forms being the search for missing people and rescue related messages), we expect the prevalence of *networkers* and *speakers* supporting this type of actions. Accordingly, we foresee an increase in the number of users not directly affected or linked to the crisis, including *monologists* or *replicators* (i.e. giving emotional support and asking for accountability). In the case of the role of *retweeters*, we anticipate a high volume of this type of users across all crisis phases, although they might exercise different orientations: one more focused on supporting news media and eyewitness reports during crisis response, or another more oriented to supporting digital volunteers during post-crisis initial recovery. We expect *retweeters* and *common users* supporting the messages of celebrities and politicians during post-crisis phase.

To summarize the main contents of this section, Table 1 describes how Congosto (2018) originally operationalized each category and our first expectations for communication during crises. This approach

Table 1
Operationalization for the user-role taxonomy in social media during emergencies crises.

User role	Conditions (original codification)	Expectations for emergencies
<i>Speaker</i>	Received retweets being three times greater (<i>low speakers</i>), ten times greater (<i>medium speakers</i>) or one hundred times greater (<i>high speakers</i>) than their volume of posted tweets.	Actors being highly retransmitted (e.g. calls for rescue actions, important situational information...). Conversation across all crisis phases usually takes place around them. We expect to find affected people and authorities during response, and celebrities/politicians during post-crisis. If a <i>speaker</i> propagates misinformation, could be very difficult to counteract.
<i>Networker</i>	Number of tweets equal or greater than the total mean. Number of received retweets equal or greater than the total mean. Number of received retweets / number of sent retweets equal or greater than 0.5.	Actors (especially news media and some citizens) showing equilibrium between being retransmitted, content creators, and disseminators. Key actors for co-production across all phases.
<i>Monologist</i>	Number of tweets equal or greater than the total mean. Number of received retweets / own tweets equal or lesser than 0.3.	Actors (especially some citizens and local media), contributing to generate extensive information that, although could be interesting, is not very disseminated. They also disseminate messages to a lesser extent.
<i>Retweeter</i>	Number of tweets equal or greater than the total mean. Number of sent retweets / own tweets equal or greater than 0.5.	Actors responsible for message dissemination (with the exception of authorities, which will retweet less). Candidates to be part of a wide co-production strategy.
<i>Replicator</i>	Number of sent replies / own tweets equal or greater than 0.6.	Actors, mostly citizens, giving voice to complaints, seeking for accountability (post-crisis), expressing feelings... Authorities responding to misinformation, pulling information (crisis response), clarifying information...
<i>Isolated</i>	Number of sent retweets equals to 0. Number of received retweets equals to 0.	Actors (usually a few citizens) that are not willing to participate disseminating information.
<i>Automatic</i>	Majority of tweets have as source aggregators or other automatization apps/bots.	Actors automated/programmed. Vector for outdated information/misinformation during all phases.
<i>Common user</i>	None of the abovementioned conditions.	Actors (mostly citizens) that, in big numbers or combined with <i>retweeters</i> around certain actor, could heavily increase its retransmission capabilities. If the retransmitted actor is unrelated to the emergency, <i>common users</i> could be helping in temporarily hiding relevant information.

Source: own elaboration based on Congosto (2018).

comprises the essence of each of the previously identified categories, regarding a technical perspective and through very accurate measurements. Across this section, our analytical framework has reinterpreted the abovementioned categories according to the literature on social media and emergency management. Using a variety of tools, that we discuss in the next methodological section, our study applies these developments and then performs the analysis of data.

3. Case selection, methods and data

This section presents our case selection, data sources and research methods. In this article we test the user role taxonomy by analyzing audience's configuration and behavior on *Twitter* during the crisis response and the post-crisis from one extreme environmental event hitting Spain: the flash floods that occurred in Sant Llorenç des Cardassar, Majorca Island, on October 9, 2018. Our research question is: *During an emergency situation (e.g. Majorca flash floods), how do different actors behave on Twitter, according to the displayed functionalities of this social media platform?* Using data from *Twitter* processed through an open-source algorithm, as well as using SNA and statistical processing, we study the behavior of different actors according to our taxonomy of user's roles in social media, during the different stage of the crisis.

3.1. Case selection

We have selected the flash floods that occurred in the town of Sant Llorenç des Cardassar, located at the east of the Majorca Island (Spain), on October 9, 2018. During this date a severe thunderstorm discharged rainfall of up to 220 mm in just two hours. The force of the rain flooded a natural stream located near the town causing devastating effects: 13 death people and the destruction of several infrastructures on the east of the island (Agencia Estatal de Meteorología (AEMET) Meteorological Spanish Agency, 2018). The selection of this case is supported by the nature of the tragedy itself, and also because *Twitter* was used by different actors during the sequential stages of this crisis.

Through the *Twitter* hashtag #SantLlorenç, thousands of people interacted both during and after the crisis. Thus, *Twitter* users posted 36.109 tweets during October 9 and October 15 using this hashtag. During this period of time, other hashtags were used, such as

#MallorcaAlCor (1480, with an emotional perspective), #InundacionsMallorca (5196 tweets) and #InundacionsIB3 (promoted from the regional broadcasting television station IB3, with 3670 tweets). However, in this article we will focus on analyzing the hashtag #SantLlorenç, having confirmed that the greatest part of the activity in social media during this crisis, including different social actors and authorities, occurred inside this hashtag. We are also aware that there could be activity and interaction without using any of the hashtags in operation at that time. Our study includes typical limitations of *Twitter*-based studies using hashtag analysis (Bruns, Burgess, Crawford, & Shaw, 2012).

3.2. Data collection and analysis

Now, we detail the different stages during the data collection and analysis processes. After several days following-up the event via traditional media and social media, we downloaded tweets from #SantLlorenç hashtag, extracting a total amount of 36.109 tweets. Data was collected using the open source python tool t-hoarder (https://github.com/congosto/t-hoarder_kit). This tool was also used for data conversion in SNA, and to classify tweets according to our role taxonomy (Congosto, 2018).

After extraction, tweets were classified according to two crisis phases. During the crisis response we gathered a total amount of 14,200 tweets. We have included tweets posted from 6:59 pm October 9 (when initial information, images, and videos alerting about the flash flood started to appear in *Twitter*) to 8:39 pm on October 10 (when the Spanish Meteorological Agency, AEMET, posted a tweet indicating that they have removed weather alerts for Balearic Islands). During the post-crisis phase we obtained a total of 21,909 tweets. In this case, tweets ranged from 8:40 pm on October 10 to 11:59 pm on October 15.

3.3. Methods

We have supported our data collection process with automatic processing techniques. The automation process to collect tweets was possible thanks to *t-hoarder kit* capabilities. First, *t-hoarder* allowed us to convert data into files readable by *Gephi* (.gdf), a software for network visualization. By using *Gephi*, we were able to visualize the interactions

Table 2
Coding values for types of actors.

Type of actor	Features
Authority (general)	Local/municipal, regional/state and national/federal authorities not related to weather or emergency management.
Authority (emergency/weather agency)	Local/municipal, regional/state and national/federal authorities related to weather or emergency management (for example, police, weather agencies, firefighters, army, etc.).
NGOs (general)	Civil society organizations not related to weather or emergency management.
NGOs (emergency/weather related)	Civil society organizations related to weather or emergency situations (for example, Red Cross or VOST).
Citizen (general)	User personal accounts.
Citizen (emergency/weather interested)	Personal accounts that have in their descriptions weather or emergency related information (as a profession or hobby), and that posts weather or emergency information on a regular basis.
Political	Political parties official accounts. Politicians accounts (if they have in their Twitter description a political affiliation).
News media	TV, radio and newspaper official accounts. Journalist personal accounts (if they have in their Twitter descriptions that they belong to a news media or if they state that they are journalists).
Company	Private organizations accounts different from news media (for example, hotel resorts, insurance companies, etc.).

of different actors during the event. For visualization purposes, we have filtered actors by giant component, and also by modularity class (big partitions), which give us the picture of some of the main communities for crisis response and post-crisis stages. Graphs were drawn around retweeting dynamics (measuring the number of input retweets) using the Force Atlas 2 algorithm provided by Gephi. The resulting graph was useful to understand audience composition and how information flows occurred between the most important actors by exploring the dynamics of retweets. Due to possible ethical issues, usernames were anonymized (except for certain relevant authorities and celebrities that we comment in text). Second, *t-hoarder* allowed us to classify users extracted from the SNA regarding to the fact that it incorporates an algorithm specifically designed for classifying users according to our taxonomy specifications.

All users were also coded according to the type of actor (Table 2). We developed this activity manually. For this coding process, the user's name, description (bio), as well as the tweets posted were also taken into account. In case of doubts, the case was considered as a "missing value". Initially, the classification was carried out analyzing authorities, citizens, news media and associations/organizations as key actors. Once the analysis advanced, additional categories were added improving the accuracy of the process and making a more precise investigation of the variety of profiles we were encountering. Data was processed using the statistical package Stata, conducting crosstabs between the type of actors and user roles. Chi-square tests were also carried out.

4. Results

On October 9, 2018, Sant Llorenç des Cardassar, a small town (8328 inhabitants) located on the east of the Majorca Island (Spain), suffered the worst storm in its history. In just 2 h, a severe thunderstorm discharged rainfall of up to 220 mm, which produced the rapid overflow of a nearby natural stream. This event resulted in 13 casualties, also causing the destruction of homes, businesses, and critical infrastructure. In this section we display the results of our study, presenting how different audiences behaved on Twitter, and testing our user roles taxonomy across crisis and post-crisis phases.

Social media, and specially the microblogging platform *Twitter*, were extensively used during the floods. As shown by Fig. 2, tweets began arriving from the beginning of heavy rains, during the evening of October 9, starting at 6:58 pm (537 tweets). But the most important peak of activity occurred that night and during October 10 (18,444 tweets). This process happened at the same time that the torrent overflow took place, and with the first initial recovery hours, quickly becoming a trending topic in Spain. Although during October 11 the number of new tweets was still high (9365), a progressive decline in activity began to occur. Both mentions but specially retweets appeared to be very high across all days. Replies, however, were quite low (322 throughout the crisis). Data show that *Twitter* was widely used for dissemination of information. Finally, the majority of users joined the

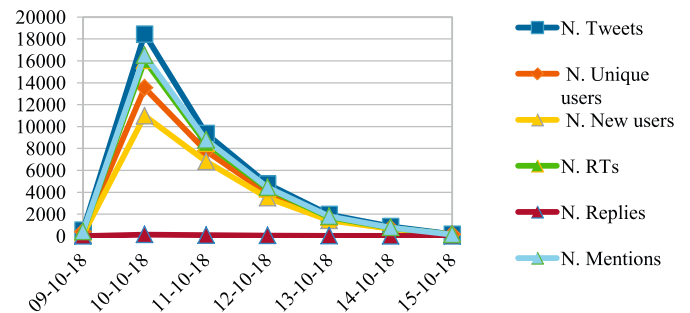


Fig. 2. Aggregated data for the #SantLlorenç hashtag.

hashtag during October 10 (10,983 new users) and October 11 (6814 new users).

4.1. User roles during crisis phase

The thunderstorm began to wreak havoc with important floods starting somehow between 6:30 pm and 7:00 pm. First images about what was happening in Sant Llorenç started to arrive at 6:58 pm via *Twitter*. In the following hours, a network based on propagation was generated. Fig. 3 shows the main communities that emerged during crisis phase and how messages were disseminated by using the retweet mechanism. At the bottom of the graph, two of the main communities were mainly sustained by the participation of two citizens. Citizen 1 made a call for searching a missing person, demanding wide diffusion:

"(citizen name) has disappeared due to the floods of #SantLlorenç. Please, we need help to find him. It was near son Vives (located next to the village of Sant Llorenç), his van is there but he is not. Many thanks".

Although this user had very few followers (130), Citizen 1 tweet was able to reach a great audience (975 retweets). Citizen 2 tweeted photos about some missing or rescued animals, getting a massive number of retweets (1200 retweets), also despite this user's low number of followers (333). During the first hours of the tragedy *Twitter* especially favored rescue calls coordinated by a citizen-to-citizen approach. The number of followers was not an important factor, and these citizens were able to reach higher retransmission thanks to the joint action of *retweeters* and *common users*. Thus, Citizen 1 and Citizen 2 were classified by the algorithm as *high speakers*.

Regarding to actors under the label *authorities*, the propagation essentially favored messages from three sources. The most retweeted node was the *National Police* of Spain (@policia, Authority 1 in our graph), with several tweets focused on informing about ongoing operations, but also with tweets aimed at offline collaboration with citizens, such as:

"Activated a special telephone number to attend all the people who need

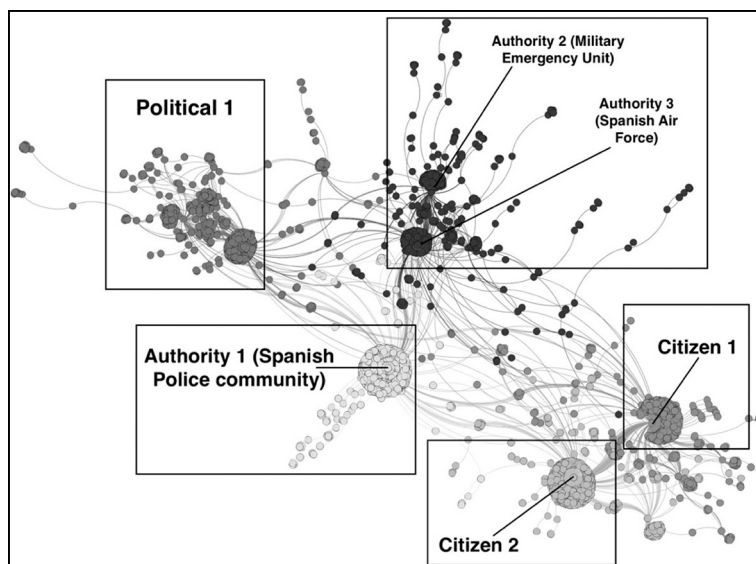


Fig. 3. Message propagation network for #SantLlorenc showing the main communities during crisis response phase (by received retweets).

help or want to provide information about flood-related incidents. 900,600,112. #Mallorca # SantLlorenc <https://t.co/jPcMPs1RSh> (975 retweets).

Other widespread authorities were the Military Emergency Unit (@umegob, Authority 2), and the Spanish Air Force (@ejercitoaire, Authority 3), which posted information about the deployment of initial response operations. These users were classified as *high speakers* and *medium speakers* respectively, and they greatly benefited from retweets of their own followers' community. Finally, the early appearance of political accounts (Political 1 in graph) was also enhanced by pre-established communities focused on sharing supportive messages of a certain political party. The interactions between all these communities (authorities, citizens, political...) were not high, but neither scarce, which indicates that it is probable that some *retweeters* simultaneously helped in the diffusion of different relevant actors.

Table 3 suggests the most frequent behaviors in relation to Twitter functionalities. As we expected, the predominant role was the “*common user*”. These users helped, together with *retweeters*, to increase the spread of messages broadcasted by authorities and affected citizens thanks to their large numbers. Looking at the roles that performed concrete behaviors, the most prominent was *retweeters* (18,5%, 1875 users). This reinforces the idea that the most widespread behavior was contributing to the dissemination of messages. As we have previously advanced, many of these retweets were intended to support the dissemination of calls to offline actions and information about ongoing operations. Although very few *networkers* appeared in the conversation, *retweeters* favored the development of a high group of *speakers*. The

presence of *low speakers* was high (279; 2.7%). However, *medium speakers* and *high speakers*, that is, users with the highest diffusion rates, were relatively scarce. As long as we found no *isolateds*, we may confirm that the majority of people involved in the conversation contributed to the process of message propagation, at least to some extent. As we anticipated, very few users showed concrete behaviors towards bi-directional conversation (39 *replicators*, 0.38%) during this initial phase. Finally, it was remarkable the absence of users who posted automated messages, which also implied that the probability of having bots in the conversation was quite low.

With respect to the propensity of different actors towards certain user-roles, we found some interesting patterns. Table 4 shows crosstabs between user-roles and types of users during crisis response. As it is shown by chi square (606.0344, Pr = 0.000), differences are sufficiently big to conclude that these two variables are significantly related to each other. In general terms, some type of actors exhibited clear propensity to represent certain roles. On the one hand, authorities were more propense to be *speakers* than any other actor, especially if their functions are related to emergency management or weather agencies (59.09% of propensity towards being *low speaker*, 9.09% for being *medium speaker* and 4.55% for being *high speaker*). This makes sense, as they are usually direct sources of critical information during the response phase. On the other hand, citizens were the actors most likely to be *retweeters* (92.44% and 78.26% if they have an interest in weather or digital emergency volunteering), followed by political actors (66.50%), news media (59.70%), NGOs related to emergency volunteering (57.14%) and certain companies (50%). *Retweeters* seem to be an extremely heterogeneous group, reflecting the importance that sharing mechanisms have in these situations.

For the rest of the roles, propensities were much lower. Along with certain authorities, citizens were the only type of actor capable of being broadly broadcasted (reaching *high speaker* rates), but in a considerably low percentage (0.13%). The propensities to play the role of *networker* were also extremely low and corresponded almost exclusively to news media (with a very small 3.73%). *Monologists* were also scarce, being citizens interested in emergency volunteering the most likely towards performing this role (6.52%). Finally, *replicators* were also low in numbers, being the most propense authorities specialized in emergency management or weather agencies (4.55%) and citizens keen on digital volunteering (4.35%), although it is clear that these actors have shown a greater propensity for other roles. In conclusion, we should be careful with these interpretations due to the disparities in the number of cases between the different types of actors.

Table 3
User roles during crisis response phase.

Role	N	%
Speaker (high)	3	0.03
Speaker (medium)	18	0.18
Speaker (low)	279	2.75
Networker	6	0.06
Monologist	27	0.27
Retweeter	1875	18.50
Replicator	39	0.38
Isolated	0	0.00
Automatic	0	0.00
Common user	7886	77.82
Total	10,133	100.00

Table 4
Propensity of different type of users for specific Twitter roles during crisis response (%).

	Authorities (general)	Authorities (emergency/ weather agency)	NGOs (general)	NGOs (emergency/ weather related)	Citizen (general)	Citizen (emergency/ weather interested)	Political	News media	Company
Speaker (high)	0.00	4.55	0.00	0.00	0.13	0.00	0.00	0.00	0.00
Speaker (medium)	6.90	9.09	2.17	0.00	0.19	0.00	3.05	2.99	0.00
Speaker (low)	58.62	59.09	54.35	42.86	4.78	10.87	29.95	28.36	50.00
Networker	0.00	0.00	0.00	0.00	0.06	0.00	0.00	3.73	0.00
Monologist	0.00	0.00	2.17	0.00	0.71	6.52	0.00	3.73	0.00
Retweeter	31.03	22.73	39.13	57.14	92.44	78.26	66.50	59.70	50.00
Replicator	3.45	4.55	2.17	0.00	1.68	4.35	0.51	1.49	0.00
Total (percent)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
(N)	29	22	46	35	1547	46	197	134	24

Pearson $\chi^2(48) = 606.0344$ Pr = 0.000

4.2. User roles during post-crisis

Once the flood decreased in intensity and the AEMET withdrew the weather alert, it was time to begin to slowly get back to normal. During the post-crisis phase, the most active users changed completely, in addition to the type of messages they posted. Initial recovery was full of

emotional and supportive messages, and the highest propagation ratios corresponded to messages from popular individuals. As shown in Fig. 4, celebrities such as @marcmarquez93 (motorcycling pilot, Citizen 3) got the most attention and retweets:

“A big example @RafaelNadal helping those affected by flash floods in Mallorca. All my encouragement and strength to the affected families.

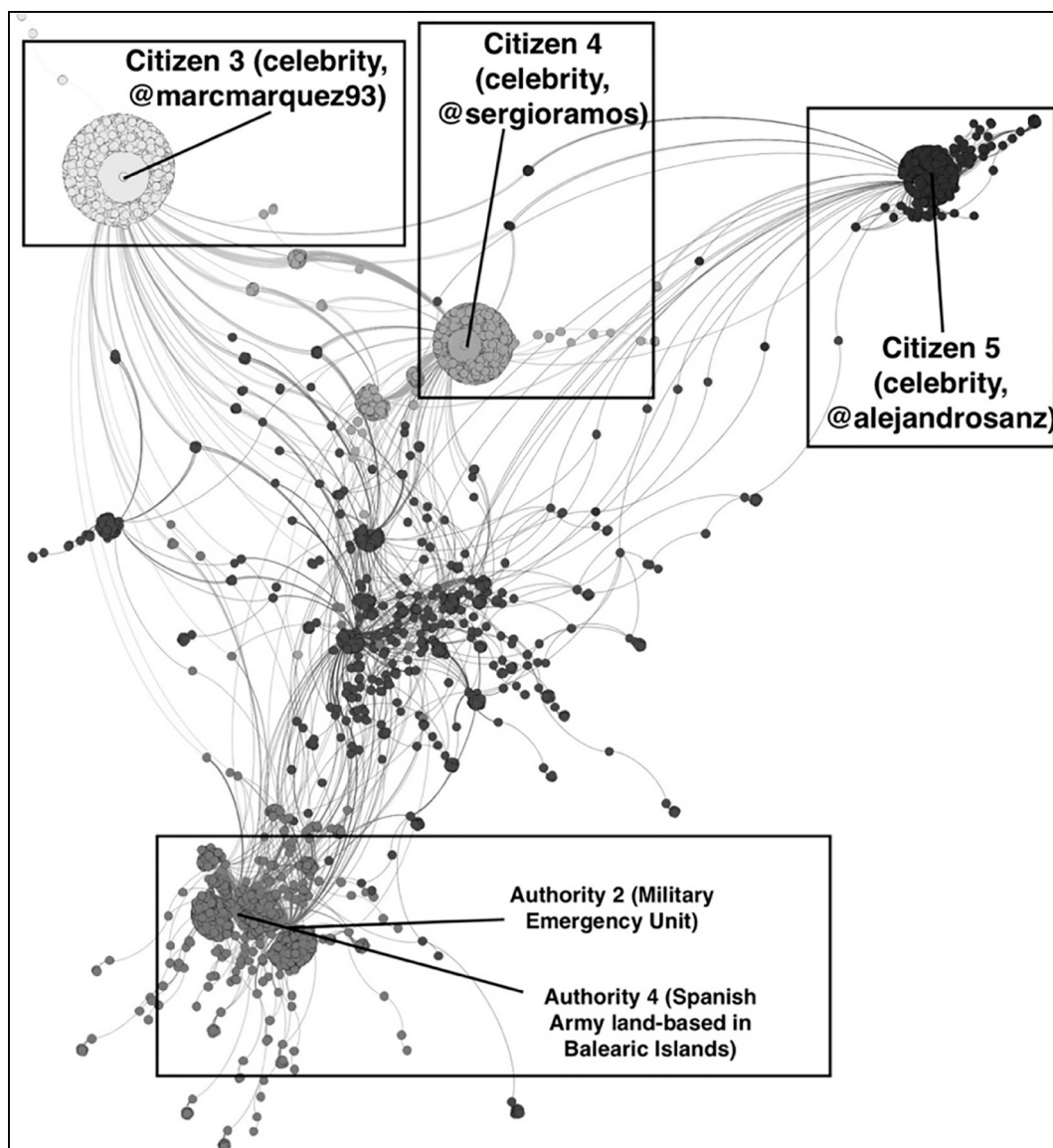


Fig. 4. Message propagation network for #SantLlorenç showing the main communities during post-crisis phase (by received retweets).

#SantLlorenc #Mallorca <https://twitter.com/marcmarquez93/status/1050104388151336960>".

Also, @sergioramos (footballer, Citizen 4) or @alejandrosanz (singer, Citizen 5) took part of the conversation during this post-crisis stage. This implied a change in audiences, turning the focus on giving voice (as *high speakers* or *medium speakers*) to actors less directly related to the tragedy, and with large communities of followers that, probably, were not directly affected by the situation.

Addressing the role of authorities, they had presence as *high* or *medium speakers*, some already seen in the response phase, and new ones directly involved in rescue operations and recovery tasks. For instance, the Military Emergency Unit (@umegob, Authority 2), previously seen as a *speaker* during crisis response, continued to sought diffusion on messages that portrayed search operations for a missing child:

"#SantLlorenc In zone, 54 soldiers from #UME and 12 from @COMGEBAL_ET with engineering machines. Tomorrow we will continue collaborating in search of the little children, tracking every possible place, investigating every hint, removing mud and obstacles. Good night <https://t.co/tA4L3gOLUP>".

On the other hand, the regional account for Balearic Islands of the Spanish Army land-based branch (@COMGEBAL_ET, Authority 4), posted emotional messages and information about ongoing operations. It seems that the search for diffusion was carried out with the objective of making citizens know that emergency agencies were still working hard in the recovery process.

Regarding to specific user roles (Table 5), similar patterns occurred to those seen in the response phase. A critical mass of actors was responsible for message propagation (2442 *retweeters*, 15.24%). Then, the diffusion was not towards calls for action, but rather to strengthen the reach of emotional and supportive messages from celebrities or to spread information about on-going operations. This action was also probably enhanced by the presence of large numbers of *common users*. However, on this occasion, they were accompanying celebrities. The *speaker* role maintained similar levels in comparison to the response phase. A similar behavior happened with *networkers*, as these actors again displayed low levels (7; 0.04%). The presence of the *replicator* role was somewhat higher than in the response phase, but still quite limited (77 *replicators*, 0.48%). Finally, as it was the case for the response phase, no presence of *isolateds* or users with signs of message automatization were detected.

Addressing the propensity of certain actors towards different user roles (Table 6), we found some variations regarding to the response phase. Again, differences were sufficiently compelling to conclude that these two variables are significantly related (chi square 827.7894 Pr = 0.000). Authorities specialized in emergency management reinforced their position as *speakers* (61.11% as *low speakers*, 11.11% as *medium speakers* and 5.56% as *high speakers*). The other type of actor reaching the *high speaker* role were the citizens (0.09%), mostly

Table 5
User roles during post-crisis phase.

Role	N	%
Speaker (high)	3	0.02
Speaker (medium)	10	0.06
Speaker (low)	308	1.92
Networker	7	0.04
Monologist	25	0.16
Retweeter	2442	15.24
Replicator	77	0.48
Isolated	0	0.00
Automatic	0	0.00
Common user	13,152	82.08
Total	16,024	100.00

celebrities, although as the percentage denotes, they were few. Non-emergency related ONGs managed to get higher propagation rates as low speakers (68.75%) than during the response phase. In terms of *retweeters*, they continued to display a preponderant and very heterogeneous role. Unlike crisis response, non-emergency related authorities were more propense towards performing this role (50%). NGOs related to emergency volunteering or weather associations (60.61%) incremented their propensity towards being *retweeters* during the post-crisis phase. As with crisis response phase, citizens (91.53%), citizens interested in emergency management (80.65%), political accounts (64.71%) and news media (59.60%) were mainly classified as *retweeters*.

Other differences could be identified regarding to the response phase. Non-emergency related authorities reduced their message propagation capacity, and they were not able to position themselves, at least, as *medium speakers*. In terms of *networkers*, news media continued to be the most propense actor to perform this role (3.31%), followed by citizens interested in emergency volunteering and weather amateurs (1.61%), but as during response phase percentages were very low. Unlike with the response phase, citizens interested in emergency volunteering or weather amateurs were not the most propense role towards becoming *monologists* (3.23%), and they shared similar percentages with news media (3.31%) and emergency related NGOs (3.03%). These percentages were also very low. Finally, during post-crisis, bi-directional interaction from *replicators* was even more scarce. Unlike crisis response, authorities showed no propensity towards becoming *replicators*. The type of actor more oriented to become *replicator* was the citizens (3.12%). As during the response phase, we should be cautious interpreting these percentages addressing the differences in the total number of cases.

5. Discussion

This section depicts some lessons and discuss our results with the aim of presenting a more unique approach towards Twitter user roles during emergency situations. We discuss this proposal taking into account possible transitions between crisis response and post-crisis stages and the different types of actors. This part of the article argues how these categories contributes to existent communication and emergency response theories. Finally, we advance practical implications for public sector practitioners and emergency management.

5.1. Advancing a typology for communication roles in Twitter during crises management

Our Table 7 summarizes our contribution, from the original taxonomy, based on the analysis of our data and the results of this article. Data from our case study suggested putting our attention in who has the voice. In the previous role taxonomy (Congosto, 2018), *speakers* and *networkers* displayed the roles performed by the most widely spread users. However, our case shows that additional distinctions should be made depending on how voice is achieved. Despite having a very small community of followers, some citizens (such as Citizen 1) gained greater dissemination during crisis response phase because their messages were perceived as critical and important to share. However, other actors played the role of *speakers* mostly having a large pre-established community of followers (i.e. celebrities Citizens 3, 4 and 5 during the post-crisis stage). In consequence, we argue that it is important to distinguish between two different types of voices that we have labelled as the "voice of the crisis" role and the "outsider voice" role.

The *voice of the crisis* role represents those Twitter users being massively retweeted because they have something critical to say about the tragedy. For this role, previous followers' community is not a key aspect to gain successful diffusion. During crisis response, some citizens that were massively retweeted could be considered as *voices of the crisis* (Citizen 1 and 2), as they were directly affected by the tragedy and

Table 6
Propensity of different type of users for specific Twitter roles during post-crisis (%).

	Authorities (general)	Authorities (emergency/weather agency)	NGOs (general)	NGOs (emergency/weather related)	Citizen (general)	Citizen (emergency/weather interested)	Political	News media	Company
Speaker (high)	0.00	5.56	0.00	0.00	0.09	0.00	0.00	0.00	0.00
Speaker (medium)	0.00	11.11	0.00	0.00	0.23	0.00	0.74	1.32	0.00
Speaker (low)	50.00	61.11	68.75	36.36	4.47	12.90	32.35	30.46	45.00
Networker	0.00	0.00	0.00	0.00	0.05	1.61	0.00	3.31	0.00
Monologist	0.00	0.00	1.25	3.03	0.51	3.23	0.74	3.31	0.00
Retweeter	50.00	22.22	30.00	60.61	91.53	80.65	64.71	59.60	55.00
Replicator	0.00	0.00	0.00	0.00	3.12	1.61	1.47	1.99	0.00
Total (percent)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
(N)	26	18	80	33	2148	62	136	151	20

Pearson chi2(48) = 827.7894 Pr = 0.000.

provided information or requested for help. Some emergency-related authorities (including Authority 1 and 2) should also be considered as *voices of the crisis*, as they reached high diffusion by posting information on initial operations. In this case, these authorities benefited from their pre-established communities. During post-crisis phase, affected citizens disappeared as main voices, while authorities, news media and some NGOs continued to be widely spread. In the case of news media, the ability to be widely spread because of the type of information they were sharing (i.e. updated situational information about ongoing operations and weather information) was accompanied by the potential of this type of actors to increase the visibility of the authorities using retweets (Chatfield et al., 2013; Chatfield & Reddick, 2018; Lin et al., 2016; Wukich et al., 2019).

On the other side, we name *outsider voice* the role performed by those users being massively retweeted despite not posting critical information about the crisis. During the crisis response phase, this role was not prominent among the main speakers. This was epitomized by politicians (i.e. Political 1), who posted emotional support messages that were widely retweeted. They became external voices to the crisis, thanks to their large pre-existing communities. During the post-crisis phase, celebrities (such as Citizen 3, 4 and 5) became relevant to the conversation. From footballers to singers or social media influencers, they gave support and expressed their feelings about what happened. These accounts were widely retweeted by their pre-established fan-base which, in many cases, were also outsiders to the tragedy. In fact, at this point it should be noted that an excessive proliferation of outsider voices could somehow have distorted the conversation (Highfield et al., 2013), ultimately hiding critical information. For example, the fact that the post-crisis is filled with celebrity messages with great impact can make these messages appear earlier in the queue of Twitter featured content, leaving behind critical information about the crisis. And, therefore, withdrawing visibility from the *voices of the crisis*.

Our approach depicts implications for theories on communication and crisis coordination. For example, the four-channel model (Pechta et al., 2010; Sellnow & Seeger, 2013) seeks to characterize the communication channels and explore the role of various “publics” (Sellnow & Seeger, 2013). By applying our distinctions in terms of voices, it could be easier to found from affected citizens to “citizen journalism” practices and try to make the most of them. On the other hand, related theories to the network coordination perspective (Tierney & Trainor, 2003) have based their arguments on declaring the importance of integrating emergent groups efficiently in flexible structures in order to coordinate crisis responses. Better coordination will happen if authorities have more information about what actors have been giving voice, as a means to guide the effective detection of citizen needs, and even foresee circumstances in which the information might be obscured by the excess of outsiders' voices.

The third role, the *monologist*, has remained similar to what we expected in the conceptual framework. During crisis phase, *monologists* were usually emergency-interested citizens and local news media, and

during post-crisis, also certain NGOs. Despite having some relevant content, *monologists* have not managed to gain enough retweets to become *voices of the crisis*. A typical example of a *monologist* has been the citizen posting first person images about the floods that are not widely disseminated despite the interest of the content. During post-crisis, this functional behavior is slightly modified and focuses on message repetition to draw attention (Reuter et al., 2013). These messages are usually very simple in terms of content and form, often without images or links, and repeat the same (for example, a user that constantly posts messages stating that the cleaning work of a street has not yet started). During the post-crisis, they sometimes retweet content from the *voices of the crisis*.

The study of the category *retweeters* in our case study revealed the need to make some additional adjustments in previous approaches. As with the category *speakers*, it is necessary to understand the retweeting behavior regarding to how and to whom they retweet. We have distinguished between *digital volunteers* and *unconditional sharers*. On the one hand, *digital volunteers* are *retweeters* focused on constantly disseminating information broadcasted by *voices of the crisis*. This behavior remains stable throughout all phases of the crisis, although the dominance of some actors to become digital volunteers' changes. Here, NGOs (emergency related) and authorities (non-emergency related) seem to be more prone to perform this role during the post-crisis stage. *Digital volunteers* are one of the main engines of content dissemination. They will constantly share information from trusted sources that they consider to be critical and relevant. They are probably linked to the co-production of communication during emergencies using retweets that other authors identified in the scholarly literature (Chatfield et al., 2013; Chatfield & Reddick, 2018).

On the other hand, we have the *unconditional sharer* role. As the name denotes, *unconditional shares* are willing to retweet content regardless the type of information. This is so because they express some kind of loyalty to a certain account or group of accounts. And they will usually retweet everything from these account or accounts without any prior verification. During crisis response, the effect of *unconditional sharers* could be harmless and even beneficial, as they are usually part of authorities' communities. And, thus, they will favor the spread of time critical information. However, during post-crisis phases, *unconditional sharers* could be part of big fan-bases, or part of the community of a user who, at a certain moment, could posts non-verified information, contributing to the spread of misinformation and fake news (Reuter et al., 2017; Wukich, 2016).

These two functional behaviors could be important for future developments of theories on communication and crisis coordination, such as the four-channel model. To the extent that *digital volunteers* can be properly coordinated, the success of a message reaching the right audiences during this situation should be greater. However, it should be noted that most of these actions appear spontaneously and are somehow unpredictable (Chatfield et al., 2013; Lin et al., 2016). On the other hand, it exists a threat that the number of *unconditional sharers*

Table 7
A typology for communication roles in Twitter during crises management.

Role during emergency	Overriding type of actor		Overriding interactions	
	Based on	Crisis response	Post-crisis	Crisis response
Voice of the crisis	Speakers, Networkers	Affected citizens, authorities (emergency related), news media, NGOs	Authorities (emergency related), news media, NGOs	Posts widely shared messages on situational information and calls for action
Outsider voice	Speakers	Political accounts	Celebrities, political accounts	Posts widely shared noncritical information
Monologist	Monologists	Citizens (emergency interested), news media	Citizens (emergency interested), news media, NGOs (emergency related)	Repeats information without getting much attention
Digital Volunteer	Retweeters	Citizens, political accounts, news media, companies	Citizens, political accounts, news media, companies, NGOs (emergency related), authorities (non-emergency related)	Sends constant retweets to voices of the crisis (co-production strategy)
Unconditional sharer	Retweeters	Citizens, NGOs (emergency related)	Citizens, authorities (non-emergency related), NGOs (emergency related)	Sends constant retweets to concrete accounts regardless of what they post (but it could be non-critical information)
Replicator	Replicators	Authorities, citizens (emergency interested)	Citizens	Sends many replies to clarify crisis management accountability
Isolated	Isolateds	Citizens (non-emergency related)	Citizens (non-emergency related)	Never retweets official or non-official crisis information
Automatic	Automatics	Citizen	Citizen	Posts crisis information (real or fake) in an automatic way
Lurker	Common users	Citizen	Citizen (non-emergency related)	Gives only one retweet to an outsider voice

linked to fan-based communities in unofficial accounts is greater than that those of official authorities' accounts during certain moments of the crisis (for example, during initial recovery), which could jeopardize the visibility of certain content, or make unreliable, contradictory and even inaccurate content more visible.

Our findings about *replicators*, *isolateds* and *automatics* have confirmed previous approaches to the same topic. In the first case (*replicators*), their activity has been scarce during crisis response and post-crisis and we can highlight some differences in terms of the type of actor most prone to perform this role (authorities and emergency-interested citizens during pre-crisis, and citizens of all kind during post-crisis). Also, we have identified a tendency towards messages clarification during crisis response and seeking accountability during the post-crisis. In the second case (*isolateds*), it is not possible to give more details since this role was not found during the case study. Finally, the lack of content published using automation mechanisms (*automatics*) signals that one of the potential vectors for outdated news or misinformation was not present during the flash floods crisis. However, given the rise of this type of posting content in political campaigns or other political events, it will be interesting to continue researching for it in future studies about crisis management in government social media. Particularly, as recent events are showing (i.e. COVID-19 crisis) (Chen et al., 2020) the existence of automating posting and bots could become socially harmful and divert the effort of authorities exploring how to deliver official information about a particular situation of crisis.

Last but not least, we have renamed the category *common user* as the “*lurker*” role, based on our SNA findings. A *lurker* is a user not directly related to the crisis as an affected actor or someone interested in it. A *lurker* is a Twitter user that, at a certain point, receives a tweet regarding the crisis on his/her Twitter timeline and decides to retweet once. This individual action has no instant effect and it is difficult to detect as a functional behavior, as unlike *digital volunteers* or *unconditional sharers*, *lurkers* are not constantly retweeting. However, the true power of a *lurker* lies in the effects of that retweet added in large numbers around specific actors (González-Bailón et al., 2013). During the crisis response phase, we found *lurkers* to positively affect the sharing potential of certain voices of the crisis, complementing the action of *digital volunteers*. However, during post-crisis, a large number of these *lurkers* became part of fan-based celebrities' communities (*outsider voice*), strengthening the capacity to disseminate their content.

5.2. Practical implications for public managers

Our findings show that profiling user role taxonomies might provide added value to public managers improving their capacities during emergency management. First, expanding the knowledge about how users behave regarding to platform mechanisms could help practitioners to communicate in social media with different groups of actors during the consecutive stages of an emergency situation, and to manage the transition among them. For instance, during crisis phases they could be able of detecting and handling help requests by monitoring conversations from incoming *monologists* accounts of concerned citizens, directly responding to their complaints, suggestions, and calls for action. This aspect will provide authorities some advantages facing threats and help protecting affected citizens more quickly, as they will be ready to discover messages that using traditional management patterns would not receive attention.

Using and automating the typology presented in this article, authorities and public managers could be better equipped to understand the transition among different stages of the crisis and prepare accordingly. For example, they may be ready for a probable increase in the number of *unconditional sharers* during the post-crisis phase and try to incentivize or discourage certain dissemination practices to facilitate the visibility of critical messages. In the same way, they can be prepared to detect *voices of the crisis* belonging to affected citizens and quickly support their initiatives or collect relevant information on actors

directly affected by the extreme event.

Our user role taxonomy could also be helpful for authorities to increase their efficiency in terms of coordination. Our classification allows managers to better detect and leverage key citizen to citizen and citizen to authorities' initiatives, as well as to improve coordination of information flows with other authorities and news media. This will occur if practitioners implement the idea of "authority/power dissemination", at their disposal during a critical event. Thus, this will facilitate to forge a temporary disaster response community based on *voices of the crisis*, while regularly managing who and what type of information is constantly retransmitted.

Besides, we argue that this taxonomy could help authorities to identify promoters of fake news. While having a monitorization over *unconditional sharers and lurkers* and the directionality of information flows, it could be possible to quickly detect false rumors and misinformation. Early detection of *automatics* could also give practitioners information about possible outdated data sources or misinformation channelers. Within a more reactive strategy, also it should be possible to establish a control over *voice of the crisis* and *outsider voices* to verify the truthfulness of highly promoted content.

Finally, if authorities develop better understanding of how audiences behave, they would be able to influence users' behavior in self-desired directions. Following Baldwin et al. (2012), it is possible to change citizens' behavior from individualist positions to collaborative and proactive participation through five phases. This user role taxonomy could have positive impacts during emergency situations on *detection* and *evaluation* phases, as getting information of how actors are behaving is crucial to the response strategy. For example, if authorities find out that the amount of *isolateds* is growing during a phase of the crisis, they could react stimulating the mood for retweeting with direction to official and trusted sources.

6. Conclusions

This article has addressed audience's configuration during emergency situations. Our work has proposed to systematize these behaviors as "user roles", that is, as a set of different attitudes/behaviors and actions that users can take in relation to specific social media platform mechanisms or user characteristics. Our study has reinterpreted a social networking user role taxonomy (Congosto, 2018), using social media and emergency management literature. Empirically, we have tested this framework studying how multiple actors behaved in *Twitter* during the 2018 flash floods in Sant Llorenç des Cardassar (Majorca, Spain) across crisis response and post-crisis phases. Results confirm variations related to directionality between functional roles depending on the stage of the crisis, as well as on the type of user. Besides, this article has raised valuable contributions for crisis development and crisis coordination models, that we have conceptualized as a distinctive approach towards *Twitter* functional behaviors during crisis in the discussion section.

Also, this study has some limitations. One of the constraints is that it has been applied to a specific platform (*Twitter*). Despite this work has been implemented during a particular extreme event and geographical context, this might not affect the potential generalization of the taxonomy to other types of crisis. Nonetheless, to expand our comprehension about how user role taxonomies could be applied to emergency management using social media, it might be important in future studies to gather qualitative data coming from personal interviews with practitioners. Besides, we have supported our study on data collected from a hashtag, and this might imply overlooking some activity about this crisis not included in #SantLlorenç tag. Finally, we have crosstab type of actors' propensity to play certain user roles. Nonetheless, this inclination could also had been affected by other aspects regarding organizational and institutional characteristics of authorities or contextual socio-demographic variables (Criado, Rojas-Martín, & Gil-García, 2017).

Future studies are needed to foster the application of user role

taxonomies to social media, in general, and emergency management, in particular. The main contribution of this article was defining a unique taxonomy able to study audiences' configurations during emergency situations. It is important that future research continues applying the taxonomy in different contexts, from routine to critical management, in order to make additional adjustments to this categorization. Therefore, this will increase our ability to address the behavior of audiences and generalize results of research in different contexts and situations.

Acknowledgements

This study was supported by the Research Grant RTI2018-095344-A-I00 (SmartGov_Local), Spanish Ministry of Science and Innovation.

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