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Communication-related vulnerability to disasters: A heuristic framework

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ABSTRACT

The concept of social vulnerability has been increasingly applied in disaster literature, but its communicative drivers have remained understudied. In this article, we put forward a heuristic framework for explaining how communication-related factors may adversely affect people's capacity to prepare for and respond to disasters. This will help researchers, policy makers, and practitioners in the field of disasters and crises to systematically identify individual, social-structural, and situational factors of vulnerability that shape how people access, understand, and act upon information about hazards. We integrate ideas from recent literature on information disorders – various forms and effects of false or harmful information that are characteristic to modern communication ecosystems – to improve our understanding of how the new media environments may transform the ways people learn about hazards and cope with disasters.

1. Introduction

'Vulnerability' is one of the key concepts explored in disaster literature [1–3] and it generally refers to the proneness of people to experience adverse effects due to the impact of hazards. While vulnerability has been historically grasped at the United Nations level as a characteristic of countries, regions, or buildings (e.g., [4]), more recently the focus has shifted to societies and individuals [5–7]. The understanding of the factors that create or increase vulnerability has broadened: these include not only exposure (e.g., people are more likely to be exposed to earthquakes in seismically active areas of Chile, Japan, Italy) and susceptibility (e.g., aging houses, roads and machines are more prone to accidents) but also coping capacities and therefore social structures as well as disadvantages of individual living situations (e.g., poor people may lack resources to respond appropriately to a hazard).

Social vulnerability research has traditionally focused on identifying and mapping certain high-risk groups, such as children, elderly, homeless, and people with acute medical conditions and chronic diseases [8,9]. Recent literature, however, suggests that vulnerability should be studied as a dynamic characteristic, since it is the result of the interactions between individual, social-structural, and situational factors that may change over time [10,11]. This promotes the idea that vulnerability is not something that we are born with or that is uniformly attached to certain social groups (such as, for instance, persons with disabilities or elderly) but depends on and may vary due to the interrelations between individual and contextual factors (e.g., [12]). In other words, anyone is vulnerable under certain circumstances and in certain situations. Thus, to call an individual 'vulnerable' should be understood as a description of a current status, in relation to context, which might be improved by changing particular factors. Communication is one of the key factors that can either increase or decrease people's vulnerability to disasters. In this article, we intend to systematically unpack communication-related drivers of vulnerability.

Methodologically, the framework we develop is based on a scoping study. A scoping study is the recommended strategy when a greater conceptual clarity in a specific field of evidence is aimed at [13,14]. As is characteristic to scoping studies, we identified and analysed a wide range of academic literature from communication and disaster studies available from Web of Science, Scopus, and Google Scholar databases as well as documents by government agencies and international organisations (United Nations and European Commission). When searching for articles and documents, we used keywords 'disaster', 'social vulnerability', 'information behaviour', 'social media', 'misinformation', 'disinformation', and 'false information'. In addition, we reviewed a

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variety of disaster cases (ranging from terrorist attacks to long-term power cuts) represented in reports by international organisations, government institutions, NGOs, news media and think tanks from across the world. We specifically focused on materials that addressed at least one of the following questions: How do vulnerable people communicate prior, during and after a disaster? What types of information and ways of communicating have helped people cope with disasters? Who have suffered or become more vulnerable due to communication-related problems or due to being exposed to false information?

The article proceeds as follows. In Section 2, we discuss what communication-related vulnerability to disasters may involve and where it may occur. In Sections 3–5, we bring specific examples from disaster literature to illustrate how people may become vulnerable in the stages of accessing, processing, and reacting upon information about risk and disasters. And in Section 6, we put forward a framework for mapping out the communication-related drivers of vulnerability in terms of certain conditions in which people send, receive, and respond to information about hazards, and which can be shaped by the interaction of three types of factors: individual (e.g., various impairments, limited language skills), social-structural (e.g., inadequate official preparedness measures), and situational (e.g. breakdown of communication channels).

2. Communication and disaster vulnerability

'Communication' can be conceptualised and theorised in various sophisticated and competing ways [15], but most commonly the term is used to refer to processes of sending and receiving messages/information and processes of producing and reproducing meanings. For pragmatic purposes, communication processes can be divided into elements such as *senders/sources* (e.g., callers who contact local emergency services for assistance; emergency managers who send warnings), *messages* (e.g., the content of the warning: information in the form of text, talk, sound, images, etc.), *channels* (e.g., television, phone, warning siren), *recipients* (e.g., particular individuals or groups who receive information about an emergency), and *effects* (e.g., changes in recipient's behaviour as a consequence of the communication). Communication involves the use of symbolic resources (signs, language) and comes with the omnipresent danger of miscommunication/misunderstanding. Communication reflects personality (beliefs, emotions) and is constitutive of societies, cultures, and identities. Communication as human interaction is intertwined with various uses of communication technology and communication formats while people and institutions have become increasingly dependent on media [16,17].

For crisis and disaster managers, communication is primarily a management tool that serves various functions and purposes [18,19], such as awareness raising about risks and encouraging protective behaviour among people in preparation to hazardous events (i.e., risk communication), and giving warnings and triggering particular behavioural responses by people at risk during hazardous events (i.e., crisis communication). For those affected by a particular disaster, communication essentially involves meaning making [20]. It covers gathering information of the hazard (i.e., knowledge, facts, news), that helps to make sense of the situation, and potentially to take steps to minimise the impact of the hazard. These steps can involve, for instance, evacuating themselves from a flooded area as well as sharing official evacuation messages on social media so that their followers know how to evacuate, too.

In this article, we treat communication in its various guises as one of the variables that affects people's vulnerability to disasters, be it positively or negatively. In our view, individual and group vulnerabilities in crises may stem from a variety of communication-related factors. People may encounter challenges in sending, receiving or understanding information about hazards and, as a result, cannot take appropriate action to protect themselves or others. For instance, people may:

- not be able to request assistance due to missing or unreliable communication technology (e.g., no emergency calls can be made when terrestrial/mobile networks are disrupted),
- not receive any warning or guidance messages regarding a hazard because these messages were not sent via a channel they (are able to) use (e.g., when only acoustic evacuation signals are employed then deaf people are excluded),
- not understand received information (e.g., because it is presented in a foreign language, or in an unclear manner),
- receive too much or conflicting information and hence are not able to decide what is important, or what is accurate or not,
- believe in false information about hazards or crises,
- regard correct information about hazards as false (e.g., because they believe the sender is untrustworthy).

Some forms of communicative *in*action by people may increase their own vulnerability or that of others affected by a disaster; for example, if they do not share information that would help in rescue or recovery, not ask for help during a crisis, or not seek social support via communication during post-crisis recovery. Moreover, having access to information about hazards and understanding the related risks may not automatically lead to appropriate protective action: people may lack necessary resources to act (e.g., money to buy or rent property in a safer area), or do not want to act because they do not trust the source(s) of crisis information.

Individuals and groups may engage in communicative behaviour as senders/sharers of messages that may increase vulnerability of others by confusing or misleading them, such as sharing false information that one believes to be true (misinformation) or sharing false information on purpose (disinformation). These problems should be interpreted in the context of what has been recently called 'information disorder': a global information pollution that includes unprecedentedly fast, cheap, and widespread creation, dissemination, amplification, and consumption of various forms of false and/or harmful information [21].

Intentional or unintentional false or misleading claims, malicious disinformation, rumours, pranks, and outdated information that people may be exposed to in relation to disasters can put them or others at increased risk and/or complicate the work of emergency management institutions. For people (potentially) affected by a hazard, it may be difficult to assess the accuracy of each piece of information that they receive, or what may have been the intentions of its creator or sender. There is a heightened need for fact-checking, social sense-making, and sharing of stories and images about possible hazards and disaster events. False information may adversely affect people outside the spatial or temporal confines of a disaster event. And while the increasing use of social media has created new avenues for building disaster resilience (e.g., emergence of support networks online), it has also amplified some vulnerabilities (e.g., possible online harassment of disadvantaged groups in times of crises).

Our literature review indicates that communication-related vulnerability to disasters can be understood as occurring in one or more of the following three consecutive stages:

1. People may become vulnerable when they have no or limited access to sources of information and to other people. When their capacity to send and/or receive messages (either face-to-face or mediated via some channel of communication) is somehow hampered, it would make it difficult or even impossible for them to request assistance when in danger or to be alerted about an imminent hazard.
2. Even if people can seamlessly send and receive messages, they may become vulnerable if there are difficulties with understanding the content of the messages and assessing their reliability. This may happen, for instance, when information is presented in a way that is not tailored to the needs of particular groups (e.g., tourists may not understand warning messages in the local language) or due to being exposed to false or contradicting pieces of information.

3. People may become vulnerable if they cannot react adequately to crisis information. For instance, people may stay put after receiving an official evacuation message because they cannot evacuate due to some physical impairment, they do not possess necessary resources, do not want to leave their property or livestock behind, or because they are not willing to comply with the orders of authorities who they regard as untrustworthy or malevolent.

In the following three sections, we develop these ideas further and provide specific examples from disaster literature to illustrate how people may become vulnerable in these stages.

3. Accessing

People may experience difficulties in receiving warnings and guidance or asking for assistance and warning others when communication infrastructure is unreliable or damaged, when crisis information systems disregard their sensory impairments, or when socio-economic disadvantages limit resources, habits and skills for adequate information seeking among some groups or individuals.

3.1. Poor or broken communication infrastructure

Individuals residing in remote areas may not receive warning messages or have difficulties keeping themselves informed about hazards and crises due to scarcer means of communication reaching these areas. For instance, they may suffer from poor mobile reception or internet access (e.g., rural areas in Germany, see Refs. [22].

Moreover, in some cases the impact of a disaster event itself may cause serious damage to vital channels of crisis communication. For instance, during the 2017 wildfires in Portugal, due to the demolition of cell towers in fire, people in remote villages did not receive fire warnings in time [23]. Similarly, thousands of mobile base stations stopped working due to damage by the earthquake and tsunami, and subsequent blackouts in East Japan in March 2011 [24].

3.2. Overlooked sensory impairments

Crisis information systems are often not accustomed to individuals with sensory impairments leaving them in a disadvantaged situation in preparing for or responding to a crisis [25].

Individuals who are visually impaired or blind may become vulnerable in emergency situations because they are “unable to perceive visual messages and to visually assess unfamiliar environments” and are likely to miss visual clues, such as the colours of flashing lights [26]. They may be unaware of the important emergency information that is disseminated in visual form only and not made available in Braille or audio formats.

Crisis communication systems where acoustic signals (e.g. sirens, loudspeaker vans, radio) are given priority leave hearing-impaired individuals but also those without sufficient knowledge of the respective language/signals (e.g., tourists, migrants) in a disadvantaged position. Hearing impaired individuals are unable to hear alarms or spoken announcements [26]. For example, hearing impaired persons received evacuation and support information neither in the aftermath of hurricane Katrina in Louisiana, United States, in 2005 [27] nor the 2002 flooding in Dresden, Germany [28]. Older adults may develop similar impairments and may be less likely to hear distant alarms, or may have difficulties in reading or perceiving pictures due to poorer hearing or visual acuity [29,30].

The above examples indicate the structural shortcomings in making risk or disaster information accessible. Unsurprisingly, people with functional limitations have been often found to be reliant on others for the provision of information and thus their crisis communication processes are more complex compared to others [31]. In addition, young children, elderly, or those with chronic diseases are more likely to rely on family and friends for disaster-related communication, in comparison to individuals without disabilities [31,32]. When information is made accessible to persons with impairments, it allows them to take necessary actions and thereby activates their capacities [33]. Accordingly, communication that fosters rather than assumes abilities and capacities is a precondition for increasing disaster resilience [19].

3.3. Socio-economic status affects information seeking

Access to crisis information may vary among individuals and groups based on their wealth and socio-economic status. Disadvantaged people may be deprived of the resources, habits and skills for seeking information about hazards and disasters.

Not everyone has adequate resources to purchase technical devices for receiving crisis information. For example, the German disaster-warning app NINA (*Notfall-Informations-und Nachrichten-App*) only runs on smartphones [34] and thus remains inaccessible to users of older mobile phone types or individuals who do not have a mobile phone.

A lack of habit or skills to use appropriate information source may increase vulnerability in crisis and disasters. In emergencies, younger people have been found to be better equipped and more positive about using social media, in comparison to older adults, among whom almost a third (29%) do not use a smartphone which is a prerequisite for accessing social media while not at home [35]. A recent study in Australia indicated that older adults relied mainly on radio and expected a phone call on their landline, whereas families with younger children relied on mobile apps, social media and website for emergency information [31]. The above suggests that older adults are more likely of being excluded from support, advice or instructions provided via social media before, during, or after the disaster event.

The level of preparedness or vulnerability to crises may also depend on people’s habits of searching for information that in turn are often shaped by socio-economic status and socio-cultural customs. According to Spence et al. [36]; individuals from lower economic strata have reduced possibilities to seek out information from media in crises. Due to their limited economic and political power, poorer populations are mainly motivated to seek information about what directly affects them and from their real-life connections, such as family and school [37]. For example, Spence et al. [38] report that survivors of the 2005 hurricane Katrina in the United States had different levels of crisis preparedness and information-seeking behaviours based on race and socio-economic status: African American survivors were likely to rely on interpersonal networks and were less likely to use the internet for information seeking.

The situation for women in developed nations differs from that in the developing world due to differences in income, education, mobility, or different religious and cultural constraints, all of which restrict their access to and use of information technologies [39]. A case study carried out in Haiti after the 2010 earthquake indicates that Haitian men were more active information seekers in comparison to women [40]. Such differences in information seeking behaviour were driven by socio-cultural customs: females simply did not consider gathering information to be their responsibility [40]. However, findings from a recent study in 30 European countries ([35]; n = 1034) indicate that women had significantly more positive attitude towards using social media as a source for information during emergencies, in comparison to men. Women (33%) were also significantly more likely than men (20%) to share information on social media about emergencies.

In sum, vulnerabilities emerging at the access stage are largely shaped by structural factors that could be addressed by policy makers by introducing measures to (a) increase the robustness and extend the availability of communication infrastructure, (b) make disaster information universally accessible, including to people with impairments, and (c) reduce socio-economic inequality in society. However, as modern life tends to be saturated with information and technology, limited access may often be perceived as a relatively minor problem compared to the challenges arising from the overabundance, inaccuracy, or

deceptiveness of the messages received.

4. Understanding

People may not understand messages about hazards if these are presented in a way that does not correspond to their needs, skills, and experiences. They may be left with misperceptions about hazards and their overall situational awareness may be misguided also when they are exposed to false or misleading information. Due to the growing use of social media, people's vulnerability to false rumours is increasingly shaped by new forms of collective fact-checking and sense-making regarding risks and disasters. Below, we will exemplify these aspects in turn.

4.1. Overlooked cognitive limitations

The presented risk or disaster information may be useless if it is not adapted to the needs of a particular group. For example, many people may not understand complex terms and concepts used in relation to hazards, such as tornado categories or context-specific risk predictions (e.g., '100-year-flood'). Indeed, the very notion of 'risk' – a term that is used to capture the combination of the probability of a hazardous event and its negative consequences – is in itself rather complicated and can be understood or perceived in different ways due to psychological as well as cultural factors [41]. Individuals with limited cognitive capabilities, especially children, may not recognise signs of environmental danger or understand the threats [33]. They may become anxious and confused in response to emergency signals [42]. In a similar vein, elderly people may feel confused by messages that include jargon, technical terms, euphemisms, and guidelines including multiple conditions [29].

4.2. Exposure to false or misleading information

Various official and unofficial sources may issue erroneous, misleading, or contradicting information during a crisis. People may find it difficult to judge the relevance and credibility of the information received and therefore remain unable to take appropriate protective actions.

Official warning messages may not serve their purpose if they exclude facts that are essential for people situated in particular geographical areas (e.g., the height of tsunami waves about to hit a specific coastal region). People may be vulnerable to false information even when they are located far from a disaster area as rumours related to a crisis event may also affect those who are not directly threatened. For instance, after the 2011 nuclear leak in Fukushima, Japan, a rumour that originated in a microblog caused a salt shortage panic in China:

> Many customers were under the mistaken impression that iodized salt—the type of table salt commonly sold in China—would protect them from radioactivity released in Fukushima, should it drift their way. Others believed that the radioactivity would mean contaminated sea salt in the future, and that they should stock up on uncontaminated salt while it was still available. Still others feared that the sudden run on salt foretold a coming shortage, and they too rushed to buy salt [43].

It is likely that in this case many people believed the rumours due to the nature of the threat: the danger of radiation "is an intangible, time-unlimited and deadly threat, which can come from all directions, and against which protection is difficult or impossible" [44].

From an emergency management perspective, people may be seen as vulnerable to false information when they find it *difficult to assess the reliability of information*. For example, immediately after the March 11, 2011 earthquake in Japan, people relied on Twitter as an important communication tool to spread warnings, help requests, and reports about themselves and the environment. In a later survey, "[m]any users mentioned that they couldn't tell true information from false, especially when they saw emergency messages, such as, 'I'm about to die' or 'Can anybody help me?' After a while, some of those tweets turned out to be false" [45]. People also reported that their confusion was made worse by the sheer number of disaster-related messages on Twitter and because they could not easily find important messages as a lot of irrelevant information was tweeted with #disaster hash tag [45].

The problem of assessing the reliability of publicly disseminated information is not unique to crises. In a 2018 Eurobarometer survey of a total of 26,576 respondents in 28 European Union countries, 21% said they were 'not very confident' and 5% 'not at all confident' that they "are able to identify news or information that misrepresent reality or is even false" [46]. The findings also showed that elderly people (who use social media less frequently or do not use social media at all) were less confident in their ability to identify false information. Within internet and political communication research, there is some evidence to suggest that people who do not use multiple news sources and are least skilled in using internet search engines are most vulnerable to online misinformation [47].

4.3. The need for fact-checking

There are many guises of false information [21] which range from satire and misleading content (misinformation, which may be shared without intending harm) to manipulated or fabricated content (disinformation, which may be shared with destructive intent). False information about hazards and disasters may spread most broadly via stories produced by news organisations/journalists (i.e. disaster journalism), or via social media postings by various individuals/groups who sometimes remain unidentifiable.

Disaster journalism ideally includes professional reporters examining community disaster mitigation and preparedness, providing disaster warnings, reporting on disasters, and facilitating community disaster recovery and resilience [48]. However, journalists' stories may also cause confusion or distrust when their reporting is based on unverified information or misrepresents the situation. The situation may be exacerbated by the tendency of journalists to construct emotional dramatised disaster narratives, which rely on stereotypes and emphasise conflict [49].

Individuals, businesses and governments increasingly use social media tools, such as Facebook, YouTube, Twitter, and Instagram to interact with others and to share and monitor all sorts of content, including texts, images and videos about risks and emergencies. In hazardous situations, people may not rely only on 'official' data sources. They may seek and share information via social media to assess the situation, determine what to do, and share their views [50] – so it is likely that they share or receive some inaccurate or incomplete information within their networks that may put them or others at risk and/or hamper emergency response or recovery.

In a disaster situation where the desire for relief and information is high, false information may spread very quickly via social media. For example, during the July 22, 2011 terrorist attack in Norway, the police stated at 5.28 PM that they had "… people on their way" and at 5.31 PM a person on the island was told that the police would be there in "… minutes". However, at that time, no patrol had been deployed from the nearest police station. Dissemination of incorrect information about how far the police had progressed towards the location persisted until the arrest. Interviews about the use of social media with eight survivors of the attack highlighted that in the absence of official social media statement, it was difficult to ascertain whether something on social media was true or not [51].

In a similar vein, during the mass shooting in Munich, Germany, in 2016, although only one person committed the shooting, 67 places of perceived shootings were discussed in social media [52]. Several rumours which were later debunked as misinformation went viral during the 2017 Manchester bombing [53] and the 2013 Boston Marathon

bombings [54]. And in the aftermath of the September 2018 earthquake and tsunami disaster in Indonesia, much false news circulated in social media, including WhatsApp and Facebook: for example, false claims of the death of the Mayor of Palu, aftershock earthquakes, and offerings of free flights to flee the disaster area [55].

Social media can be used both for ill and for good in the context of disasters. On the one hand, "disaster reporting and curation by unknown individuals and organisations may raise concerns about the accuracy of information, the potential for rumours, the maliciousness of use (such as scams conducted by social media), and the protection of privacy" [56]. On the other hand, however, social media can also be employed for (collective) fact-checking and debunking myths/rumours about disasters. The use of social media may potentially help to decrease the number of false alarms, as more 'social sensors' take part in checking and filtering data [57].

Next to fact-checking by individuals, government agencies may engage with people via social media as a part of their overall risk communication and crisis communication efforts [58]. Termed 'rumour management', this involves government agencies scanning for false information originating from an external source and offering corrections and/or clarifications – usually during response operations, but admittedly this might be necessary also for preparedness/resilience building [59].

4.4. The need for social sense-making and sharing

Unsurprisingly, "rumours are often viewed as a negative aspect of crises, something that we should seek to minimise" [54]. The fear of misinformation is one of the main reasons why emergency response professionals may be hesitant about integrating social media into their formal work practices [60,61].

Some authors regard rumours as part of collective problem solving or 'social sense-making' with an aim to agree on a common understanding of the events that have occurred [62]. Personal anxiety and personal involvement in a disaster play an important role in rumouring behaviour [63]. The latter aspect of rumouring was also highlighted by the participants of Huang et al. [54] study who admitted that they shared information on social media during crises so as to enable other members of the public to stay informed.

However, sometimes this information sharing results in passing forward erroneous information. The findings of Huang et al. [54] led them to hypothesise that "social media plays a role in development of emotional proximity, and that this emotional proximity has a mediating effect on the spread of misinformation during disaster events". News media also often repurposes unconfirmed information shared on social media, especially eyewitness reports, into news stories of their own [64,65], thereby helping to verify the social media posts and creating viral effects.

Sharing of sensational and unfounded stories during a crisis could be seen as a common practice among some online communities. For example, during the 2014 Ebola virus outbreak, the postings on the social news sharing site Reddit amplified panic and uncertainty, all of which overshadowed the reality of the health crisis [66].

In such a context of information disorder, official warnings may be mistaken as spam and therefore neglected. The above examples remind us that false information is a complex phenomenon that is not always produced with a malicious intent (disinformation), but it is certainly important to pay attention to the ways in which it may interfere with crisis response and recovery.

5. Reacting

People do not always engage in adequate protective action after having received information about a hazard or a disaster that could affect them. Their inability or unwillingness to change their behaviour may be rooted in disadvantageous socio-economic circumstances and previous experiences. How people react to information depends on whether or not they trust its source. Some communicative reactions to disaster information may be unhelpful and even increase others' vulnerability by harming them. We will consider these aspects in turn.

5.1. Socio-economic disadvantages

Social and economic inequalities in society may impede appropriate responses to information on hazards. Individuals in precarious situation have less means to engage in self-protective activities, such as choosing to live in a safe area or stockpiling food and supplies [67], and they tend to be slower in responding to evacuation messages [68]. Young people as well as families with young children have been found to be quicker to respond to disaster warnings in comparison to older adults [69]. Elderly and those who are visually impaired, hearing impaired, cognitively impaired, physically limited, or who constantly need medications or medical care often cannot react upon warning messages without someone's assistance [26,27]. Moreover, people may choose not to follow safety guidance because there are other values at stake, such as the wish to protect their own property.

Disadvantaged populations may often be unaware of the danger or deny that they are at risk and therefore do not engage in disaster risk reduction [70]. People who think that disasters are completely beyond their control may adopt a fatalistic attitude and make no attempts to get out of their predicament [71].

More generally, people tend to interpret risk messages based on what they already know and have experienced [72,73]. People with no previous risk or disaster experience tend to have low risk perceptions, which also reduces their motivation to follow safety advice or to take protective action [74]. For example, in the case of the 2007 Southern California wildfires, residents who had previously experienced similar fires, were reported to function well in such kind of stressful situations, in comparison to newer residents who were only discovering what it means to live in fire-prone areas [75].

5.2. Distrust

People's trust in a particular source or type of information, or a channel via which a message about a hazard is received may play a crucial part in their decisions whether or not to react upon a message [75,76]. Based on their personal experiences, affiliations and socially shared attitudes, individuals may attach different levels of trust to various information sources, such as the government, first responders, media, peers, or family. For instance, a survey by the National Rescue Association in Finland showed that 54% of respondents thought that social media contained a lot of misleading information and 49% thought that mainstream media stirred up fear and insecurity [77]. Trust in information received via different kinds of media – written press, radio, television, internet – may differ significantly between various socio-demographic groups and between countries (see, for example, [46]. In general, a warning from a credible source may be expected to have a greater impact on recipients' behaviour, whereas if the source is not considered to be trustworthy, people usually seek information from other sources.

Moreover, the way a crisis message is presented may influence people's motivation to act in the context of risks or crises [78,79]. When messages about a hazard mention the location, time, and magnitude of the impact of an event, people tend to trust the message more and also take precaution [80]. For example, during the 2012 Waldo Canyon wildfire in Colorado, the warning messages sent via Twitter which included protective action guidance together with the descriptions of hazard impact, location, and message source were more effective than messages that only provided situational updates without any protective action guidance [80].

Disadvantageous social conditions of individuals or groups, including distrust towards official institutions and their communication,

may drive people to follow other information sources that may distribute misleading information. For example, when mandatory evacuation order was made in advance of Hurricane Ike's landfall on September 13, 2008 in Texas, United States, a survey later showed that an (unfounded) concern about legal status among undocumented residents influenced their evacuation behaviour.

> Many were afraid to seek evacuation assistance, and feared they would be required to show identification to board evacuation buses. None had experienced this in the past, but stated they had heard rumours of such requirements./ … /Although FEMA [Federal Emergency Management Agency] officials announced that no one would be questioned during evacuation, undocumented immigrants expressed beliefs that they were not considered to be part of the evacuation population./ … /The misconception that immigration enforcement occurred on evacuation routes prevented 'receipt' of the right information, and to them deportation was a greater threat than the hurricane. ([81]; p. 205).

Hearsay/rumours may discourage certain marginalised groups such as undocumented immigrants from seeking help in particular situations, thereby placing them in increased danger. Researchers suggest that for people in such contexts, "unique plans ought to be developed/ … /to enable easier and less 'chancy' information gathering and less fearsome forms of communication throughout the community, particularly during periods of calm" [81]. It is also necessary for emergency management institutions to better understand the various patterns of crisis-coping strategies that people may adopt as well as the reasons why they may sometimes ignore warnings or other crisis information [82].

5.3. Helping or harming?

One of the common features of disasters is the spontaneous emergence of self-organising voluntary groups who seek to help victims and participate in crisis management [83]. This self-organising occurs increasingly via social media [57,84–86], where people may be exposed to false or misleading messages that provoke misguided or harmful reactions.

For instance, in response to the 2013 floods in Dresden, Germany, citizens used Facebook groups to offer or seek help. These groups had more than 100,000 supporters and were run by a range of actors, varying from individuals to charity organisations [87,88]. However, bottom-up self-organisation of unaffiliated volunteers led to incidences of misinformation and reactions that worked against disaster relief. One example was the gathering of several hundreds of people who built a sandbag wall without authorisation right on top of a permanent flood wall where mobile steel-plate extensions were meant to fit on top.

> The 10,000 sandbags that had been placed on top of the wall would thus have to be removed to accommodate the extensions. The fire department ultimately decided not to remove them because it would be too time-consuming, and the water level was not expected to exceed the height of the floodwall in any case. ([89]; p. 107).

Another example of the spread of misinformation in response to Dresden floods was related to the development of an online flood map for the city of Dresden. In peak times, more than a thousand people approached the website per minute. However, it suffered from both consciously inserted disinformation as well as missing or false information due to operating errors. Although volunteers regularly corrected faulty information, the Federal Office of Civil Protection and Disaster Assistance [90] reported problems like decreasing motivation, difficulties in handling the website, and a lack of volunteers during the night-time.

In a disaster context, social media can also become a channel for verbal attacks. Crisis situations may lead to increased hate speech – insulting, blaming or discriminating individuals or groups for their backgrounds, beliefs, or ideas. For example, after the July 22, 2011 terrorist attacks in Norway, rumours quickly spread on Twitter about an Al-Qaeda attack as a response to Norway's participation in military operations in Afghanistan and Libya. A large number of tweets blamed radical Muslims and the Norwegian Anti-Racist Centre recorded a surge of hateful speech against Muslims and immigrants online [51]. Similarly, Fischer-Preßler, Schwemmer and Fischbach [91] identified rumours and misinformation, hate speech, and bigotry in tweets about the 2016 Berlin Christmas market attack in Germany. Tensions between groups within a country and attempts by other governments in meddling with internal affairs of neighbouring counties are factors contributing to intentional manufacturing of false information [92].

To counter the spread of hateful or false messages online, people may engage in various forms of digital activism. For example, in the context of the 2013 Dresden floods, people warned each other about misleading information, apologised for spreading wrong information, or simply deleted those Facebook contacts who posted speculations [90].

The above review shows that in cases where information about a crisis is insufficient or unclear, people's creativity and desire for relief from uncertainty may lead them to come up with or believe in false stories and take steps that increase their own vulnerability or that of others.

6. Drivers of communication-related vulnerability

An important analytical insight we can draw from our review is that in each of the three stages described above, communication-related vulnerability can be understood as being driven by (a combination of) factors that fall under three types:

- *Individual* factors arise from personal physical, mental, emotional or behavioural conditions that could make it difficult or impossible for people to send, receive, understand, or react to information about hazards. These include cognitive, sensory, and mobility impairments (e.g., one cannot hear, see, read, walk), limited skills (e.g., a small child cannot read; a tourist may not understand the local language), and limited resources (e.g., one has no spare money to buy a communication device for sending or receiving disaster information).
- *Social-structural* factors arise from various historically, politically and culturally constructed forms of social inequality, and configurations of government policies that exacerbate (or fail to mitigate) these. People in some areas may suffer from poor communication infrastructure. Disaster information may be distributed by authorities via channels that certain groups cannot (afford to) access or do not usually use, or in a language that they cannot understand. Social support for some disadvantaged groups may be lacking and, due to social marginalisation, distrust may grow among them towards officials and news media as sources of warning messages and disaster information.
- *Situational* factors are complications to disaster communication that emerge in the specific context of a particular disaster. Some of these complications may affect access (e.g., communication channels may be disrupted due to power outages caused by storms or wildfires) while others affect understanding (e.g., exposure to false or misleading information) or reactions (e.g., lack of previous experiences with a particular type of hazard).

What the above points allude to is that vulnerabilities related to sending, receiving and interpreting disaster information and the related reactions may easily defy simple one-dimensional attributions, such as ascribing vulnerability to a particular demographic group. Societal groups like elderly people, persons with disabilities, or people who are part of a minority are inherently heterogeneous and their condition is embedded in a social context, which may be either supportive or disadvantageous to these persons [3,10,93]. While vulnerability is

linked to socio-demographic markers such as gender, class, or race, it needs to be studied with an intersectionality approach [94] that lends the analysis the necessary differentiation to uncover the specific ways in which communication-related vulnerabilities unfold. For example, although being deaf has the potential to increase vulnerability, particular measures may be employed by policy makers, disaster managers, or self-organising communities that could mitigate this (e.g., by providing interpreters, written information, or visual warnings).

From this perspective, all drivers of vulnerability are to a large extent influenced by social or structural factors. Individual and situational factors are closely related to problems of socio-economic inequality, inadequate preparedness policies, and the erosion of public trust in government and media.

We summarise our overall framework for understanding communication-related vulnerability in Table 1. It demonstrates how a variety of individual, social-structural, and situational drivers of vulnerability can be mapped out in the stages of accessing, understanding, and reacting to risk and disaster communication. Admittedly, the examples provided in the table are not meant to be comprehensive. The framework is intended to be used as a heuristic guide that would help to systematically identify possible communication-related vulnerabilities in a particular disaster scenario involving particular people in a particular time and place.

Table 1
Drivers of social vulnerability in relation to accessing, understanding, and reacting to risk or disaster information (examples).

	Individual	Social-structural	Situational
Accessing (capacity to send and receive messages)	No access due to functional impairments (e.g., poor hearing or eyesight) No resources for purchasing a device or channel No skills or habit to use the source	Poor communication infrastructure (e.g., no radio reception or internet access) Information is distributed via channels that certain groups cannot access or do not usually use Norms or customs limit information seeking (e.g., gender division in information seeking)	Broken communication infrastructure (e.g., cell towers destroyed in fire)
Understanding (capacity to adequately interpret messages)	Inability to read Limited language skills Limited mental capacity Lack of knowledge (e.g., of the meaning of warning signals)	Information is provided only in one language Information provided is too complex, confusing, not tailored to the needs of specific audiences	Exposure to false or contradicting information Difficulties in interpreting context-specific risk predictions (e.g., '100-year-flood')
Reacting (capacity to take protective action)	Lack of skills for self-protection Lack of resources to stock up with supplies Inability to evacuate due to mobility impairment Lack of power (e.g., suppressed groups, prisoners)	Lack of support for disadvantaged groups Lack of preparedness measures Distrust towards sources of disaster information (e.g., officials, social media, news media)	Type and magnitude of hazard affect the degree of personal control over one's situation Lack of previous experiences Simultaneous events may drain attention and energy

7. Concluding remarks

Social vulnerability to disasters may often have a communicative component or driver. It is important for disaster researchers, policy makers, and emergency responders to systematically identify these vulnerabilities and devise concrete ways for reducing their causes or at least mitigating their impacts. In this article, we have put forward a new heuristic framework to support this endeavour.

While an analytical distinction can be made between individual, social-structural, and situational drivers of communication-related vulnerability, the actual degree of vulnerability is usually shaped by an interplay between these factors in a particular context of a hazard or a disaster. The most consequential drivers of vulnerability are often social-structural: those that arise from various forms of social inequality, and configurations of government policies that exacerbate (or fail to mitigate) these. When policies and other social-structural measures are introduced that support equal access to and broad understanding of risk and disaster communication, and when improved social conditions help to increase everyone's capacity and willingness to react appropriately to hazardous situations, then individual factors – those related to various impairments, lack of resources, skills, and capacities – become less critical. In other words: by tackling social-structural drivers of communication-related vulnerability, we also reduce the potential of individual drivers to bring about adverse effects.

Our review of literature suggests that it would be inappropriate to point a blaming finger at any disadvantaged individuals or groups for having 'failed' to overcome by themselves any of the barriers to communication described above. People increasingly face hazards and related communication problems that they are not able to detect, understand, and manage on their own (as individuals/households/communities) and where institutional support is needed. As a minimum, disaster managers should maintain a robust communication infrastructure (i.e., guarantee access) and carefully tailor their messages to the needs of particular audiences (i.e., try to improve understanding). However, to raise everyone's ability and willingness to react adequately upon risk and crisis information, broader social and political changes may be required. These might include the introduction of effective measures to support disadvantaged groups, improve overall preparedness and resilience, and cultivate social trust in society.

Among situational factors of vulnerability – that is, complications to communication that emerge in the specific circumstances of a particular disaster – those related to people's exposure to false or misleading information seem most acute. In the context of global information networks and information pollution, (mis)understanding, sense-making, and fact-checking are essentially collective processes that should not be seen as depending only on individual mental capacity or skills. False information and hate speech spread almost instantly via social media and may be very difficult to debunk or contain. Problems of false information are intertwined with problems of social trust, social exclusion, and discrimination that may require addressing at the highest levels of politics and policy making. For instance, recent research indicates that different political and media systems may be more or less well equipped to deal with problems related to online disinformation based on a number of systemic factors, such as political polarisation and weak public service media [95]. Communication scholarship also points at an overall increase in relativism towards factual information in high-choice media environments [96]. We believe that further systematic engagement with the latest insights from media and communication research – especially those pertaining to information disorder – would greatly benefit the field of disaster studies, because the challenges posed by false information are not limited to risk and crisis communication but affect the overall functioning of society.

Admittedly, the heuristic model proposed in this article has been painted with a rather broad brush. It draws attention to some of the possible mechanisms of vulnerability but does not fully testify to the complexity of their temporal, spatial, physical, ecological, cultural,

political, economic and institutional aspects. The value of a heuristic model such as ours can only become evident when it is taken up by others – scholars, policy makers, risk and emergency managers, communication professionals – who recognise it as adequate for identifying and understanding certain manifestations of disaster vulnerability. It is yet to be seen how the issues highlighted in our model could be integrated into existing frameworks for assessing vulnerability (e.g., [97]). More studies are needed to further specify how communication-related vulnerability could affect people in various phases of disaster management: prevention, preparedness, response, and recovery. Similarly, future research could demonstrate how communication-related factors may make people vulnerable in different ways when they experience different types of crises, such as disasters triggered by natural hazards, pandemics, technological accidents, or human malevolence. It is also necessary to chart communicative drivers of disaster resilience and, based on that, devise more effective ways for improving social resilience.

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