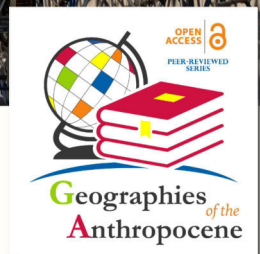


EARTHQUAKE RISK PERCEPTION, COMMUNICATION AND MITIGATION STRATEGIES ACROSS EUROPE

Piero Farabollini, Francesca Romana Lugeri, Silvia Mugnano
Editors



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Cover: Norcia, Piazza San Benedetto. On the left, the civic tower of the Town Hall; on the right, the safety intervention of the facade of the Basilica of San Benedetto, heavily damaged as a result of the seismic events that affected central Italy starting from 24 August 2016.

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6. Geoscientists' voice in the media: framing Earth science in the aftermath of Emilia 2012 and Amatrice 2016 seismic crises

Andrea Cerase¹

Abstract

In the aftermath of an earthquake, broadcast and traditional media play a crucial role, fulfilling complex social and psychological functions. Geoscientists are sought by the media to provide scientific assessments of seismic phenomena as to explain both what is happened and what is yet to come, also suggesting ways to mitigate risk at individual and societal level.

The visibility of scientist and their ability to spread their voice across the media is a very important aspect of disaster narratives, as it provides an opportunity to disseminate and receive relevant messages about hazard, risk mitigation and resilience. The genuine appetite for scientific knowledge (Wein et al., 2010) stresses the role of journalistic mediation along the whole risk / science communication process, as it improves newsmedia credibility along with public's understanding of both seismic phenomena and related risks.

The here presented research considered the media coverage of scientific issues during the Emilia 2012 and Amatrice 2016 seismic crisis by the four most circulating Italian national newspapers within the 31 days following the first earthquake shock. The comparative analysis of the two seismic crises considered 288 news stories, being analysed through content analysis, an empirical methodology that allows analysing media messages as well as other types of communicative texts, in order to formulate statistical inferences on their explicit meaning (Neuendorf, 2002).

The analysis made emerge two relevant points. First, media coverage of geo-science follows the 'typical' life cycle of news. Most of the articles are indeed concentrated in the very first days, rapidly decreasing in the following days till to disappear at the end of the month. Second, the daily amount of

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news story is significantly defined by three variables: the maximum magnitude of aftershocks in the previous day, the number of days after the ‘zero event’ and the degree of controversy / conflict that arises from scientific evaluation of the ongoing phenomena.

Keywords: Media; Earthquakes; Science Communication; Geoscientists; news framing, agenda building.

1. Introduction

When a socio-natural disaster occurs, the media system as a whole is called upon to perform various relevant social functions, ranging from the dissemination of early warning messages to the creation of a public space for political debate about risk management and mitigation measures’ sustainability (Cerase, 2018). After a disaster, broadcast and traditional media play a crucial role, fulfilling complex social and psychological functions, which can alternatively foster or hinder the return to normality of both exposed communities and society at large. In the immediate aftermath of a disaster the media system is asked to fulfill relevant and complex symbolic functions, providing a continuous flow of information on the ongoing situation, to foster social and behavioural change, to give emotional support, to recall experiences from past events and to provide causal explanations of current events (Stalling, 1990; Massey, 1995; Perez – Lugo, 2004).

Scholars from risk communication field have recognized that information (and of course misinformation) can both amplify and mitigate the consequences of physical events (Kasperson *et al.* 1988; Kasperson, Kasperson & Kasperson, 1996; Pidgeon, Kasperson, Slovic, 2003). According to an early definition issued by Barney Turner: “disaster equals energy plus misinformation” (Turner, 1978: 186). Hence, socio-natural disasters also represent an important test for scientists, policymakers as well as citizens to readdress and reorganise risk assessment and mitigation strategies. From the early stages of a disaster, the media provide a set of symbolic resources and an arena to *stage* the debate on risk mitigation, also making available opportunities for scientists to deliver scientific knowledge to a larger audience, enhancing public awareness about risks, suggesting adaptive behaviours to cope with disasters and encouraging a change of social and political factors that may worsen the outcome of disasters (Perry, Tierney, Lindell, 2001; Pantti, Wahl-Jorgensen, Cottle, 2012).

Communication responds to the primary need of bringing order into a disrupted / discontinued reality, fostering the creation of shared and consistent narrative structures to make sense of the ongoing events. However, information is neither self-evident nor neutral, and must be first organized within shared cognitive structures (narrative frames) to make a comprehensive sense of the event, to be used to define situations and to provide basic knowledge that may help people to take decisions in a very difficult and uncertain situation.

Seen from another perspective, notably the Social Representation Theory perspective (Moscovici, 1981; Moscovici, 1993; Joffe, 2003; Joffe, 2012), one can say that a disaster is nothing more than the concrete actualisation of a particular risk, whereby the pre-existing representations given in a certain culture suddenly become insufficient and inadequate to provide causal explanation of the ongoing events. In such a situation people need a rationale to re-adapt their worldviews and to address decisions that should be taken. The media play a prominent role in “translating” expert knowledge “from a more reified, scientific universe into lay thinking” (Joffe, 2003, p. 60).

Although profound changes occurred in the mediascape in recent decades that enhanced and strengthened online communication: in times of crisis, traditional broadcast media such as newspapers, television networks and radio station still continue to play a crucial role in re-organizing the mess of non-hierarchized information, inconsistent claims, rumours and misinformation that characterise the internet as realm of disorganised skepticism (Krimsky, 2007). Traditional media provide audience with some relevant points of reference to arrange information about events within a coherent and comprehensive framework, and they also underpinning effective mitigation action as well as a different understanding of future risks.

As a consequence, it is supposed that media may provide a kind of “seal of quality” for the information which are gathered, selected and conveyed to the public, also providing a well-recognized arena to foster public debate. Broadcast media such as television, newspapers and magazines are still today an essential resource for citizens to cope with disasters, responding to public demand for trusted, viable knowledge to ground interpretations of such complex and elusive events. Especially in the first days following a major earthquake, scientists are asked by the media to provide scientific assessments of seismic phenomena, to explain both what has happened and what is supposed to happen in the near future. Therefore, geo-scientists’ visibility and voice across the media is destined to increase and become central in the narrative of disasters, and therefore the immediate aftermath of a disaster can provide an unprecedented window of opportunity to disseminate relevant

messages about hazard, risk mitigation and resilience. As recalled by Anne Wein and her colleagues, the urge to make sense of the event thus results in a genuine appetite for scientific knowledge (Wein et al. 2010), stressing the role of journalistic mediation along the whole risk / science communication process, as well as the ability of the media to provide the public with steady and authoritative point of references to anchor their understanding of disasters and related phenomena.

Despite the excessive optimism of some supporters of the digital revolution, traditional broadcast media still retains a strong power to decide the issues to be included in the public agenda along with the narrative frames through which they will be represented. Moreover, traditional media still continue to be used by the most educated sections of the population as complementary sources of information along with the Internet, while they are practically the only source used by less educated people (Censis, 2019; Istat, 2019).

It follows then that traditional broadcast media have been everything but replaced by digital media, instead they have only changed their role within a broader process of digital convergence. The growing diffusion of computers, tablets and smartphones has enabled such a convergence process by which a number of cumbersome devices such as telephones, televisions, stereos, and cameras have been gradually incorporated into smaller portable devices. Any content may be digitalised and easily managed, copied and shared on different platforms and then incorporated into new daily communication practices, which involve users in different forms of communication also remediating traditional broadcast media into new forms of social usages (Bolter & Grusin, 1999; Jenkins, 2006).

Nevertheless, journalistic mediation continues to play a central role in responding to the diverse and important needs of the directly affected populations and the communities and societies in which they operate, providing information on the current situation as well as emotional support, promoting social exchange, evoking past experiences of similar situations and, above all, providing causal explanations of ongoing events.

The media are a relevant resource for citizens to cope with socio-natural disasters, as they represent a crucial resource to understand risks. As postulated by the theorists of the Social Amplification of Risk, the catastrophic event not only updates the risk, but it triggers a series of communication processes that do not only concern scientific and institutional communication, but must refer to any message conveyed by any source through any channel, without restrictions on the direction of flow or on the

breadth of the audience involved, and also take into account messages conveyed involuntarily (Kasperson et al., 1988).

Since first researches on media coverage of earthquakes, evidence highlight that media portrayal of such events is everything but a mirrored reflection of physical “reality”. Indeed, the amount of news stories, along with the frames selected by the media to arrange a representation of the event, depends not only on physical factors such as magnitude and (of course) number of casualties and injured people, but also depends on a variety of social factors, including the way media are likely to build “typical” news frames for different types of issues, which should be referred to the concept of *media logic* (Altheide & Snow 1979), by which media contents, and more in particular news stories, are “molded by a format logic” (*ibidem*: 201). The concept of media logic is widespread used in media literature to indicate the specific frame of reference of the production of media culture, and how it works as a way of seeing and interpreting social affairs, selecting and organizing raw material and packing it into predetermined formats (e.g. TV news, newspapers’ interviews and so on). Media logic works as a “grammar of media communication” envisaging particular ways to organize, present, and emphasize news content and styles (Mazzoleni, 2008).

Given this premise, literature on media coverage of earthquakes has shown that a number of factors can result in increased / lessened media coverage of earthquakes. Among the others, one may recall geographic location, cultural vicinity, economic and political relations between the country where earthquake occurred and the country of the media that covers it, the possibility to highlight a connection or an affinity between the community hit by the earthquake and the audience of the media, the power status of the source, the availability of neutral accounts of earthquake-related stories such as the involvement of Heads of states or other political personalities in DRR efforts (Gaddy & Tanjong, 1986; Singer et al. 1991; Koopmans & Vliegenthart, 2010; Jamieson & Van Belle, 2018). Unfortunately, the majority of these studies are concerned on the way American or Western media cover earthquake-related stories, and these do not consider the way Italian media focus on earthquakes occurred in Italy, with few exception. In recent years, Dominici published an extensive research on media coverage of the destructive 2009 Aquila Earthquake and of the disputed issue of responsibility / liability for damage and victims, using content analysis techniques. Interestingly, the author found that experts were called in question in almost one in four articles (24,12%): seismologist, geologist and technicians weighed for almost half (49,48%) of the whole articles involving experts’ opinion (Dominici, 2010).

2. The research

An accurate analysis of media coverage of socio-natural disaster may support a better understanding of both social and political responses to the event, and may also provide a solid explanation of factors and circumstances that make scientists' opinions and advice newsworthy and salient, shedding light on the way scientific knowledge is communicated by the media in a crisis situation. In particular, it is worthwhile considering whether each catastrophic event should be understood as a case in itself or whether, on the contrary, research may find common aspects in the representation of similar events which occurred at different times. More significantly, the media works as a kind of "social glue", being able to share information and definitions of the events across geographic boundaries and different sub-groups within society at large. In essence, the media arrange both textual and visual content into consistent and robust narrative frames, that are crucial to enable people in interpreting and making sense of the whole event (Miles, Morse 2007: 366).

This research considered the media coverage of scientific issues during the Emilia 2012 and Amatrice 2016 seismic crises, to the extent they were covered by the four major Italian national newspapers within the 31 days following the first earthquake. The research considered 248 issues of these newspapers, and collected and processed data by using content analysis, an empirical methodology for analysing media messages as well as other types of communicative texts in order to formulate statistical inferences on their explicit meaning (Neuendorf, 2002). Such a comparative analysis of news media coverage of Emilia (2012) and Central Italy's earthquakes (2016) highlights the relationship between physical events and media representation of expert knowledge, and emphasizes key trends and some significant signs of change in the news frames which have been used to assess and communicate seismic risk.

Since disasters are potentially traumatic events which are experienced by a wide population within a limited time horizon, the media are likely to pay more attention in the acute phase of the event, with particular regard to the three early stages of the disaster cycle: normalcy tragically disrupted, people escaping and searching for help, and officials working to restore order and find causes (Houston et al., 2012). For these reasons we decided to consider the whole coverage of scientific issue in the four Italian major national dailies (*Repubblica*, *Corriere della Sera*, *La Stampa*, *Il Messaggero*), issued within one month (31 days) after the first shake, retrieving all the news stories containing scientific information about earthquakes, seismology, risk

mitigation and seismic engineering. We analysed 248 issues, resulting in a total of 288 news stories that met at least one of the following criteria: 1) the content mainly focuses on scientific issues; 2) research institutions are cited; 3) scientists or experts are cited; 4) the news story refers to scientific articles or similar; 5) the story contains processed data, maps or scientific explanations (e.g. seismogenic processes).

On these premises we collected 150 news stories for the earthquake in Emilia and 139 for the earthquake of Central Italy. As shown in Tab. 1, there are some significant differences in the whole number of articles for each media outlet between the two considered events: along with a substantial reduction for Repubblica (-4,5%), data highlights a growth for il Messaggero (+ 4,6%) and La Stampa (+ 2,9%) while the percentage remains virtually unchanged for Il Corriere della Sera (-0,1%).

Table 1 - *Sample description - number of news stories and newspapers*

<i>Newspaper</i>	<i>Emilia</i>		<i>Central Italy</i>	
	N	V%	N	V%
La Repubblica	35	23,3	22	15,8
Il Corriere della Sera	40	26,7	37	26,6
La Stampa	42	28,0	43	30,9
Il Messaggero	33	22,0	37	26,6
Total	150	100,0	139	100,0

The selected research methodology is quantitative content analysis, which consists of accurate, precise, objective, reliable, repeatable and valid procedures to analyse media messages as well as other types of communicative texts in order to formulate valid inferences on their explicit meaning (Neuendorf, 2002).

Such a methodology “is a research technique for making replicable and valid inferences from data to their context” (Krippendorff, 1980: 21) and basically consists in a set of rules to draw such inference from contextual and text-based variable (Roberts, 1997: 283). This research technique provides that any news story can be split into a number of smaller units (attributes) that may refer to any relevant feature of the news content (e.g. length, position, number of columns occupied, number of news stories about the same topic, photos, captions and so on) which are then coded into variables and then

analyzed through statistical methods in order to explore frequency distributions, relations between variables and causal effects, thus making it possible to formulate and test particular research hypotheses.

A general hypothesis of this study concerns salience and frames. For the scope of this work salience is first and foremost defined in terms of attention (number of news stories on a specific issue or frame) and prominence, which refers to the positioning of a story within a media text to communicate its importance (Kiousis, 2004). To ensure a more effective measurement of prominence, we developed a normalized salience index NSI that measures the prominence of any single news-story and it is calculated as the product of relative positioning index (RPI) and the relative visibility index (RVI). The first one (RPI) provides an accurate measurement of the relative distance of the news story from the front page, while RVI measures the page visibility of the article based on its collocation within the page and on approximate calculation of the area occupied by the news story within newspaper sheets. In both cases indices span from 0 minimum value to 1 maximum value, which also allows to compare newspapers with different styles and overall number of pages. Such two indicators are found to be highly correlated in both two events (0,875 for Emilia EQ and 0,779 for Central Italy EQ), thus providing a convincing evidence that such indicators are actually measuring two distinct dimensions of the same concept.

3. Discussion

3.1. General features: similarities in the two events

The comparative analysis of news media coverage of Emilia (2012) and Central Italy's earthquakes (2016) highlights the relationship between physical events and the media representation of expert knowledge, and emphasizes key trends and some significant signs of change in the news frames used to assess and communicate seismic risk.

The newsworthiness of scientific advice cannot be taken for granted: the analysis made two important points emerged. First, media coverage of geoscience follows a 'typical' life cycle, broadly compatible with hype media theory (Vasterman, 2005). Most of the articles are indeed concentrated in the very first days or around single seismic events with larger magnitude. The overall number of news stories rapidly decreases in the following days, until it disappears at the end of the month. This result is consistent with other recent research literature (e.g. Dominici, 2010; Devès et al., 2019), whose

authors complain for the ephemeral attention of the media toward socio-natural disaster, also recognizing a recurring way to frame earthquake.

Nevertheless we do not agree that decay in media attention might be interpreted as a media bias rather than an effect of aforementioned media logic. Within the public arena model, media are to be considered as a place to stage public discussion on a limited number of emerging social problems rather than being a showcase to display a billboard campaign. This model provides an ongoing competition between different topics to enter the media agenda and then a relatively short life of single news stories, as a result of a dynamic process of competition among the members of a very large ‘population’ of social problem claims that are staged in institutional arenas, which include the media and of course public opinion and politics and where only few problems can gain widespread attention at one time (Hilgartner and Bosk, 1988). Of course, scientists may keep the attention of the public opinion high on seismic risk related problems, but they can manage it for limited periods only.

Second, the daily amount of news stories is significantly defined by three variables: the maximum magnitude of aftershocks in the previous day, the number of days after the ‘zero event’ and the degree of controversy / conflict that arises from scientific evaluation of the ongoing phenomena. Along with substantive features of the event, the possibility to define an event in terms of a clash between opposing interest groups fits the needs of news storytelling, thus enhancing newsworthiness, since ‘events can be cast into conflict stories with a more or less standard plot’ (Gamson, 1985: 618). As trivial as it may appear, data show that EQ and other disasters are likely to trigger a sudden increase in the number of news stories until a point of saturation, followed by a slower decrease. In simpler words, data provide evidence of an inverse correlation between the number of news stories and the number of days that have passed since the first “big” shake, by which media attention decreases over time unless other disaster related events (such a funeral, a press release from authorities and first and foremost a bigger shake) prompts new attention thus increasing coverage again.

Evidence also suggest that the amount of news stories on a daily basis is significantly dependent on the physical events, and more precisely, it is found to be higher when stronger shakes interrupt the alleged linearity of return to “physical” normalcy. Data shows a strong correlation between the intensity of seismic activity (measured on a daily basis) and the amplitude of coverage in newspapers on the following day. The higher number of news stories about scientific issues is very likely to follow the maximum EQ magnitude recorded on the previous day (INGV - National Earthquakes Centre, 2016).

Nonetheless, coverage amplitude is not affected only by physical intensity of EQ but also by other “social factors”, namely the conflict arising from controversial issues related to risk assessment and their implication on people’s lives and the local economy.

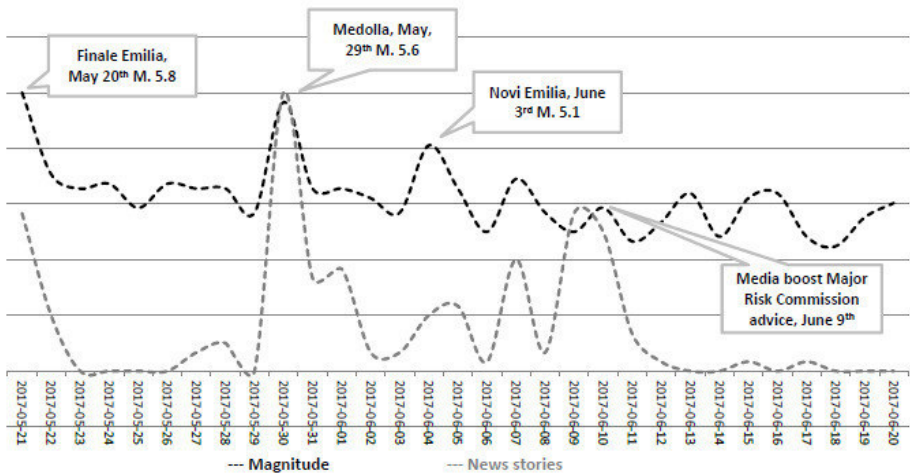
For example, in 2012 the Major Risk Commission made a statement about the evolution of seismic sequence, thus suggesting a possible eastward migration of seismicity. Such an assessment triggered a huge wave of concern, outrage and other social reactions, revamping media attention on EQ science.

When available, images and infographic content are likely to increase both the salience and newsworthiness of scientific issues. The ability to provide graphic content discloses a “window of opportunity” to reach the general public and to improve their understanding of seismic phenomena and related risks. However, using infographics does not necessarily mean a trivialization or a popularization of scientific advice. In fact, given the limited space available in any newspaper page (limited time when it comes to television in relation to the overall time of any newscast), a graphic presentation of complex contents, such as the description of a fault system or the subduction between two continental plates, can provide a description of a multifaceted physical process in an eye-catching way, thus saving a lot of space to express the concept through text. To better substantiate this, our research provides some cases which deserve a closer qualitative discussion. As some stunning images from satellite interferometry about ground displacement occurred as a consequence of EQ were made available by Scientific Institutions and Space Agencies, they were given widespread and immediate visibility on other broadcast media such as television news and the homepages of online newspapers, which then led to them being taken up and spread by traditional newspapers, sometimes on the front-page.

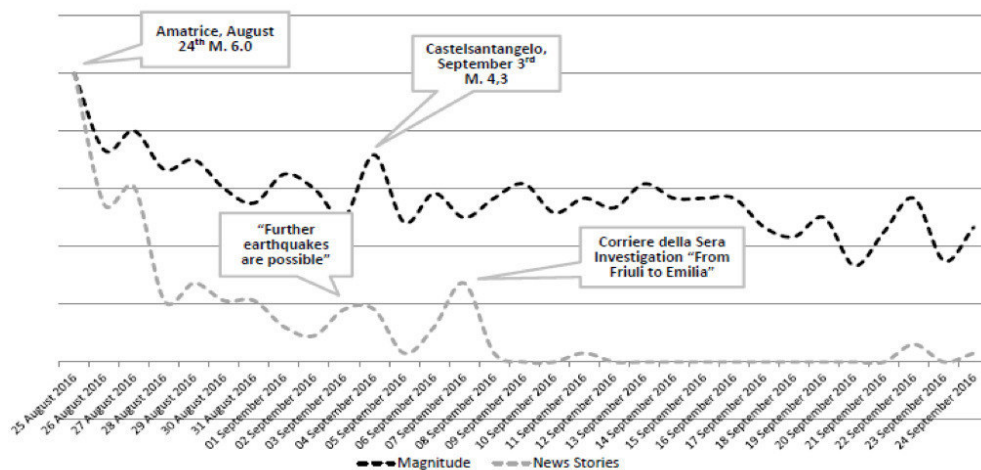
For both earthquakes, data shows a strong correlation between the maximum magnitude recorded the previous day (INGV - National Earthquake Centre, 2016) and the number of news stories about scientific aspects of earthquakes. The scores of such correlation coefficients (σ Pearson) are respectively 0.597 for the Emilia seismic crisis and 0.847 for the Central Italy earthquake. Furthermore the overall number of news stories decreases over time and this tendency is described by a strong negative correlation between the number of articles and the days elapsed since the first earthquake. For Emilia the value σ is -0.563, while for Central Italy σ is -0.715. Although tautological, the frequency of the articles is directly proportional to the intensity of the shocks of the previous day and inversely proportional to the days passed. Nonetheless, such relations are not plainly linear: relevant

discontinuities have been found when media decide to go in-depth through journalistic inquiries as well as when a controversial issue emerges and demands to be covered. The concern of citizens and authorities has intensified as a result of seismicity migration from central Emilia to the eastern provinces. The Major Risks Commission has sounded the alarm for the possible new earthquakes in the so-called “third fault segment” triggering a huge amount of reactions from scientists, officers and local administrators, the latter? worried about mitigation measures and possible economic impacts on economy and tourism.

The time series of seismicity and news coverage (graphs 1 and 2) highlights some relevant issues. In the aftermath of the Central Italy earthquake the highest number of scientific articles coincides with the strong initial shock, indeed 33 news stories were published on 25 August (see graph. 1). A little discontinuity – not due to seismicity – has been found on September 7th, when the Corriere della Sera published an extensive journalistic investigation on both impacts and legal implications of five major earthquakes, “from Friuli to Emilia”.



Graph. 1 - Emilia Earthquake: Magnitude and news stories over time.



Graph. 2 - *Central Italy Earthquake: Magnitude and news stories over time.*

3.2. A closer comparison of differences between the two events

These two events have both points in common and important differences. The earthquake of Central Italy claimed more lives, more than ten times the one that occurred in Emilia-Romagna. Secondly, the overall magnitude of destruction, in terms of building and infrastructures which collapsed or were seriously damaged, was much higher than in Emilia-Romagna. Third, the first earthquake hit a relatively limited area, whereas the second one hit four different regions of Central Italy, with a lower density of industrial activities and thus led to less damage to the socio-economic fabric, which, from the very beginning, has made risk assessment and disaster recovery operations more complicated. Furthermore, a great deal of heterogeneity emerged in the damage suffered by households and buildings in municipalities that are relatively close to each other. Experts from applied seismology and seismic engineering were immediately called into question by the media, and they correctly framed such a difference as a consequence of the different quality in the built environment. In particular, until the second M 6.5 big shake of October 30th, that greatly exceeded the magnitude of August 24th event (and in any case is beyond the time interval considered by the research), the municipality of Norcia suffered less damage with respect to Amatrice, Accumoli e Arquata due to a wide refurbishing and consolidation plan that was carried out after a smaller earthquake in Norcia in 1979. Seen through a more qualitative lens, the increased role of scientists and experts (engineers and experts of hazard) literally forced newspapers to turn the narrative frame

of “unexplained differences” into a powerful, long-lasting and pervasive narrative about resilience, encompassing the role of scientists, civil protection authorities, local authorities and government in a long term strategy to improve both building quality and mitigation measures.

Such differences also emerge from data, since data on news frames were collected for each single new story and for both two events. In other words, across the two events the voice of scientists is differently spent by the media to nurture different perspectives on the event per se and on risk mitigation strategy, as to cope with future similar events. Recalling Robert’s Entman popular definition we should recall that “to frame is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation and/or treatment recommendation for the item described” (Entman, 1993: 52). Framing is therefore a particular way of defining and approaching a particular problem, and the media not only can throw a light on a particular issue rather than others, but also can provide a particular way to understand them and to act accordingly (Scheufele, 1999).

Nonetheless, the media are not the only social actor involved in frame building since it is influenced by the intrinsic logic of the newsmaking process (Altheide & Snow, 1979), and it is mediated by a number of factors such as social and professional norms and values, organizational constraints and routines, influences from interest groups together with ideological or political orientations of journalists themselves (Tuchman, 1978; Shoemaker & Reese, 1996; Scheufele, 1999).

Furthermore, framing should not be intended as the way journalists spin a certain story to promote a particular vision of the problem in order to deceive their audiences. Framing should rather be seen as a necessary tool to present relatively complex issues – including advanced scientific research - to make them accessible to the general public given the journalists’ ability to play with existing cognitive schemas (Scheufele & Tewksbury, 2006).

To better understand narrative frames and whether and how they would have changed between the two events, we first provided a qualitative analysis of the emerging issues in order to provide a clear and effective categorization of the issues on which the media were soliciting scientists’ opinions as they emerged from news stories. We applied the thematic analysis (TA) which is a qualitative method widely used in social sciences for identifying and analysing recurring patterns of meaning within a given (textual) data set. Such patterns are defined as themes, and they may both refer to manifest or implicit contents (Joffe, 2012). Within the media research, the concept of thematic frame may refer to the way news stories are focused on information regarding

some well-identifiable general trends which provide background or “takeout” stories within the whole coverage (Iyengar, 1990).

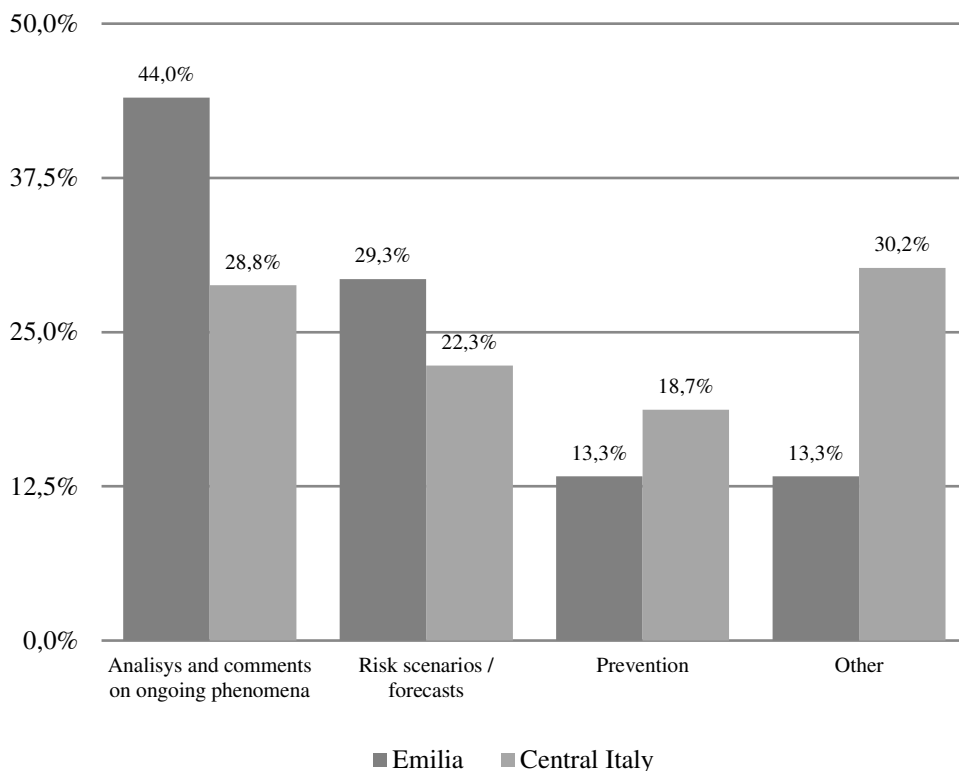
On the basis of these qualitative criteria, four distinct news frames were identified to describe the general ways in which scientific knowledge and expertise are related to some specific thematic issues. We have therefore developed a set of criteria to assign as homogeneously as possible to each of the news stories to one of the frames identified, with the aim of measuring their relative weight and check if there were any changes over time. The first concerns the analysis and evaluation of phenomena, i.e. the description and explanation of what had just happened or was happening in the hours or days immediately preceding. This category, among other things, included the analysis of seismogenic mechanisms, evaluations of the intensity of shakes or their localisations.

Risk scenarios instead refer to the possible future evolution of the phenomena themselves, such as the possible duration of the swarm, the phenomena of seismic migration that accompanied both earthquakes and the possible activation of the now famous third segment.

Prevention, on the other hand, refers to all activities aimed at risk reduction within a much broader time horizon, and includes sub-themes such as building codes, risk regulation, hazard assessment along with the debate on the policies to “secure” buildings, neighborhoods or entire areas exposed to seismic risk.

Inevitably, although the number of categories may be expanded, it is virtually impossible for all cases to be described in such a way, making it necessary to create a residual category “other”. Although these data have only descriptive intents, in the dataset on the Central Italy Earthquake, the notion of historical seismology has been legitimated by the media as a way to assess hazard and explain in a more effective way ongoing phenomena, as it represents approximately 10% of scientific issue coverage providing a relevant matter of interest for both future research and science communication as well.

Such an analysis provides evidence of the changing role of scientists between the two considered events (see graph. 3). On the one hand, namely Emilia EQ, scientists were mainly asked to describe the events and their possible development on a short time perspective, as their role mainly consisted in providing diagnosis of the seismic crisis and possibly short time theories on its possible evolution. On the other hand, scientist got more space to talk about long time mitigation strategy along with other relevant scientific topics, such as historical seismology rather than results from up-to date research.



Graph. 3 - Recurring themes in media coverage of Emilia and Central Italy EQs.

The role of geoscientists including seismologists, geologists and physicists, deserves a closer examination. We first borrowed and readapted the marketing concept of “share of voice” in the analysis of the two different disasters. By “share of voice” we mean the percentage of news stories containing direct quotations of scientists in the overall number of articles considered. “Share of voice” should be intended as a direct measure of geoscientists’ ability to address media debates on scientific aspects of earthquakes, as well as their ability to influence the way news stories are framed by the media. According to Iyengar (1991: 163), the presence or the absence of interviews with “talking heads” (e.g. scientist) is an essential diagnostic criterion to identify thematic reporting, as it complies with journalistic norms about objective journalism. Data show that the “share of voice” of geoscientists has substantially grown from 2011 to 2016, both in absolute values and percentages (tab. 2).

Table 2 - *Share of voice of geoscientists*

	<i>Emilia</i>		<i>Central Italy</i>	
	N	V%	N	V%
Yes	49	32,9	57	41,0
No	100	67,1	82	59,0
Total	149	100,0	139	100,0

More in detail, geoscientists are more likely to be cited when the main issue of the article is about diagnosis (analysis and comments on ongoing events) or prognosis (short-time forecast and risk scenarios).

Table 3 - *News stories citing geoscientists and thematic areas*

		<i>Analysis and comments on ongoing phenomena</i>		<i>Risk scenarios (forecast)</i>		<i>Prevention</i>		<i>Other</i>		<i>Total</i>
		N	V%	N	V%	N	V%	N	V%	
<i>Emilia</i>	No	48	72,7	19	43,2	15	75,0	19	95,0	101
	Yes	18	27,3	25	56,8	5	25,0	1	5,0	49
Total		66	100,0	44	100,0	20	100,0	20	100,0	150
<i>Central Italy</i>	No	14	35,0	17	54,8	23	88,5	28	66,7	82
	Yes	26	65,0	14	45,2	3	11,5	14	33,3	57
Total		40	100,0	31	100,0	26	100,0	42	100,0	139

Nevertheless, data highlight some relevant changes in variable distributions between the two events (*Tab. 3*), and in 2016 researchers from earth sciences were mainly sought out for short time analysis on ongoing phenomena, losing some ground in relation to the elicitation of risk scenarios

and in addressing long-term prevention measures, where Earth scientists are basically replaced by engineers and risk managers².

Saliency indicators highlight a puzzling change in the way scientists' opinion appears in newspapers. Although one may expect to see an increased role of scientists in the media, newspapers made different choices, as it emerges from the distribution of mean values of normalised saliency index (NSI) of the news stories which were found to cite different kind of scientists and experts. Some interesting differences have been found between media saliency of scientists in the two events under consideration: geoscientists' saliency significantly decreased between Emilia and Central Italy events along with Risk Managers. Despite the growing relevance of prevention issues, engineers also lost something in terms of saliency, while other scientists (including figures such as psychologists, social scientists and economists) registered a significant increase.

Tab. 4 - *Normalised saliency index NSI: mean values in news stories citing different types of scientists.*

	<i>Emilia Earthquake (2012)</i>			<i>Central Italy Earthquake (2016)</i>		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
<i>Geoscientists</i>	0,3791	0,16784	49	0,2934	0,25006	57
<i>Risk Managers</i>	0,3885	0,24971	7	0,3082	0,25518	10
<i>Engineers</i>	0,3581	0,19079	16	0,3416	0,23139	31
<i>Other scientists</i>	0,3768	0,20719	8	0,4337	0,15139	10

4. Conclusions

Within a general hypothesis which provides that expert knowledge is used by the media to build a general representation of the disaster as well as a resource to cope with environmental uncertainty when earth systems disrupt

² Data showed that engineers were among the most prominent figures in the news coverage: during the Emilia earthquake, they were mentioned in 22.5% of articles, and this percentage increases up to 32.3% in the aftermath earthquake of Central Italy. Such a trend might be partially explained by the greater emphasis on prevention issues, which lead to a greater attention toward seismic and structural engineers.

the continuity of the recovery phase, it would be worth to see if geoscientists' visibility could be explained as an effect of endogenous factors rather than exogenous. We assume that endogenous factors are related to organizational needs of the newsmaking process (as recalled in media logic theory) while exogenous factors deal with the physical reality of the event, such as the maximum magnitude of earthquakes recorded in the day prior to publication, the occurrence of a big shake within some days along with the days elapsed since the first (big) event that triggered media attention, along with the fact that there were strong shocks in the previous three days ($M \Rightarrow M_w 5$). This is a theoretically relevant hypothesis that shows how the involvement of scientists stems more from the needs of news organizations to construct a satisfactory explanation of the disaster and to shore it up through the use of expert knowledge rather than depending only on the physical characteristics of the event itself (such as seismicity or the duration of the seismic crisis).

Media coverage of scientific issues tends to concentrate in the first days after the first main shock. Peaks in coverage (sudden rise of the number of news stories) appear to be closely related to three factors: A) physical intensity of the event (magnitude); B) loss of lives; C) social and political controversies arising from officials' evaluations and their supposed or expected impact on society and economics, as it happened during the Emilia crisis, when the Major Risk Commission's statement about possible seismicity migration triggered a little "news wave" about both risk and unintended consequences of such an evolution of the seismic crisis.

Relevant differences have been found in the way some scientific issues are discussed and presented, also affecting the role of single scientists and scientific institutions as legitimate holders of knowledge. Although scientists' role in general is shifting from the diagnosis of phenomena to that of expert advisor on mitigation policies, geoscientists are still asked to comment ongoing events and their possible short-time evolution.

Media should be seen as an arena, where different social actors are involved in a competition to get visibility and to stimulate responses by other social actors; indeed, a public exchange of statements and comments is likely to trigger both some reaction by other stakeholders and political controversies (Peters, 2007). As provided by the previously mentioned public arena model, different players engage in a competition to gain visibility and share of voice, and although individual scientists and scientific institutions still have a relevant role in media coverage of earthquakes, other players both from inside and outside scientific research are engaged in this vying for visibility.

Media interest for endogenous factors such as social conflict, perceived uncertainty and outrage must be considered both as a part and a consequence

of the newsmaking process. However, the media strongly rely on certified knowledge from scientific institutions and scientists recognized and legitimated as fair, objective and trustworthy sources. In such a situation, scientists and scientific institutions can no longer exclusively rely on reputation (reputation, fame and ability to influence academia) and they should improve their ability to both interact with the media and to “frame” political debate on future scenarios and mitigation measures that should be put in place. Between Emilia and Central Italy EQs significant changes occurred in the media portrayal of seismic phenomena and scientists’ work, and in particular, there was a marked increase in the weight of prevention frame (news stories mainly focused on risk mitigation issues), encompassed by a stronger presence of scientists, government representatives, politicians and risk managers.

Scientists and scientific institutions have improved their ability to interact with the media as well as to “frame” political debate on future scenarios and mitigation measures that have to come. The role of scientists appears to be partially related to their scientific leadership per se and partly to their ability to dominate media logic. Along with providing accurate explanations and scientific advice, scientists should improve their ability to provide a continuous flow of data and graphical information, such as shake maps or satellite images. Their ability to meet with the needs of the media and to build / restore reputation and credibility would likely result in an improved effectiveness of their communication strategies.

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Increasingly, socio-natural risks and disasters represent the result of an unsustainable interaction between human beings and environment. The current scientific debate has generally agreed on the idea that the impact of natural hazards needs to take into account the social vulnerabilities and exposures to risk of the affected population. The most recent earthquakes have unequivocally shown the complexity of the phenomena and their multi-scale dynamics. Indeed, the territory is the combination of natural, social and cultural environment and only by exploring its anatomy and physiology, it will be possible to manage and protect it in the best way.

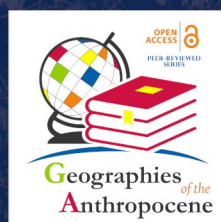
This volume collects a quite wider range of national and international case studies, which investigate how socio-natural risks are perceived and communicated and which strategies the different communities are implementing to mitigate the seismic risk. This publication has been possible thanks to a fruitful discussion that some scholars had at the 36th General Assembly of the European Seismological Commission held in Malta from 2 to 7 September 2018.

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