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SCIENCEQUAKE: A SURVEY ON THE ITALIAN SEISMOLOGISTS COMMUNITY ABOUT THE CASE OF THE ITALIAN SCIENTISTS CONVICTION FOR THE EARTHQUAKE IN L'AQUILA

G. Tipaldo[1], R. Carriero[1], A. Pizzo[1,2]
[1]*Department of Culture, Politics and Society, University of Turin, Italy*
[2]*Centro Interuniversitario Agorà Scienza, Turin, Italy*

Introduction. On 22 October 2012 the court of L'Aquila (Italy) sentenced to six years in prison six members of the "Commissione Grandi Rischi" (CGR, National Commission for the Forecast and Prevention of Major Risks, an official government body), founding them guilty of multiple manslaughter for having falsely reassured citizens five days before the devastating earthquake of 2009, which claimed more than 300 lives.

This paper, as part of a wider study on Italian researchers' science communication practices initiated in 2012 by the University of Turin (ISAAC - *Italian Scientists multi-technique Auditing and Analysis on science Communication*), will take the story of L'Aquila as a "revelatory" case study (Yin, 2003), uncovering the complex communicative interactions that today increasingly bind Science, Politics, Media and Society in risk assessment and uncertainty management. After proposing a theoretical model of interaction between the components mentioned above, the paper focuses mostly on the first of it – Science – presenting the main results of a CAWI (computer assisted web interview) survey on a sample of the Italian seismologists community from INGV and GNGTS.

The L'Aquila earthquake trial as a 'revelatory' case. We aim to use the L'Aquila earthquake trial – which lasted from September 2011 until October 2012 – as a 'revelatory case' of the deep and intricate relationships between Science (SC), Pseudoscience (PS), Politics (PO), Mass Media (MM) and Society (SO).

Fig. 1 shows a sketchy representation of the general framework within which we placed our work: the model is inspired by the so called «mediatization» model of political communication (Mazzoleni and Schulz, 1999). The «mediatization» model recognizes that the media have become «the most salient arena» (Dahlgren, 1995) for discussing relevant issues in contemporary democracies, providing a stage for «political plays» and simultaneously interacting with both politics and society, not rarely offering contents deeply affected by populism (Mazzoleni *et al.*, 2003).

According to our case study, we introduced two extra elements, Science (SC) and Pseudoscience (PS), the latter being conceived of as an endemic component of the social or the political system or both (depending on circumstances), that acquires public visibility and a certain degree of legitimacy whenever it enters the media arena.

Due to space limits, this work will be focusing only on one of the five components leaving the others – and their reciprocal interactions – to forthcoming updates. At least five reasons can be adduced to justify the choice.

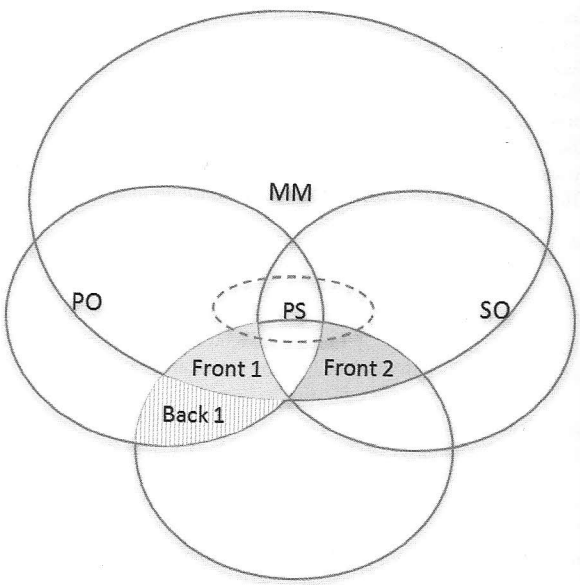

Fig. 1 – A model of mutual relationships between Science, Politics, Media and Society.

Firstly, the idea that a scientist could be prosecuted because of his/her scientific work, in advanced democracies, was something more suitable for history books than today's life. Not by chance, at least in the immediacy of the sentence, the media and not a few members of the Italian and international scientific communities spread the idea that the Italian scientists conviction was an attack on science, following the then Minister of Environment Corrado Clini, who claimed that the sentence had a sole precedent in trial held by the Catholic Church against Galileo Galilei in 1633.

This case – to move to the second reason – perfectly fits into the STS international debate on scientists' competencies when engaging with the public, pushing the discussion forward on key-points still not developed as much as it should be: how scientists think of their own role in risk assessment and emergency management, not excluding possible ethical implications; and how they represent the unavoidable – but sometimes "dangerous" – liaisons with politics in relevant decision-making processes. This is a crucial point in contemporary democracies, as Nature (2012) put down founding the verdict "perverse" and the sentence "ludicrous", worried about the serious implications «about the chilling effect on (scientists') ability to serve in public risk assessments».

A third point is about science, media and pseudoscience: an increasingly relevant twist of interests and communication strategies, which in the L'Aquila case is so sharp to be almost paradigmatic, gives the opportunity, for example, to explore whether and how Italian seismologists cope with a media logic (i.e. spectacularization and trivialization of information) keen on giving equal space to scientists and pseudoscientists (as defined just beyond), in a sort of «*par condicio*» or «equalization of positions» strategy of communication.

Lastly, we think it may argue for the sociological relevance of the study to survey for the first time the Italian seismologist community, the most directly affected scientific body by the quake in L'Aquila and what ensued.

Before moving to methods and results, it is important to underline that the five spheres composing our model are not to be intended as abstract categories. On the contrary, they precisely enclose specific social actors directly involved in the L'Aquila case. When we talk about MM, we refer to the huge video-textual documentation newspapers and televisions have produced over these years at a local, national and – not rarely – international level. By PO, we firstly and mostly intend the Italian Civil Protection and the CGR, whose members played a major role in assessing risk and managing the emergency in L'Aquila before, during and after the tragic earthquake of 6 April 2009. With SO we both refer to the Italian public opinion in general and to the citizens of L'Aquila, who more than everyone else have suffered the heavy consequences of the earthquake and a part of whom constituted as offended party kicking off trial against PO and SC. The "umbrella term" SC has in this paper quite a delimited semantic domain: it's the Italian seismologists community, where the six scientists sentenced came from. And PS is for us represented by the key-figure of Gioacchino Giuliani, a former technician of the Institute of Physics of Interplanetary Space detached to the National Laboratories of Gran Sasso. Giuliani made headlines by claiming to have predicted the disaster of April 6, 2009 with a radon detector. Yet, his profile is unfit to be represented as «experts» or «scientists» in seismology under many points of view: not appropriate CV, nor adequate academic qualifications, not belong to relevant research programs, list of publications without relevant peer-reviewed material.

Data and methods. Our data come from an online survey of 379 Italian researchers (from University, CNR, INGV and other research institutes) conducted in June 2013.[1] To reach the target population of Italian seismologists we used two email lists: GNGTS and INGV. From the former we deleted all the email addresses with an INGV account in order to avoid

1 This case study is part of a larger project (ISAAC) about science communication coordinated by prof. Sergio Scamuzzi at the Department of Cultures, Politics and Society, University of Torino.

overlaps with the latter. However we did not have direct access to the INGV list and emails were sent by staff of the Institute. After one invitation and two reminders, we received 241 valid questionnaires from the GNGTS list (response rate = 16.4%) and 138 from the INGV list (response rate unavailable)[2]. The low response rate from GNGTS is quite common in online survey: our previous questionnaire on science communication, addressed to a large sample of Italian academic scientists (ISAAC wave 1), registered a response rate of 17.4%. Unlike this case, however, we don't have *a priori* information about the target population of Italian seismologists, so we are not able to evaluate the representativeness of our sample. The latter can be characterized as follows:

- mean age is 46.1
- 64.9% are men
- 12.9% are university professors, 52.3% are research officers (at university and/or research institutes), 12.1% are technicians and 22.7% have other roles/positions (PhD students, post-docs, professionals, etc.)
- 62.1% belongs to academic/scientific associations or did so in the past

Moreover, based on reported main research interest, about 60% can be unambiguously classified as seismologists, while the rest are spread in other research fields (applied geophysics, volcanology, environmental geophysics, other).

The questionnaire included 19 closed-ended questions (52 items) focused on 4 topics: communication activities, attitudes toward the public of science, politics and the role of scientists, the case of l'Aquila (opinions on the sentence, its consequences, media coverage and media treatment of the case, the role of Giampaolo Giuliani). Twelve final questions provide information on the respondent.

Most opinion questions are Likert-type and require respondents to rate sentences on a 1-5 scale with labels only at extreme points (1=completely disagree; 5=completely agree). Principal component analysis and homogeneity analysis (Cronbach's alpha) revealed that the answers to three sets of questions can be summarized with summative scales. After appropriate reverse scoring, item ratings were averaged and three synthetic variables were created: attitude toward the sentence (6 items, alpha=0.83), attitude toward the media (5 items, alpha=0.65) and attitudes toward the role of Giuliani (5 items, alpha=0.70). All the resulting variables were re-scaled 0-10 where 10 means the most negative and 0 the least negative attitude toward the object probed (sentence, media, Giuliani).

Results. In this section, we comment upon the distributions of the most relevant items proposed in our survey. Particular attention will be devoted to any differences between INGV and GNGTS sub-samples.[3]

Topic 1: communication practices and attitudes. The answers to the question about involvement in communication activities during the last 5 years show that INGV researchers are more involved in such activities than GNGTS researchers, both during seismic events (35.8% vs. 23.9%) and during non-seismic periods or in low-risk areas (60.9% vs. 52.7%). INGV researchers, indeed, feel more prepared for public speaking during seismic events than GNGTS researchers (43.7% vs. 39.1%) and are more likely to have attended at least one specific course of risk communication (24,6% vs. 14.6% *). Consistently, a higher percentage of INGV researchers thinks that is important to attend courses on risk communication, public speaking and media analysis. The necessity of a specific formation, as opposed to a generic communication experience, is acknowledged more by INGV than by GNGTS researchers (76% vs. 63%*). However, data on participation in specific communication courses show that this research community (and/or their research institutions) pay more attention to the

2 It should be noted that the GNGTS email list includes also a number of people not directly involved in seismology. Thus, the response rate could be higher than actually calculated.

3 Statistically significant differences (p value < 0.05) are marked with an asterisk.

issue of scientific communication than the average of Italian researchers (only 6.1% attended a course; source: ISAAC wave 1).

More than half of the researchers surveyed (59.9% from INGV and 54.3% from GNGTS sample) have never been contacted by the media for interviews or comments about seismic risk, public safety and seismic risk prevention. Similar results have been found in the survey addressed to all kinds of scientists (ISAAC wave 1), suggesting that perhaps the media do not consider issues of seismic risk more important than other scientific issues.

Topic 2: representations and attitudes toward the public of science among scientists. Using semantic differential technique, we explored the image of public in scientists' mind. Researchers in both sub-samples think that their public is quite conditionable (about 75%), more biased than impartial, and more irrational than rational but, at the same time, quite open to dialogue. Moreover, the public is perceived to be older rather than younger. About 40% of INGV researchers (compared to only 19% of GNGTS researchers) think the public is "unable to learn".

GNGTS researchers believe that it is more important to transfer the scientific message rather than to engage with the public (51% vs. 42.8%*): this result could suggest different communication aims between INGV and other researchers. The former, as reported above, have more direct contacts with the public, especially in those critical situations such as during seismic sequences, when engagement and a more empathetic interaction with the public could be more necessary in order to establish a good communicative relationship.

Topic 3: politics, ethics and the role of scientists. The vast majority of researchers think that their research activities have relevant ethic implications (over 80% in both sub-samples). At the same time, 73.2% of INGV (vs. 58.6% of GNGTS*) researchers agreed that scientists should provide only technical evaluations when asked to cooperate with politics in decision-making about what to do during an earthquake sequence. Yet, according to 67.4% of GNGTS members (vs. only 38% INGV*) researchers are also required to provide an opinion on *how to manage* the risk situation. When we asked whether scientists have the duty to *publicly express* their disagreement with the operational decisions taken by governmental institutions, their answers were quite uniformly distributed along the scale, with a slight predominance of agreement scores, more marked among researchers from GNGTS.

Topic 4: the scientists facing the L'Aquila judgment. There are significant differences between INGV and GNGTS researchers about their (dis)agreement with the judgment of the court: 79.7% of the former disagreed completely or almost completely (scores 4-5) compared to 56.9% of the latter. However, when we asked their opinion on the idea that the ruling was a serious act of censorship of science like the process of the Church to Galileo, most of them disagreed (58.9%). We probed their opinion on the ruling by means of other items too. The index that summarizes their answers measures scientists' degree of hostility toward the ruling. INGV researchers scored significantly and substantially higher than GNGTS researchers (5.8 vs. 4.7 on a 0-10 scale).

With regard to the media coverage, the majority of researchers believe that information given by the media during the earthquake and about the judgment has been trivialized, dramatized and communicated superficially, and little room was available for scientists to explain the scientific points of view on the seismic events. In particular, most of them (70.9% GNGTS vs. 83.6% INGV*) accuse the media of having led the population to believe the radon thesis (as a reliable precursor for quakes) enjoys credibility from a scientific point of view, and of having given too much credit and visibility to Giuliani (92,6% INGV; 69.2% GNGTS*). About Giuliani, 89,7% of the researchers from INGV believe that he has no credibility in the scientific community but only 51,5% from GNGTS agree with this statement[4]. Researchers of both groups showed great uncertainty in judging whether Giuliani is credible or not in the eyes

4 However, 22.4% of GNGTS vs. only 1.5% of INGV has no opinion about scientific credibility of Giuliani.

of citizens. Overall researchers' attitudes toward the media and the role of Giuliani are more negative among INGV than GNGTS, as testified by significant differences in the scores on the synthetic indexes.

Scientists also believe that the ruling for the events in L'Aquila has negatively affected the availability of scientists to provide scientific opinions in institutional forums (82.4% GNGTS and 93.4% INGV*) and to communicate with the citizenship (about 70%). 45.4% GNGTS and 63.5% INGV* researchers believe that public's confidence in their research field decreased following the case of L'Aquila.

Conclusions. There are several significant and relevant differences between the two groups of scientists in various issues that our questionnaire touched upon. Generally speaking, INGV researchers seem to be more critical about the sentence, the media, and the role of Giuliani than their GNGTS colleagues. They also show greater sensitivity to communication issues, perhaps as consequence of their dramatic direct experience during the earthquake and the following months.

Both the INGV and the GNGTS groups recognize the earthquake coverage was affected by typical signs of the so called 'media logic' (trivialization and dramatization of information, deep emphasis, etc.). More, by claiming not to have had enough space to explain their point of view, they implicitly testify how still problematically they can cope with the media rules.

In fact, driven by a relentless research for emphasis and spectacularization in covering technoscientific issues (particularly those concerning controversies and conflicts) and with a strong propensity to alarmism, the media implicitly give the green light to pseudoscientists, social actors (e.g. Giuliani) whose profile is unfit to be represented as «experts» or «scientists» under many points of view, as briefly mentioned above. Yet, they claim to be admitted as fully qualified specialists in the public debate on Science and Technology, resulting not infrequently more appealing and understandable than the institutionalized scientists. The most evident media strategy that allows pseudoscience to enter the public arena in the case of the earthquake in L'Aquila – as somehow noticed by our interviews – consists in a sort of «par condicio» or «equalization of positions» approach. It refers to the media tendency, very strong in the Italian press and television, to provide public with bipolar representations of controversial issues. To those of the public less equipped to critically interpret media messages, science would therefore appear as perfectly divided into two parties, even in cases – e.g. the climate change, creationism vs. evolutionism, etc. – where the internal equilibriums of the scientific community are distributed in a very different way. The case of L'Aquila is a further radicalization of this strategy: not able to replicate any division within the community of seismologists (since scientists agree almost unanimously about the impossibility to predict seismic events), the Italian media have brought into the public debate a former technician of the Institute of Physics of Interplanetary Space detached to the National Laboratories of Gran Sasso, Giampaolo Giuliani, who claimed to have predicted the disaster of April 6, 2009 with a radon detector, without having any scientific trustworthiness in the field of seismology.

As new updates are needed to complete the in-depth exploration of what happened among the five components we briefly put in our model (fig. 1), what has been discussed so far seems to show that – while there is still much work to do to bridge science and society – such a desirable process can not be accomplished without the scientific community itself acquire communication skills and tools to effectively be on the media arena, also competing with social actors (i.e. pseudoscientists and other opinion leaders) that in an 'ideal' (as now utopian) context would not be considered competitors.

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BODY WAVE ATTENUATION OF KUMAUN HIMALAYA

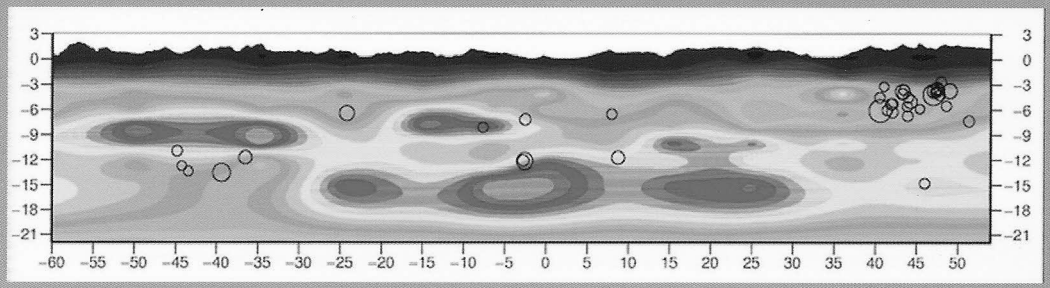
M.S. Chauhan[1], A.R. Bansal[2]

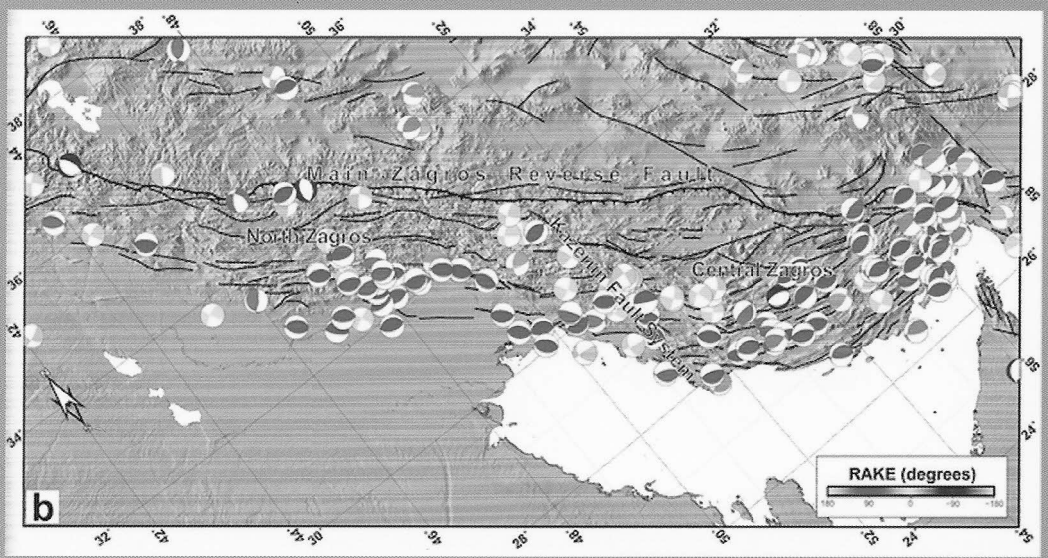
[1] University of Naples "Federico II", Naples, Italy

[2] CSIR-National Geophysical Research Institute, Hyderabad, India

Introduction. The Himalayan belt is formed due to the collision of Indian and Eurasian plates in the period 50-55 million years ago. This belt is seismically active and earthquake of varying magnitude are being observed. Most of these earthquakes are associated with great loss of life and destruction of property. For understanding of the nature of earthquakes and for reliable assessment of seismic risk in the Himalayan belt, knowledge and understanding of seismicity and the attenuation of strong ground motion are essential. Due to the vast natural resources in the Himalayan region, development of the region is being planned. For utilization of its resources major projects such as Tehri dam, Tunnels projects have been proposed. People living in this region are concerned about their survival due to the active seismicity of the region. In the light of the higher seismicity, an appraisal of the relation of earthquake occurrences with geology and tectonics of the region is very essential to make an assessment of the seismic potentialities, for survival of the lives and natural resources, and in designing of the major structures. The designing of earthquake resistant structures is a major challenge to the Civil Engineers. This challenge can be met if we develop ability to predict ground motion due to future earthquakes. The important structure such as nuclear power plants, dams, and high-rise buildings require estimate of ground motion for earthquake resistant designing. In the present work, we have made effort to understand the Body wave attenuation in Kumaun Himalaya using strong ground motion data (Kayal, 2008).

Geology of the Kumaun Himalaya. Himalaya is a large geodynamic laboratory of nature where orogeny is still in youth to early mature phases of evolution. It is one of the most active orogens of the world and is the consequence of the collision of the Indian plate with the collage of previously sutured micro continental plates of central Asia during mid to late Eocene. The Kumaun region of the Himalaya lies near the center of the Himalayan fold-and-thrust belt and is situated between the Kali River in the east and Sutlej in the west, including a 320 km stretch of mountainous terrain. This part of Himalaya exposes all the four major litho-tectonic subdivisions of the Himalaya from South to North. They are Sub-Himalaya, Lesser Himalaya, Great Himalaya and Tethys Himalaya. All the litho-tectonic zones are bound on either side by longitudinally continuous tectonic surfaces such as Main Boundary Thrust (MBT), Main Central Thrust (MCT), South Tibetan Detachment (STD) system and Indus Tsangpo Suture Zone (ITSZ). The Sub-Himalaya includes the molassic Siwalik super group of Mio-





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