An Alternative to Viewing Seismologists as Criminals

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Seismologists Enzo Boschi, Claudio Eva and Giulio Selvaggi, convicted of manslaughter

L'Aquila, a small town in the mountains of central Italy, suffered terribly in 2009, when an earthquake flattened the city's historic center and killed more than 300 people. This week, L'Aquila was the scene of another upheaval—the climax of a trial in which seismologists accused of failing to warn the public of the impending quake were convicted of manslaughter, and sentenced to prison. It was probably the first time such a trial has been held anywhere, but the situation that brought about that failure is familiar. Any merits of the legal proceedings aside, the case presents a clear sign that scientists must communicate more clearly to the public about natural hazards.

In the past few decades, we have learned much more about earthquakes, thanks, of course, to public investments in research. But, in a way, advancing knowledge helped set up the seismologists to take the fall. Old-fashioned fatalism about deadly disasters is correctly being replaced by a sense that we can apply science and technology to reduce the risk. Risk-reduction is a collective task for which the public has to rely on government authority. As a result, however, someone is sought to blame if something goes wrong. The advance of science has also made communication between scientists and the public more difficult. The characterization of future earthquakes is clearly improved, but remains inevitably vague because they are complicated and inherently unpredictable phenomena. In addition, earthquake risk tends to be extremely low in probability but high in impact, and thus difficult to convey to an unprepared audience.

In the months preceding the disaster, a swarm of some 400 small quakes--recognized in hindsight as foreshocks --were felt by residents, and this raised a call for consultation by government scientists and civil-protection officers. Just days before the main shock, those officials and scientists met and issued reassuring messages that seemed to justify a lack of emergency protection measures. They turned out to be wrong. Anger from people who apparently had the instinct to evacuate but felt misled is understandable. But with all due respect for all the victims, finger pointing after an essentially unpredictable natural disaster is not helpful, and may lead to a gigantic wasted opportunity.

The seismologists' main mistake was to allow themselves to be put in a position where they had to give a yes-or-no answer. They answered no--when in fact science can, and

should, provide a much more qualified answer. Weather forecasters do this all the time. Let's say a rainstorm seems headed our way; will it rain in our town or not? The weatherman will rarely say yes or no; he or she will offer what is called a probabilistic forecast—the percentage estimate of how likely it is the storm will arrive. Weather forecasters are getting better at this all the time, and the public is learning by experience whether to consider taking an umbrella when they hear there is a 30% chance of rain.

Like rain drops, earthquakes tend to cluster in time and space. Past seismicity can be used to forecast future seismicity in probabilistic terms. The mistake in Aquila points to the need for a routine probabilistic time-dependent evaluation of earthquake hazard, analogous to weather forecasting. We envision an algorithm, simple at first, which produces daily probabilities of damaging earthquakes, based on measurable parameters of the seismicity up to that day and possibly other relevant factors. The basic elements of such an algorithm already exist. In Aquila, given the protracted, unusual swarm of small quakes preceding the big one, any defensible algorithm would have raised flags. Seismologists would have been in a position to confirm that these had raised substantially the probability of a damaging earthquake, although the overall chance of such an earthquake remained unlikely – less than 50%[1]. The reaction should be gauged on the increase in probability not its value.

Such an algorithm might not be very reliable at first (like weather reports 30 years ago). But it would be objective, repeatable and in the public domain. Such an approach would serve several purposes. First it would be an appropriate daily reminder that measures are available to reduce earthquake risk. It would also teach the public to understand and weigh the probabilities. It would help the seismologist's task of conveying realistic appreciation of earthquake risk, which is generally low relative to many other risks, yet comes with very high stakes. We can afford a much higher probability of leaving the umbrella home on a possibly rainy day than we can afford to be sleeping in our house when it collapses.

Without that kind of language understood by all parties, seismologists in Aquila had to choose between yes and no, when "yes" meant a costly public evacuation effort and major disruption of people's lives. They were asked to take a decision that should not have been theirs. Improved public understanding of risk is essential for making good use of what we have been discovering about earthquakes and for effectively shifting to the public and their representatives decisions on protective responses. The dramatic people-versus-science saga in Aquila is a wake-up call: scientists need to communicate more and better with the public. If the public and scientists retreat from one another, they will be going in the wrong direction.

[1]The probability of a larger, damaging shock following an earthquake swarm is about 2% in Italy. See Grandori, Gungenti and Perotti, Bulletin of the Seismological Society of America, 78(4):1538-1549, 1988.