Panel Discussion

How Journalists Deal with Scientific Uncertainty and What That Means for the Audience

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Interest in how the mass media handle scientific uncertainty is fairly recent among both communication scholars and practitioners. Although scientists have long been riveted on the ways in which journalists and lay individuals interpret their uncertainty claims (badly, they argue, for the most part), it was not until late in the 20th century that communication researchers began to explore both the ways in which journalists "render" uncertainty for public consumption and how such messaging influences public perceptions (see, for example, Stocking and Holstein 1993; Friedman, Dunwoody & Rogers 1999). Today, our understanding of uncertainty representations and perceptions has been considerably enhanced by a wealth of scholarship, which is evident, for example, in two recently published special issues on "Scientific Uncertainty in the Media" (*Public Understanding of Science, 25*[8], 2016) and "Scientific Uncertainty in Public Discourse" (*Communications, 41*[3], 2016). In this panel discussion, a quartet of researchers examines these trends and some of the patterns they have unearthed.

Media Coverage of Uncertainty

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The traditional approach to science popularization distinguishes clearly between the production of scientific knowledge and its public communication. Many scientists believed that public communication of research should take place after the scientific community had "certified" new knowledge. Going public with a research finding before it had been published in a scientific journal was disapproved by the scientific community. For example, the so-called "Ingelfinger Rule" denied biomedical researchers publication of their studies in the prestigious New England Journal of Medicine if these studies had already been presented in the popular mass media (e.g., Relman 1981). There are some good arguments in support of that approach such as the possibility that

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premature science news, later found to be false, may have harmful consequences (Dixon & Clarke, 2013; Dumas-Mallet, Smith, Boraud, & Gonon, 2018). A survey among biomedical researchers in France, Germany, Great Britain, Japan, and the United States in 2005 revealed the continuing existence of the belief that public communication should follow scholarly publication (Peters et al., 2009). Yet, other answers suggested that scientists are prepared to share uncertainties and controversies with the public. Agreement to sharing uncertainties and controversies with the public was more pronounced among Anglo-Saxon researchers than among French, German and Japanese researchers.

Anyway, today's mass media, not to speak of websites, blogs and social networks on the Internet, are full of information that has not yet been published, that is preliminary, contested and controversial between scientists. Journalism increasingly reports on science in the making. Much of the online communication among scientists is open to the public such as in open access journals. Many scientists simultaneously address diverse audiences, including peers, students, journalists, and the interested general public, with their social media posts (Lo, 2016). Public communication of uncertainties and controversies among scientists and experts is almost unavoidable in the journalistic coverage of emerging technologies and knowledge relevant to policy-making. The ideal of a definite truth on which rational policy-making can be based, revealed by rigorous scientific inquiry and presented unanimously and with undisputed scientific authority, has become obsolete in "pluralistic knowledge societies" (Heinrichs, 2005).

There is no way to avoid the insight that, even if we grant science an epistemic privilege and even if we believe that there is something like a definite truth, we can never be absolutely certain that science has achieved that goal here and now. Besides basic epistemic challenges, the psychology of researchers and the social organization of research and its governance might bias scientific inquiry, scholarly publication and public communication. The presumption of sacrosanct science is thus normatively unacceptable and the inclusion of relevant uncertainties and controversies in public communication of science inevitable. Responsible journalists have to find a prudent middle way between the fatalistic assumptions that, on the one hand, any claim is as good as another and, on the other, unconditional trust in claims made by scientists.

Based on about 25 case studies of journalistic reporting on neuroscience in Germany, Lehmkuhl and Peters (2016) looked at how journalists dealt with epistemic uncertainty trying to answer two questions: Which factors influence whether journalists acknowledge uncertainty? And if journalists acknowledge uncertainty, how do they deal with it?

With respect to the first question the analysis showed that in several cases the possibility that the claims of scientists might be uncertain didn't cross the minds of journalists because of a lack of competence for science reporting. In other cases social factors dampened the journalists' motivation to explore uncertainty, for example, because they lacked sufficient "standing" in the editorial office to get support in a quarrel with scientists over the validity of their claims, or because freelance journalists anticipated that their stories would not be printed if they acknowledged uncertainty. Finally, in some cases uncertainty appeared irrelevant for the story, even if was noticed by the journalist. That was the case if the story focused on the person of the scientist rather than on knowledge, for example. Interestingly, Dunwoody (1992) presented a similar explanation for the omission of uncertainty information in risk stories, arguing that typical story frames in the field of risk reporting didn't offer a place for such information.

With respect to the second question, Lehmkuhl and Peters found that if journalists recognized the uncertainty of scientific claims as central to the story, they dealt with it in a variety of ways.

Journalists may sometimes simply skip a story if acknowledging the uncertainty of the core claim would ruin its news value. (Since Lehmkuhl and Peters' study was based on published stories, this coping strategy surfaced only as skipping of that part of the original story that was based on the uncertain claim.) In other cases, journalists include a reservation about uncertainty but still report the claim, or they implicitly show scientific uncertainty by including a critical comment or different opinion by another scientist. Most often, mentioning uncertainty tended to lower the news value of a story. However, the news value of some published stories derived from the uncertainty itself. That happened when a reported claim challenged established knowledge or when acknowledging uncertainty led to criticism of a conclusion, decision or project.

The latter case refers to an important insight into the use of references to scientific uncertainty by stakeholders, scientists and journalists: inclusion or exclusion of uncertainty information is not just a matter of accuracy but often a means of strategic communication (Guenther & Ruhrmann, 2016; Post, 2016; Post & Maier, 2016). Emphasizing or de-emphasizing the uncertainty of knowledge claims is a strategy of public communicators aiming at public attention, image, and persuasive impact. References to uncertainty help to form arguments such as that the evidence is not yet strong enough to legitimize costly action (a type of argument put forward by climate skeptics, for example), or that there is still too much scientific uncertainty about effects to justify a decision or action (a type of argument used by critics of techno-sciences, for example).

In their micro-level analysis of just one journalistic article, Simmerling and Janich (2016) illustrate the well-stocked rhetorical toolbox of journalists in suggesting uncertainty of claims. But more importantly, they demonstrated the rhetorical function of uncertainty as a means to frame the reported issue. The article they analyzed dealt with geo-engineering to counter the rising global temperatures. References to scientific uncertainty served to criticize the geo-engineering project on the grounds that its expected effects and side-effects are scientifically not well understood.

Because of the function of science to produce reliable knowledge, acknowledging uncertainty of knowledge may be thought to decrease public trust in the performance of science. In a hermeneutical analysis of media reporting on epidemiology, Jung (2012) has looked into the relation between accounts of scientific uncertainty in media stories and their implications for trust in science. She found two typical ways of how the media explained uncertainty: as a temporary phase in the scientific process of research or as resulting from corrupting influences of political and economic interests. She concluded from her analysis that the media tended to reinforce the epistemic authority of proper science in both cases by suggesting that science would deliver the expected reliable knowledge if it has sufficient time and the autonomy to work according to its established rules without interference from politics and economy.

The analysis of journalistic decision-making regarding uncertainty as well as in-depth analyses of media coverage suggest that journalism deals with scientific uncertainty in diverse ways. Epistemic uncertainty does not per se lead to distrust in science; journalists, rather, portrayed it as a normal phase in the scientific process. It represents a professional challenge for journalists insofar as acknowledging it in media stories may sometimes decrease their news value.

Journalists are more alerted regarding trust in the actual conduct of scientific inquiry if they perceive a link between stakeholder interests and accounts of certainty or uncertainty. That is the case if they perceive interests of stakeholders or science itself to influence knowledge claims, or if they perceive the strategic use of uncertainty information by scientists or other stakeholders in discourses. However, journalists too use references to uncertainty as a rhetorical tool in the framing of their stories.

Media Representations of Uncertainty: A Brazilian Case Study

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In many cases, even journalists who are concerned with covering properly scientific controversies can face challenges in putting theory in practice. This may be particularly true in moment of crisis, for example, during epidemics.

An example as food for thought is the epidemic of yellow fever in Brazil in 2017 and 2018. According to the Brazilian Ministry of Health, 353 cases of yellow fever were confirmed in the country from July 1, 2017, to February 6, 2018, of which 98 died. Another 423 cases were under investigation in the same period, with the aim to confirm a yellow fever diagnosis. From July 2016 to February 6, 2017, there were 509 cases of confirmed yellow fever and 159 confirmed deaths.

Because of the situation, the Brazilian government decided to start a massive vaccine campaign, aiming to vaccinate 20 million people. However, because there were too few vaccine doses for such ambitious campaign, it was announced that a vaccine that has one fifth of the standard dose would be provided. That, in turn, generated controversy about the uncertainties of the dose's efficacy, which was widely covered by the mass media.

According to the then-minister of health, Ricardo Barros, the so-called "fractional" vaccine was adopted following a recommendation and permission of the World Health Organization (WHO). It was argued that it provides the same protection, but for eight years: the standard vaccine is supposed to protect the person for the rest of her/his life.

However, on February 2018, when both the epidemic and the controversy were in high gear, a short communication published in the journal Memórias argued against the WHO recommendation that a single standard vaccine dose was enough to confer life-long protection against yellow fever infection. According to the author, Pedro FC Vasconcelos, further discussion on yellow fever vaccination strategies for people living in or travelling to endemic areas was required (Vasconcelos, 2018). Both the researcher and the journal, actually, are linked to the Oswaldo Cruz Foundation (Fiocruz), the main health research institution of Latin American, which is linked in turn to the Ministry of Health and is also the producer of the vaccine. To make the issue even more complicated, Fiocruz has a trusted position in society (it is actually the research institution most identifiable to Brazilians, according to national surveys). As such, Fiocruz has an important role in supporting the vaccine and should advocate in favour of vaccination.

In other words, the main health research institution has the very challenging role of producing the vaccine, advocating in favour of the vaccine and also producing scientific knowledge that can actually shed light on controversies surrounding the vaccine.

Scientific Uncertainty – Making Trust a Necessity?

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People all over the world are confronted with scientific knowledge in their daily lives, not only when using information (e.g. reading a newspaper article about climate change) but also when making decisions relevant to their daily lives (e.g. choosing a medical treatment) or engaging in political

debate and decision-making (e.g. the banning of one-use plastic items). It might be difficult to make up one's mind based on the vast amount of information that is accessible from different sources and in different qualities. Furthermore, science is subject to unbound complexity (Keil, 2008) and epistemic uncertainty (Peters & Dunwoody, 2016). Scientific knowledge is continuously growing, resulting in ever more fine-grained specialization. Furthermore, scientific knowledge becomes reliable only through continuous testing and debate within the scientific community, producing "core knowledge," which represents the current accepted state of knowledge (Cole, 1995) but only over time, while a lot a knowledge at a given time is still up to debate.

In consequence, communicating science often entails dealing with uncertainties, or conflicting claims and positions. Because of their bounded understanding (Bromme & Goldman, 2014), laypeople find it difficult to judge the plausibility (the subjective veracity) of communicated scientific information not only because of limited knowledge of science, that is, background knowledge about the topic, but also because of limited knowledge about science, that is, how science is made. In consequence, it might also be difficult for laypeople to identify reliable evidence.

However, young children are already able to identify trustworthy sources of knowledge and are wary of what appear to be untrustworthy informants (Harris, 2012; Sperber et al., 2010). In fact, deciding whether to trust sources of information might be a way to decide about its believability when judging its veracity is difficult (Hendriks, Kienhues, & Bromme, 2015). We found that, when asked to judge the trustworthiness of science communicators, laypeople differentiate among a communicator's expertise, integrity, and benevolence (Hendriks et al., 2015). For example, a communicator's motives (to convince vs. to inform) might inform laypeople's reasoning about epistemic trustworthiness (Rabinovich, Morton, & Birney, 2012), and they use information disclosed by the science communicator to infer such motives. In fact, if scientists disclose the uncertainty inherent in their work, laypeople seem to find them more trustworthy (Jensen, 2008). Similarly, including uncertainty estimates might benefit the trustworthiness of information (Joslyn & Leclerc, 2016), possibly because information might then seem more scientific (Thomm & Bromme, 2012).

These results illustrate that the disclosure of uncertainty might benefit laypeople's estimates of the believability of information and the trustworthiness of its source. This is why it is important that epistemic uncertainty be communicated. Furthermore, such results point toward a normative educational aim, namely teaching knowledge about science (process knowledge and epistemic knowledge) (OECD, 2016). Also, in science communication such knowledge could be communicated alongside uncertainties, such as methods to achieve reliable knowledge (Wilholt, 2013), and expert consensus (Oreskes, 2007). This might reduce the risk that uncertainty is misunderstood or overestimated, for example due to a journalistic default to balance contradictory positions in stories (Boykoff & Boykoff, 2004), due to political and cultural beliefs (Kahan, Jenkins-Smith, & Braman, 2011; Levy, 2017), or when uncertainty is used to manufacture doubt (Mercer, 2016; Oreskes, 2015).

When More is Not Better

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Interest in uncertainty stems in part from a concern that lay individuals often do a poor job of understanding the concept and of building it into their judgments about science and risk. But while

that concern is real, I would contend that much research on perceptions of uncertainty fails to explore what the concept actually means to a non-expert. In this brief presentation, I offer a couple of factors that are important to lay perceptions of uncertainty and then suggest a strategy for communicating uncertainty in stories about contested science that takes those factors into account.

More than 35 years ago, Kahneman and Tversky (1982) made an important distinction between external and internal uncertainty. We attribute uncertainty to external actors whenever we judge uncertainty to be driven by events in our world that we cannot control. In contrast, internal attribution of uncertainty occurs whenever we judge uncertainty to stem from insufficient knowledge, that is, attributable to internal factors in ourselves that we, in principle, can control. Much research focuses on exploring ways of packaging the uncertainty judgments of experts to maximize lay comprehension, but little of that work truly takes internal uncertainty into account.

Another important element is that most of us are heuristic information processors. That is, even when confronted with an issue important to us personally, we engage in only enough seeking and processing to attain a level of comfort in making a decision. And what counts as "enough" is often startlingly sparse. Psychologists have long noted our tendency to rely on heuristic cues, informational shortcuts that can be as superficial as a single attribute, such as brand name, a uniform, an ideological label, or the identification of someone as an expert. Important for our purposes here, the ubiquity of heuristic processing may exacerbate internal uncertainty, the perception that an individual knows too little to make sense of a risk.

Journalists fail to take that possibility into account when writing about complex scientific concepts and processes. Our tendency as journalists is to provide more explanation rather than less when we judge material to be complicated or contested. However, while we will always have some readers who will make an effort to engage in effortful, systematic processing of details, the typical reader—particularly online—is unlikely to abandon her heuristic cues. And that raises the possibility that, under some circumstances, providing less information may make uncertainty judgments by readers more interpretable than providing more.

A suggested communication strategy

The "he said/she said" story, common to much coverage of controversial science, has long been acknowledged as a structure that can make the uncertainty of the science loom larger than it actually is (Stocking, 1999; Corbett & Durfee, 2004). Adding more detail to that balancing act may exacerbate the problem. For example, in one recent study, a US psychologist found that adding comments from experts with differing views to an issue statement created confusion among readers about the extent of expert support for the statement even when one of the claims was clearly identified as supported by the bulk of experts (Koehler 2016). Put another way, even minimal detail—in this case the addition of a quote by an expert to who supported the issue position and one by an expert who did not—led readers to perceive a greater level of uncertainty about the level of expert support than was warranted.

One strategy for communicating uncertainty more accurately in such situations might invoke a two-step process:

1. Take a weight-of-experts approach to conveying uncertainty
2. Make available to that rare systematic information processor the opportunity to engage with more explanatory material via the story's web site.

A weight-of-experts strategy takes advantage of a common heuristic: that individuals value the recommendation of experts. The strategy offers a straightforward statement about the extent to which scientists with issue credibility (i.e., climate change researchers in the case of global warming) support or reject a truth claim but then—importantly—provides no additional details or quotes. We have found that such a statement, employed in a story about a non-politicized disagreement among scientists, prompts readers to more accurately assess the state of expert support for a truth claim and, subsequently, to use that judgment to reach their own conclusions about what is most likely to be true (Dunwoody & Kohl, 2017). Since such a brief articulation offers no additional detail, the second step—identifying opportunities to go deeper in one's web site to find more detailed explanations—would offer more systematic seekers and processors the kind of explanatory material they need.

What does a weight-of-experts statement look like? Here is one example, beginning with more typical journalistic story content and then revising "down" to that single statement:

Too much detail:

The city's newly picked top health official told a radio audience that "the science is still out" on whether there is a link between some vaccines and autism.

"I don't think the answer is yet there. I mean, there's still people who believe it," Patricia McManus said on a local talk show. And so I don't know. I think the science is still out."

Her comments drew sharp criticism from several experts in the field, who cited research by the federal Centers for Disease Control and Prevention and National Institutes of Health.

"Unfortunately, she couldn't be more incorrect," said James H. Conway, a pediatrics professor at University of Wisconsin School of Medicine and Public Health. "The science is clear and has been reviewed over and over not just by the CDC but by NIH and numerous studies. The information is clear that the measles, mumps and rubella vaccine does not cause autism."

A weight-of-experts version:

In the face of comments by a newly appointed city health official expressing uncertainty about evidence linking vaccines to autism, leading authorities on vaccines today reiterated that the science is clear: vaccines do not cause autism.

To learn more about the science, go here: https://autismsciencefoundation.org/what-is-autism/autism-and-vaccines/

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