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Public involvement in risk governance in the internet era: impact of new rules of building trust and credibility

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ABSTRACT

The article draws attention to the multidirectional impact of the widespread Internet communication on public involvement in risk governance processes. The prevalence of Internet communication changes the rules of building credibility and trust, and a position of expert knowledge. As online peer-to-peer information are not verified by any single trustworthy institution, the expert community often perceives it as a source of disturbance in risk governance. We refuse to frame online communication simply in terms of a threat to responsible dealing with risks and, instead, demonstrate how it creates new conditions for public involvement in risk governance, which may strengthen or hamper responsible risk governance, potentially compensating for the shortcomings of the system based solely on state agencies' activities. Basing on the qualitative analysis of three critical cases, we show how the involvement of Internet-enabled groups impacts the risk governance of specific issues in Poland. Specifically, the Internet-enabled participation amplifies evidence-based concerns (the case of city air pollution), signals new "unknown unknowns" (the case of fracking), or weakens procedures based on the body of scientific knowledge (the case of vaccination controversy). To decide when and how to harness the potential of internet-enabled public involvement and when to focus on limiting the harms it may engender, we propose a framework that takes into account the level of uncertainty, the extent to which risk mitigation policy in place reflects the scientific consensus (if there is one), and the accepted rules of credibility and trust by Internet-enabled groups to expert knowledge. We claim that risk governance processes should routinely involve analyses and actions aimed at governing risks that ignore the impact of widespread Internet use may prove counter-effective.

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1. Introduction

According to the last assessment (Kemp 2020), 2019 saw more than 4.5 billion people online, which makes 60% of the world's population connected to the Internet, with more than 3.8 billion active social media users; from 2010, the number of global Internet users rose more than tenfold. Internet penetration varies from 34% in Africa – a number that grew 10% year-to-year from 2018 to 2019 – to 84% in Europe, reaching more than 98% in some countries. As the average Internet user spends more than six hours each day connected to the Web, it changes their forms of communication, daily habits, ways of organizing work, and managing personal and social life.

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Moreover, the Internet's prevalence has an enormous impact on how people perceive risks caused by different processes – from global warming to mass migration – or new and old technologies, from vaccination to 5 G. By enabling alternative ways of knowledge creation and sharing without the control of traditional "gatekeepers" – like editors of media outlets or authors of non-fiction books – the Internet use fosters the formation of groups engaged in discussions on risk identification and mitigation. The Internet use not only allows people to reach and share different sources to discuss potential risks and remedies – or deliberate on whether and under which conditions they are tolerable – but they also organize and lobby for solutions, which draws on the particular perception of risks.

This situation creates new conditions for public involvement in the process of risk governance, which we understand as "both the institutional structure and the policy process that guide and restrain collective activities of a group, society or international community to regulate, reduce or control risk problems" (Renn, Klinke, and van Asselt 2011, 231). In contest to more traditional approaches that solely rely on actions of hierarchically organized governmental agencies, risk governance assumes that a "variety of actors, their perceptions and evaluations draw on a diversity of knowledge and evidence claims, value commitments and political interests in order to influence processes of risk analysis, decision-making, and risk management" (Irwin 2008). Thus, what becomes central for the whole endeavor is multidirectional communication with diverse groups of stakeholders through a whole process of risk governance, from risk framing to evaluation. What amplifies this diversity is the prevalence of Internet communication, with multiple groups establishing its own rules of credibility and trust. Thus, the Internet communication shapes the public involvement in risk governance and has a profound and multidirectional – yet underinvestigated – impact on the very way we construct and deal with risks.

Building on the analysis of three critical cases, this article offers a conceptual reflection on how modern practices of the Internet use create new conditions of broader public involvement in different stages of risk governance (Renn 2008). We are primarily concerned with the question to what extent – and under which conditions – the Internet-mediated public involvement contributes to the more responsible risk governance, compensating the shortcomings of the system based solely on the activities of state agencies. We show that whether these practices weaken or strengthen responsible risk governance system depends on the very characteristic of the risk, mainly the level of uncertainty, and the extent to which risk mitigation policy in place and Internet-enabled groups rely on the expert consensus (if there is one).

Despite the importance of Internet use for the practice and theory of risk governance, risk researchers seem to largely overlook this breakthrough. Chung (2011) and Chong and Choy (2018) discuss online risk amplification but do not consider the Internet's impact on risk governance. Similarly, the matter of the Internet's impact on risk communication surfaced in individual case studies (e.g. Stasik 2018; Fellenor et al. 2017). Regan et al. (2016: 8) demonstrate that in the eyes of key stakeholders responsible for risk communication, the most significant negative aspect of online communication is the spread of unverified rumors through social media networks. Recently, Berti Suman (2019; 2020) analyze the impact of co-created online maps on risk governance of air pollution. However, to do justice to the scale of the change, the Internet's impact requires comparative studies and deeper theoretical reflection. Other disciplines of social science also focus on how the Internet causes new risks rather than on how it affects the very construction of risks and impacts mass participation in risk governance. To name just a few examples, scholars consider how the Internet endangers privacy (Beldad and Koehorst 2015), the mental health of children and teenagers (Livingstone and Haddon 2009), and intellectual property (Halbert 2011). In 2018, the public scrutinizes alarming reports on the impact of online propaganda on parliamentary and presidential elections, along with the spread of prejudice (Bakir and McStay 2018), which clearly signals the urgency of further studies on how the Internet use influences many areas of risk governance.

Therefore, this article seeks to fill this gap by examining different modes of engagement of Internet-enabled social groups in risk governance processes. To that end, we first analyze new modes of building credibility and trust that emerge from the collaborative Web 2.0 and 3.0 (Mrabet 2016). Next, we shortly discuss the role of public involvement in risk governance, stressing the role of inclusivity and broad involvement for responsible risk governance. Then, to scrutinize the relevance of Internet-enabled changes in communication and building credibility and trust for the practice of risk governance, we offer qualitative investigations into three critical cases of Internet-mediated public involvement in risk governance in Poland. Namely, we scrutinize the rise of anti-vaccination attitudes, opposition to shale gas production, and urban air quality management. To better understand the challenges to and opportunities for risk governance in the Internet era, we conclude by developing a framework that analyze different impacts, encompassing the level of uncertainty, and the extent to which risk mitigation policy in place and the accepted rules of credibility and trust developed by Internet-enabled groups.

2. The internet and new modes of building credibility and trust

Let us first critically discuss how the widespread use of the Internet transforms the construction of trust and credibility, which are the critical factors in risk governance processes (Renn and Levine 1991). Various information available online – from social media discussions through reports of different expert institutions to academic publications – increasingly become the default source of knowledge for the general public and experts alike. In fact, the more we use the Internet in general, the more we trust information online (Bierhoff and Vornefeld 2004). Recent studies confirm that the Internet became the number one source of academic information for most people in the Global North (Brossard and Scheufele 2013). According to the National Science Foundation (USA), over 60% of Americans in search of scientific information turn to the Internet, while only 12% of them rely on online versions of traditional media, such as newspapers or magazines (National Science Board 2012). In the European Union, 67.5% of people use the Internet regularly while 54% seek information on subjects of health and academic knowledge online (European Commission 2012).

With functionalities like discussion fora or groups, the Internet allows for gathering people concerned with the same topic, in a similar life situation, or sharing a common passion – e.g. people on a diet, patients with a specific condition, expecting mothers, sports fans – and to share support and knowledge, coming both from individual experience and more-or-less reliable external sources. Indeed, in sustainable long-lasting online communities, rules of credibility may be quite strong, but they may or may not follow procedures of mainstream science or expert institutions. In they do, the credibility of scientific and expert knowledge shared in online groups is stronger due to the fact that it is presented by peers and not by distant experts. The impact of pieces of information may also gain in strength thanks to the fact that context makes it more emotionally loaded – and often actionable. That is, expert knowledge not only is *not* disregarded, but it is more impactful thanks to the mediation of Internet-enabled social groups. At the same time, groups' identity and legitimacy may be strengthened using scientific sources. What provides good example of such a dynamics are online groups that stress the gravity of climate crisis basing on expert reports and academic articles.

Another example of peer-to-peer activity that supports scientific consensus and strengthen science's outreach is Wikipedia: one of the biggest successes of participative alternative modes of knowledge accumulation and distribution, yet one following scientific consensus in its knowledge reporting. Even though the academia often treats Wikipedia with suspicion (Jemielniak and Aibar 2016; Konieczny 2016), independent studies consistently consider Wikipedia to be accurate and filled with a similar number of errors than the more "professional" resources (Reavley et al. 2012; Jetty, Yacob, and Lotfi 2014; Giles 2005). The generally high quality of

information available on Wikipedia and its free, open, and easy access naturally contribute to the trend of trusting the Internet. One of the reasons for Wikipedia's relative success in presenting balanced information is a meticulously developed system of crowdsourced quality control and well-established governance rules that assure the verifiability of sources and credibility of cited materials (Jemielniak 2016). In line with the spirit of new collaborative society approaches (Jemielniak and Przegalińska 2018), Wikipedia relies on the rejection of any formal authority: in fact, its community of authors strongly frowns upon anyone who claims academic credentials. Instead, the community transfers trust from credentials and people to procedures and the system (Jemielniak 2014; Reagle 2010). As long as the contributors follow the rules, the community assumes that the formal education of the author is entirely irrelevant. The rules of article elaboration on Wikipedia require using verifiable, reliable, and published sources.

The drive to spontaneously cooperate in knowledge exchange is highly visible in many other online communities. However, many of them either do not have systems and procedures as well developed as Wikipedia, or they do not put so much emphasis on academic knowledge for reasons explained above. Consequently, in many cases, the online communities participate in disseminating knowledge that may contradict the dominant system or at least not treat it as correct by default, unless proven otherwise. Moreover, the identity of some online groups may be built around the skepticism toward institutions of science. That may partly result from a disbelief in the academia and scientific objectivism (Bernstein 2011) growing in parts of the society. This growing skepticism is possibly linked to well-proven failures of trust in the scientific world (Brown and Zavestoski 2004) and suspicions about the corruptive power of big corporations (Krimsky and Nader 2004). The cases of tobacco or sugar production lobbies purposely misleading the society by misinformation about the health hazards associated with their products or the gas and oil industry neglecting the climate science are well-known examples that profoundly affected the common understanding of risk identification (Taubes 2017; Heiss and Bates 2016; Smith et al. 2011; Oreskes and Conway 2011). Hence, for some of Internet-enabled groups, the turn to online peer-to-peer knowledge sources may be the symptom of weakened legitimization of the social order, with the dominant role of the states and corporations with science in their service. It goes hand in hand with the sentiment that some inconvenient or shocking truths may be systematically hidden from the public (Böschen et al. 2006; Japp 2000; Oliver, Eric Oliver, and Wood 2014). Similar conspiracy theories are particularly abundant in discourse about the so-called "Big Industries," such as the Big Pharma, Big Food, or Big Energy. This perception further encourages trusting online sources of information, perceived as uncontrolled by mainstream agents like governments and corporations. Such a behavior is particularly common for those who experience the "non-knowledge effect:" they fear that they do not know enough, while they cannot fully trust mainstream information sources. The need to know the origin of the information may still be very strong (Durant 2010), yet many perceive traditional hierarchical knowledge sources as illegitimate because controlled by those interested in hiding the truth.

Another reason for online knowledge creation and dissemination is the general dislike for structured and hierarchical authorities. The emerging collaborative society increasingly relies on technology and the Internet to redefine the role of expertize and academic credibility (Jemielniak and Przegalińska 2018). Many of new knowledge communities often rely on a participative model and challenge the traditional expertise and formal knowledge hierarchy. As the choice of mode of knowledge creation intertwines with the way of experiencing the world – even if not fully conscious – the rejection of formal knowledge structures becomes a philosophical and generational statement. Consequently, alternative knowledge communities rely on opposing mainstream views, cherry-picking, or interpreting scientific facts differently (Goldner 2004), often seeing value in the polyphony of narratives and disliking the dominating character of scientific consensus (Visvanathan 2006). As a result, they shape an alternative cultural recognition of scientific consensus, which results in a redefinition of cultural perceptions of different risks (Kahan, Jenkins-Smith, and Braman 2011).

To summarize, the variety of Internet content becomes the default source of knowledge and scientific information for a growing part of the population, regardless of sociodemographic variables like education type or level. Depending on her interests and previous experience, the Internet user may reach both information produced by the traditional knowledge system – such as academic or press articles available online – or content produced by different online communities, from Wikipedia to less structured and more ephemeral groups active on various social media channels. Peer groups that share their experience, discuss and interpret research results and other materials distributed online may create their own rules for the credibility of different knowledge claims. Some of these claims may not conform to scientific methodologies.

The Internet's widespread use transforms the prevalent approach to the authority of certified experts: the representatives of science, the state, and agencies responsible for risk management. In its multiple forms, peer-to-peer and collaborative learning often replace reliance on expert opinion. This event puts expert knowledge in a new situation: its impact may be amplified or weakened by online communities, depending on the binding rules of credibility. If expert knowledge is amplified, elements of research are more accessible both cognitively and emotionally because people from online communities share and discuss them, as it simultaneously built and strengthen collective identity. Online discussions help to embed abstract findings or recommendation in the specific experience of peers, thus making knowledge more actionable. If expert knowledge is weakened, alternative rules of credibility may lead to the rejection of scientific consensus, again rooted in a strong collective identity, reinforced by the virtual presence of peers who share the same attitude. This new situation of more fragmented and diversified epistemologies impacts the shape of public involvement in the process of risk governance. In a growing number of cases, groups formed and sustained by means of online communication join heterogeneous groups of stakeholders who partake in risk governance by offering their opinion or lobbying for specific decisions on how to understand and deal with risks.

3. The changing role of public involvement in risk governance

The concept of governance, broadly used in social science to describe the transformation of power and agency, denotes the informal and formal processes and institutions that guide and restrain the collective activities of a group (Keohane and Nye 2000). Applied to risk problems, the concept of risk governance assumes that the task of risk mitigation is no longer the sole responsibility of state agencies but, instead, it is performed as a collective activity of heterogeneous groups of actors, who engage in the process of risk problems' identification, evaluation, regulation, and reduction. That is, apart from traditional governmental actors, stakeholder such as representatives of science, industry, and society are included in the policymaking and implementation of risk management.

Therefore, risk governance relies more on transparency in communication between experts, decision-makers, and the public, along with increased stakeholder participation (Renn, Klinke, and van Asselt 2011, 233). Moreover, this inclusive, complex, and network-based model appears more adequate in the face of risk's changing nature: risk managers often deal with systemic, uncertain, and ambiguous risks (van Asselt and Renn 2011; cf. the discussion on post-normal science, e.g. Funtowicz and Ravetz 1993; Healy 2011). Science and technology studies investigation of the construction of expertise and knowledge backs this approach with theoretical arguments and empirical cases (cf. e.g. Irwin and Michael 2003; Dryzek et al. 2009; Jasanoff 2011), demonstrating the benefits of involving the public in decision-making on issues previously reserved to experts only. In response to the changing nature of risks, public controversies on the multidimensional impact of new phenomena become a valuable resource that enables the community to detect "unknown unknows" rather than simply hinder efficient decision-making (cf. Callon, Lascoumes, and Barthe 2009).

In consequence, the task of risk communication functions not as a separate phase in which well-informed experts and representatives of state agencies transmit knowledge to the passive public. Instead, communication should flow among different stakeholders and accompany all phases of the governance process, from pre-assessment through appraisal and evaluation to management (Renn 2008, 47–48). Such a communication model serves different goals, from discussing values and interests through sharing experience and information to building support for decisions (van Asselt, Renn, Klinke, and van Asselt 2011, 439 and 440; Löfstedt 2003). Inclusive communication at different stages ensures that the process of risk governance is more open and iterative rather than closed and linear. In our reading, the Internet creates an opportunity for risk managers to interact and engage with multiple publics (Regan et al. 2016) and implement postulates of constant communication. The Internet creates spaces for social discussion about which risks are tolerable and acceptable, which are one of the most controversial issues in risk governance processes (Renn, Klinke, and van Asselt 2011).

The widespread use of the Internet lowers the entry barrier in the public discussion on risk governance. Under current circumstances, not only well-established representatives of civil society – like acclaimed NGOs – can partake in this process but also smaller or even marginal groups determined enough to communicate their position to other actors engaged in risk governance. At the same time, processes described in the previous section changed the rules of creating the credibility of evidence claims and trust among parties, thus magnifying the diversity of voices heard in each discussion.

To summarize, the model of risk governance frames the communication between different stakeholders as the prerequisite for a successful process, and it assumes contribution from previously excluded parties such as social movements and citizen advocacy groups. Thus, in parallel with the development of new modes of peer knowledge sharing on the Internet, there emerged a less centralized and less hierarchical model of risk governance. In this alternative model, new actors like NGOs and social movements gain the position of legitimate partners.

In order to scrutinize real-life consequences of the Internet-enabled participation of different stakeholders in the processes of risk governance, we will review three cases that illustrate different effects of Internet-enabled activities related to risk governance. Our comparison will allow us to propose a framework of relations between the Internet-mediated involvement of publics and expert knowledge in the processes of risk governance.

4. The internet and risk governance

4.1. Case selection

Due to the widespread use of the Internet, virtually every public discussion about risk identification and mitigation occurs not only in traditional channels but also in the virtual space. This statement holds true for cases from the highly controversial procedure of shale gas production ("fracking;" Hopke and Simis 2017) to the niche topic of ash dieback disease (Fellenor et al. 2017). It is not to say that other, more traditional settings lose relevance. On the contrary, the Internet exchanges add a new layer to all of the more traditional activities (Stasik 2018), from parliamentary hearings through official stakeholder meetings to grassroots gatherings and chats with local opinion leaders. Facing a large number of cases, we decided to base our conceptual reflection on theoretical sampling, taking into account the following conditions:

- To secure the homogeneousness of the sample, we narrowed the pool to the cases in which chemical agents potentially threaten human health. Thus, we set aside public debates on issues of national security, political risks, or threats to the environment that do not mention the physical well-being of people.

Table 1. Selected cases against strong scientific consensus.

	Low uncertainty/strong scientific consensus
Universal vaccination is a safe measure to control the risk of epidemics	Yes
Shale gas production processes are safe for the human health	No
Air pollution in populated areas has a strongly negative impact on the human health	Yes

- To secure the relevance of our sample, we decided to follow globally discussed cases in their local manifestations. We start with the presentation of a specific global challenge so as to later focus on a situation in the selected country. To exhaustively scrutinize our cases, we closely consider the issues from one country: Poland. Poland has high Internet penetration and – like many other countries of the former Eastern Bloc – it has a low level of general trust in others and low level of trust in the government (Domański 2014a; Domański 2014b). Moreover, the level of structured institutional public involvement in shaping public policies and risk governance system is rather low, with the dominance of a hierarchical state-centered approach. That is, inclusive risk governance is a normative postulate rather than an empirical fact.
- As our interest lays in the interactions between the level of uncertainty, and the extent to which risk mitigation policy in place and Internet-enabled groups rely on the expert consensus (if there is one), we selected the cases that differ in the level of uncertainty/existence of the strong scientific consensus (Table 1).

Although the cases under scrutiny are by no means representative – in statistical meaning of the term – we believe that they provide rich material for theoretical considerations and a good point of departure for further validation studies.

4.2. Vaccination and new risks for public health

The rise of Internet-enabled anti-vaccinations group seeking to modify policies on the mitigation of infectious diseases risks best illustrates the biggest challenges facing responsible risk governance in the face of internet-enabled public involvement. In this case, due to the uninvited participation of a new actor, the once settled issue stemming from expert knowledge and universal consensus is again subjected to a heated debate and presented to the public as uncertain and ambiguous.

The management of infectious diseases risks by universal vaccination – after many battles at the beginning of the vaccination history – used to be socially accepted, with the assumption that risk for vaccinated individuals is much lower than health benefits of both individuals and the whole population. Decisions regarding mandatory children vaccination are taken by the government advised by experts without public consultations, and these decisions were followed by parents for decades. Based on that policy, many children vaccinations are mandatory in the Poland. The policy follows a scientific consensus on optimizing the overall social benefits, reducing health hazards, and the financial burden of treatments, not to mention contributing to the GDP growth (Masia et al. 2018). However, the last decade witnessed a systematical increase in the number of children in Poland without mandatory vaccination, which mirrors the trend in many other Western countries: from 5,300 refusals in 2012 to more than 50,000 in 2019 (Stachura 2020). Despite possible administrative penalties and fines, the final decision about vaccinating a child in Poland ultimately resides with the parents (Braczkowska et al. 2018), while the Polish education and health care system disallow refusing service to non-vaccinated children. As a result of declining vaccination ratios, the Polish society recently fell below the safe threshold of herd immunity for many common diseases (Plans-Rubió 2017), including measles and rubella.

The Internet plays an important role in the dissemination of anti-vaccination beliefs that lead to a wave of vaccination refusals. The anti-vaccination movement has been able to largely self-organize and effectively utilize new media for its cause (Wilson, Atkinson, and Deeks 2014). The movement's impact on the general population grows because even mere exposure to theories that vaccination poses significant danger to children's health increases skepticism toward vaccinations (Jolley and Douglas 2014). Interestingly, the spread of anti-vaccination attitudes may correlate with the growing need for more information. In fact, not only do general knowledge education and overall scientific literacy not reduce anti-vaccination tendencies but they actually increase the polarization of views (Lewandowsky and Oberauer 2016; Hornsey, Harris, and Fielding 2018). To make matters worse, information echo chambers and social networks' filter bubbles further polarize attitudes to vaccinations. The parents who are the most likely to not vaccinate their children are also those who will likely seek information from other parents (Hagood and Mintzer Herlihy 2013). The people who decide about vaccination choices largely overestimate the risk of adverse effects and underestimate the risk of the disease itself. That is, instead of locating the source of threat in the spread of infectious diseases, they see it in the very vaccination procedure.

In many ways, anti-vaxxers like to refer to research, even if they cherry-pick or use retracted publications like the infamous discredited study on autism as the side effect of vaccines by Andrew Wakefield (Ranscombe 2017). Noteworthy, the dispersed networks of alter-medicine communities often also involve journalists and activist scientists with degrees in unrelated fields, sometimes even medical doctors (Eastwood 2000; Winnick 2005). Unlike some social movements in the recent history of medicine – which struggled to build equal relations with scientists and doctors turning from merely "objects of study" to qualified "colleagues" (Callon and Rabeharisoa 2003; Epstein 1995) – the anti-vaccination movement does not want to supplement but actively combat scientific knowledge. The movement often does so indirectly. For instance, anti-vaxxers self-organize in the social media and offline under postulates of stricter control of vaccinations, a more flexible calendar of immunization adjusted to individual growth rate, or fair compensation for victims of vaccinations (Kaufman and Kaufman 2018; N. Smith and Graham 2017).

This is the case of the Polish anti-vaccination movement, expressing distrust to official procedures for reporting vaccine adverse events. The movement mobilizes supporters to report vaccination injuries, which aims to create an alternative set of data based on citizens' reports that may be used in the public debate. Members of the anti-vaccination movement do not limit their activity to online campaigning as they formed an association that seeks to change public policy on vaccination. Their actions include collecting signatures under a petition to abandon the mandatory vaccination program and make vaccinations voluntary, renting anti-vaccination billboards, and organizing meetings with MPs who support their cause. Through these actions, they want to influence healthcare regulations and drive the policy away from the firm scientific consensus. Although they have not succeeded in changing regulations so far, the sum of individual choices inspired by anti-vaxxers already creates a new risk for public health. Simultaneously, doctors and nurses report receiving an increasing number of questions about vaccinations from parents, even those who do not refuse to vaccinate their children (Komorowksa-Szczepańska 2015). That is, the medical staff must be ready to present and defend the policy that they implement. In itself, we may view this more open exchange between parents and medical professionals on the effects of vaccination as a positive tendency, but it appears as far less positive in the broader context of the anti-vaccination movement.

To summarize, online peer-to-peer communication greatly supports the spread of anti-vaccination attitudes against the scientific consensus. These attitudes already result in the rising number of parents who refuse to follow official state policy. Online communication in anti-vaxxers groups builds on fear for health of babies and children and distrust toward science and the state. Moreover, the anti-vaxxers employ the libertarian argument that individuals should have the right to choose what is best for their families. They claim that individual risks from

vaccination are intolerable and that the impact of vaccination is uncertain, at the same time neglecting the threat of infectious diseases. This way, they want to impact risk framing; that is, on what society decides to interpret as relevant risk topics (Kahneman and Tversky 2000; Reese 2007). However the online presence strengthens and broadens the movement's base, it also has centralized structures with a clear agenda, budget, and leadership.

The above case demonstrates that the involvement of internet-enabled groups may hamper the effectiveness of risk mitigation strategies by influencing people who share responsibility for its implementation by following state recommendations. At the same time, the case reveals that the crisis of credibility and trust in expert knowledge poses real challenges that should be addressed.

4.3. Shale gas and the transboundary risks debate

The emergence of local opposition against shale gas development – supported by an international online anti-fracking movement – demonstrates how the participation in Internet communication gives new actors access to resources needed to formulate alternative risk framing, estimation, and evaluation. Similarly to the vaccination case, new actors draw attention to the uncertainty and ambiguity of the risk. However, in contrast to the above case, we cannot say that there is a scientific consensus regarding the scale and nature of risk and the best risk mitigation policy. How does the widespread use of the Internet impact the public involvement in risk governance processes in the case of fracking?

Shale gas development involves the production of natural gas from shale formations, in contrast to conventional production that extracts gas from easier accessible reservoirs. To make shale gas exploration possible, gas&oil companies developed and upscaled new drilling techniques, involving hydraulic fracturing, called "fracking." The massive adaptation of the technology in the USA made this country one of the leading producers of natural gas in the world. Indeed, in 2011, the USA overtook the long-term leader of natural gas production, Russia. Despite the fact that shale gas in the USA succeeds in terms of produced volume, there continue numerous controversies regarding the overall impact of fracking on human health, the environment (Weinberger et al. 2017; Elliott et al. 2017; McKenzie et al. 2017), the quality of life, the long-term wellbeing of communities (Short and Szolucha 2017; Hirsch et al. 2018), and climate change (Frumkin and Patz 2018). Scientist investigate these issues, but they were first raised by anti-fracking activists around the world (cf. e.g. Hopke 2015; Vasi et al. 2015; Lis and Stasik 2017). No need to add that the industry disagrees with these interpretations and emphasizes shale gas production profits for the economy, local communities, and the climate. Due to uncertainty about the overall impact, many states and local governments banned or introduced a moratorium on the use of hydraulic fracturing, while other welcomed shale gas production with open arms. That situation shows that the impact of fracking is a case with significant uncertainty and ambiguity: there is a lack of a strong scientific consensus about the scale and nature of risk and the best risk mitigation policy. What is the impact of the Internet on the public involvement in risk governance processes in this case?

First, the anti-fracking movement built a strong presence in the Internet. The documentary *Gasland* partly contributed to this success (Vasi et al. 2015). However, it is not only the documentary that made a difference because it is explicitly aimed at stimulating public involvement in the debate about the risk mitigation of fracking, as demonstrated by contact information to the local anti-fracking US organizations on the film's website. Moreover, the activists extensively used Twitter (Hopke 2015) and created several bottom-up websites that focus on the danger of fracking and encourage resistance against its development (e.g. frack-off.org.uk). Support from celebrities and artists was another factor that publicized the matter (e.g. artistsagainstfracking.com). Importantly, apart from the persuasive materials produced and published by the activists,

we also find online sources produced by experts and scientists who indicate the adverse effect of fracking, which is a crucial difference in comparison to the vaccination debate.

The combination of easily accessible persuasive content and access to expert reports about the risks was what made the Internet so important in the significant change in local debates on shale gas development. As discussed by Stasik (2018), access to the Internet dramatically changes the dynamics of local discussions about the risks and benefits between potential investors, local government, and concerned residents. This was especially significant in Poland, where the government and the media almost unanimously favored shale gas development and downplayed any risks connected to the impact on the environment and human health (Lis and Stankiewicz 2017). In such circumstances, the residents from prospecting drilling areas reached for the alternative framing and counter-expertise surfacing in the global discussion on possible impacts of fracking. Moreover, the residents struggled to broaden the discussion beyond issues of physical risk and include values like justice (Szolucha 2018) and their cultural understanding of space and time (Lis and Stasik 2017). Furthermore, the residents and their supporters who protested against the development utilized tools offered by Web 2.0 to create their own narrations, reach the global public, and build networks of support (Lis and Stasik 2018; Cantoni, Lis, and Stasik 2018). Empowered by the Internet's possibilities, local activists lobbied for the tightening of fracking safety procedures. This way, they demand the right to be included in the process of risk governance. Specifically, they want to partake in interdisciplinary risk estimation and evaluation.

To summarize, the case signals several changes in the dynamics of risk governance. First, we may no longer contain the discussion on the potential impact of new technologies to national frameworks. Local and global discussions on risk intertwine more easily and inevitably than in the past: the local debate cannot escape global controversies due to the widespread use of the Internet. In practical terms, it means that business representatives in a village in Poland should be ready to explain: why fracking is banned in Germany? Why was there a scandal about fracking in Pennsylvania? Or, why does the company break the law in Ecuador?

Second, public engagement in the governance process may amplify the opinion of experts – at least those who support the position defended by the protesters. Thus, unlike in vaccinations, the opposition of Internet-enabled engagement and experts is not the primary one in the fracking controversy. However, it does not suffice to say that Internet-enabled social movements use expert knowledge. In fact, we may assume that social movements in some cases inspired the production of knowledge on the adverse effects of fracking.

Third, as with the vaccination controversy, the engagement in this case stems from a distrust of state safety procedures and corporate goodwill. Activists believe neither the official institutions to have the power and will to guarantee the safety of the local community nor the gas and oil companies to assume responsibility for potential unintended consequences.

4.4. Air pollution and the agency of a networked public

According to the World Health Organization (WHO), air pollution is the leading cause of death worldwide, with 4.2 million premature deaths caused by outdoor air pollution (who.int/airpollution/en/). Scientific proofs of the ill effect of air pollution abound (Arden Pope III and Dockery 2006). However, many regions of the world struggle to implement effective policy measures to significantly limit health risks. In this case, the goal of public involvement in risk governance is often to mobilize the authorities to follow experts' recommendation. One of the measures is to spread the awareness of the danger so as to create pressure on policymakers and other actors engaged in risk governance, e.g. industry and local governments. Here, the Internet plays a prominent role.

Among the tools globally used to spread the awareness of air-pollution risk and pressure governments are mapping systems that offer real-time online information about air quality. Such tools are created by institutions independent of governments: from bottom-up citizen actions through global NGOs like Greenpeace to global institutions like the WHO. For instance, a Japanese movement, SafeCast, concentrates on monitoring radiation after the Fukushima disaster (Brown et al. 2016) and is a highly successful spontaneous scientific initiative of citizens that emerged in response to the immediate health hazards after the catastrophe, as they were not addressed quickly and decisively enough by the authorities and the academic community. Similarly, the SmartCitizen platform connects different sensors and people to help them build open indicators and tools for collective city governance (Austen 2015). As analyzed by Berti Suman (2019), Greenpeace in cooperation with local organizations developed an online map to counter the problem of haze in equatorial Asia, successfully drawing global attention and improving peoples' ability to cope with fires and haze events.

What enabled citizen sensing movements to raise and gain momentum is widespread access to smartphones with online connectivity and the use of apps that monitor the quality of the environment in real time. As a result, we witness the rise of participatory knowledge production and the successful collaboration of scientists with citizen science communities (Geoghegan 2014; Wyatt et al. 2013). In the case of maps based on data provided by citizens and publicly offered by independent institutions, collective learning bypasses traditional expert institutions without leading to the creation of an alternative knowledge system. Instead, such collective learning leads to the production of new data and social involvement in risk monitoring. In the case of app-mediated engagement in risk monitoring, the user experiences a direct access to the data that she may evaluate by herself and discuss with the community of peers, instead of relying on distant and non-accountable experts. Hence, the user does not have to depend on the – potentially distrusted – authority of the state, corporations, or academic institutions, which goes along with distrust to hierarchical authorities. Thus, the case of public involvement against air pollution signals that the questioning of science's authority results from the misfit of top-down communication to the current needs and customs. In other words, this case reveals that users appreciate solid data on risk exposure and engage in sharing this information if only they experience these data are transparent.

In Poland, the level of air pollution is among the highest in Europe and regularly exceeds the safety thresholds set by the WHO. According to the 2016 report (WHO 2016), 33 out of 50 cities with the highest degree of air pollution in the European Union are located in Poland. While the burning of coal emits PM 2.5, sulfur dioxide, and nitrogen oxides (Vasev 2017), individual furnaces and cars exacerbate the problem of air pollution even further. A 2017 report of the European Environmental Agency shows that more than 47,000 Polish citizens die each year from diseases linked to air pollution (EEA. 2018). Experts knew about the scale of Polish air pollution and its adverse effect on human health and the environment for many years. However, decision-makers developed no policy to tackle this issue, for instance, by applying quality standards for the coal available on the market, technical standards of furnaces, or limits of car traffic during serious air pollution episodes.

However, the situation started to change with the growing pressure from the concerned public. This was possible thanks to the emergence of the Polish anti-smog movement: a spontaneous grassroots citizen science phenomenon. Starting with 2016, the Polish media and society became more sensitive to the issues of air pollution, from which emerged several knowledge communities, quickly followed by small entrepreneurship. Instead of referring to the academia or state-sponsored agencies for help, these communities largely self-organized to gather and disseminate knowledge about PM 2.5 levels, the best practices for its reduction, and the most effective air filtering methods. Furthermore, the anti-smog grassroots organized lobbying through city activists to influence municipal authorities and local governments to actively reduce air pollution. Instead of waiting for official alerts, many began using apps that enable people to

check pollution levels and evaluate their risks. Moreover, social media helped to spread the news about dangerous smog events, effectively substituting the public system. The Polski Alarm Smogowy movement (Polish Smog Alert; polskialarmsmogowy.pl) and local initiatives cooperating under the same label (27 in August 2018). The movement focuses on gathering data on air pollution from real-time monitoring and academic studies, on networking activists, and on lobbying local and state government for improving policy (Frankowski 2020). Thus, as observed by Berti Suman (2019), the mapping of air pollution indeed had double effects: it visualized the politically masked risks and triggered social agency.

To summarize, the anti-smog movement in Poland influenced the risk governance of air pollution. First, the movement raised popular awareness about the air pollution problem. It reached many citizens who applied individual strategies to limit their exposure, for example by using outdoor masks or installing indoor filters. Second, the movement witnessed first successes in changing the risk mitigation policy. An increasing number of regions passed legislation aiming to reduce the pollution generated by individual heating systems and developing official alert systems. Thus, Internet-enabled public involvement contributed to the closing of a gap between scientific recommendations on air pollution risk mitigation and public policy.

4.5. Summary

We shortly analyzed three complex cases of the Internet-enabled public involvement in risk governance by asking how today's practices of the Internet use create new possibilities of broader public involvement in different stages of risk governance. We have no doubt that the scale, dynamics, and impact of involvement in each case would have been completely different without the widespread use of the Internet by engage individuals. Thus, we draw attention especially to the issue of credibility and trust produced by new peer-to-peer mechanisms of Internet exchanges, which may both amplify and diminish experts' voice. However, in each case the mechanism of using the Internet to enter debates on risk framing, estimation, evaluation, and management – that is, partaking in risk governance processes – is very different.

The anti-vaccination movement uses it to oppose institutional science, accuse it of a lack of transparency, and seek change in legislation against evidence-based recommendations. This case illustrates the crisis of trust and credibility of mainstream institutions of state, science, and industry. Although it claims to collect alternative data on vaccination injuries, there is no transparent methodology in anti-vaxxers' endeavor. Instead, the movement focuses on re-framing the understanding of risk; that is, on locating risk not in the spread of infectious diseases but the vaccination procedure itself, by creating the impression of a lack of expert consensus on the safety of the procedure.

By contrast, the Internet access allowed local anti-fracking activists to use expert knowledge produced in a different context to foreground that the discussion on risk evaluation is not settled. Thus, the activists claimed that internationally discussed issues – raised by the global anti-fracking movement – should be considered in specific locations despite the fact that they were mostly neglected by national policy-makers. Furthermore, the activists also raised justice-related concerns important for risk estimation. Moreover, they not only used the results of research but also inspired scientists to address the issue of the multidirectional impact of shale gas production. In the situation of existing uncertainty, their voice was important to identify different perspectives and values.

Finally, the anti-smog movement managed to change the perception of the urgency of the air pollution problem and – through public pressure – bridge the gap between scientific consensus and public policy. The use of apps offering instant access to real-time data gives the user independence from distant and non-accountable experts, but this practice does not lead to a counter-scientific interpretation. Hence, the smog case shows that social movements may amplify science-based concerns, should there be accessible data in a form adapted to the Internet communication. It is especially important for the cases when public policies do not follow expert recommendations

Table 2. The impact of public involvement of Internet-enabled groups on risk governance.

	Strong scientific consensus	Scientific consensus reflected in risk management	Construction of rules of credibility and trust by Internet-enabled groups	Impact on risk governance
Vaccination	Yes	Yes	Rejection of expert knowledge Participation in online groups opposing the scientific consensus The creation of alternative crowdsourced data set on vaccination injuries	Struggle to re-framing risk understanding The amplification of risks for individuals against scientific evidence
Shale gas production	No	Does not apply	Reaching and sharing sources of different genre and quality, from popular documentary to expert and scientific reports Cooperation with like-minded experts	Participation in risk estimation and risk evaluation The amplification of "unknown unknowns" and justice-based concerns
Outdoor air pollution	Yes	No	Reaching and sharing evidence-based sources Participation in online groups supporting scientific consensus Collecting real-time data Using apps to give citizens access to real-time data on air pollution	Struggle to reframe risk understanding to render visible the harm caused by air pollution The amplification of science-based concerns

despite low uncertainty, like the case of climate crisis. Here, too, public involvement in the actions like Fridays for Future seeks to amplify evidence-based concerns (Table 2).

The analysis of three selected cases shows that to scrutinize the impact of Internet-enabled public involvement in risk research, we should consider both a movement's approach to expert knowledge and the scale to which public policy reflects the expert knowledge. Moreover, Internet-enabled groups have different strategies of using peer-to-peer learning typical for Internet communication, which may both strengthen and weaken the voice of experts.

5. Conclusions

The emergence of Internet-enabled social groups announces an enormous change in public involvement in different stages of risk governance process that is here to stay. It means that public dependency on expert-based, central, hierarchical, and homogenous knowledge institutions is now weaker than it used to be. The Internet-enabled peer-to-peer learning and network-based coordination of actions. This new connectivity goes hand in hand with the distrust of networked citizens for the capacity of public institutions to adequately secure the necessary safety measures. Therefore, risk managers often perceive the informal online communication about risks as its own source of threat. However, we reject the framing of online communication's prevalence simply in terms of a threat to effective risk governance. Instead, we emphasize that the Internet creates new mechanisms that may have both positive and negative consequences for the quality of risk governance and public safety.

Ten years ago, it was almost unimaginable that the anti-vaccination movement would appeal to a growing number of parents and try to influence national health systems by pointing to individual risks despite the scientific consensus. It was unthinkable that residents from a small village in Poland would quote recent expert reports from the USA on a meeting with industry experts. It was inconceivable that the inhabitants of a large city would begin their winter morning by checking an app that monitors air quality to decide whether to go out with or without an anti-

smog mask. Nevertheless, only ten years passed for us to witness a transformation in the relationship between expert knowledge, risk management institutions, and universal Internet-enabled participation. Still, it is very important to understand that in each of these cases, internet-enabled publics acted basing on different understanding of credibility and trust.

Further comparative studies are necessary to understand these dynamics better, basing on the insights from studies of risk studies, studies of the Internet, and studies of new social movements. However, we claim that the acknowledgment and response to the changing rules of public involvement in face of widespread use of the Internet should become the essential requirement in every risk governance process.

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