Environmental Debates over Nuclear Energy: Media, Communication, and the Public

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Environmental Debates over Nuclear Energy: Media, Communication, and the Public

Environmental debates over nuclear energy often center around two polarized sets of arguments – the potential benefits of nuclear energy as a clean way of producing energy, helping to mitigate climate change and the concerns over the possibility of ionizing radiation release and nuclear waste contamination of the environment. As a form of clean energy, the environmental benefits of nuclear energy can be attributed to its low carbon emission (International Atomic Energy Agency [IAEA], 2014; Lovelock, 2004; Monbiot, 2009). On the other hand, previous nuclear accidents have triggered concerns about the possibility of ionizing radiation leaks and nuclear waste contamination to the environment (IAEA, 2014). The debates over nuclear energy are further compounded by arguments over other potential benefits of nuclear energy such as reliable energy production, economic competitiveness and stable electricity prices, and the potential adverse effects of nuclear energy such as the possible proliferation of nuclear weapons and the high upfront costs of nuclear power plants (IAEA, 2014). In the aftermath of the 2011 Fukushima-Daiichi nuclear incident in Japan, many nations such as Germany, Belgium, and Switzerland decided to phase out nuclear power, but nations such as China, India, Finland, the UK, and the US are planning or already building new nuclear energy plants (Goodfellow, Dewick, Wortley, & Azapagic, 2014; World Nuclear Association, 2019).

The contested issue of nuclear energy is much discussed in the mass media and it has sparked considerable scholarly research, drawing interest from wide-ranging fields, including communication, political science, sociology, and public policy. Many studies focus on news media coverage in North America or Europe. These studies, for instance, have examined the kinds of frames that were used to depict nuclear energy in the US media (e.g. Gamson & Modigliani, 1989), and the reframing of nuclear energy as a means to mitigate climate change in the UK (Doyle, 2011). Another prominent line of research tends to focus on media

coverage of nuclear energy in the aftermath of major risk events such as the 1979 Three Mile Island nuclear accident in the US (e.g. Friedman, 1981; Stephens & Edison, 1982), the 1986 Chernobyl nuclear disaster in Ukraine (e.g. Friedman, Gorney, & Egolf, 1992; Gale, 1987), and the 2011 Fukushima-Daiichi nuclear incident in Japan (e.g. Binder, 2012; Kepplinger & Lemke, 2016; Kristiansen, 2017; Li et al., 2016). For example, analysis of news media coverage in the aftermath of these nuclear accidents showed that the low carbon emission benefit of nuclear energy in mitigating climate change was greatly deemphasized in the media, while the potential threat of ionizing radiation from nuclear power plants to human health and the environment were given the heavy spotlight (Friedman, 2011; Kristiansen, 2017). These event driven studies collectively point to how a nuclear energy accident triggers the mass media to devote heavy attention to nuclear energy and its detrimental potential.

A large body of research has also looked at the general public as a key stakeholder, analyzing how various social, psychological, and demographic factors shape public perceptions of nuclear energy. Generally, these studies, mostly based in North America and Europe, have shown that key factors including benefit perceptions (Choi, Kim, & Lee, 2000), trust (Kim, Kim, & Kim, 2014), and knowledge (Siegrist & Visschers, 2013; Stoutenborough, Sturgess, & Vedlitz, 2013) are positively related to public acceptance of nuclear energy, while risk perceptions (Arlt & Wolling, 2016; Kristiansen, Bonfadelli, & Kovic, 2016; Tanaka, 2004) could negatively sway public acceptance of the controversial technology. In addition, value predispositions and beliefs such as political ideology or environmental values (Van Der Pligt, 1985; Van der Pligt, Eiser, & Spears, 1984), as well as demographics and geographical proximity (Bird, Haynes, van den Honert, McAneney, & Poortinga, 2014; Ho et al., 2014; Kristiansen et al., 2016) have been found to shape public support for nuclear energy. In the UK, although the general public perceive nuclear energy as risky, many of them accept the technology conditionally as a way to mitigate climate change (Pidgeon,

Henwood, Parkhill, Venables, & Simmons, 2008), and public opinion remains rather consistent even after the Fukushima nuclear incident (Jones, Elgueta, & Eiser, 2016). On the other hand, the public in countries such as Thailand and Vietnam do not think that their countries are ready for nuclear energy, in part, due to misconceptions of how nuclear energy facilities can be easily weaponized (Ho, Oshita, Looi, Leong, & Chuah, 2019).

Similar to media discourse, a substantial number of studies tends to be event-driven, examining shifts in public opinion after major nuclear accidents. In particular, comparing public opinion before the Fukushima nuclear accident, studies observed a sharp dip in public acceptance of nuclear energy right after the accident (e.g. Arlt & Wolling, 2016; Carrington, 2011; Kim, Kim, & Kim, 2013; Siegrist & Visschers, 2013; Visschers & Siegrist, 2013).

Challenges and research gaps in extant studies

Although a substantial number of studies on nuclear energy and communication have surfaced over the past few decades, there are apparent gaps in research that the various articles in this special issue on "Environmental Debates Over Nuclear Energy: Media, Communication, and the Public" seek to address. First, many studies have taken a shorter-term focus on issues, such as the heightened risks in the aftermath of a nuclear accident. Major nuclear power plant accidents in recent history, including the 1979 Three Mile Island incident, the 1986 Chernobyl accident, and the 2011 Fukushima-Daiichi nuclear accident, have spark interest among scholars in risk perception studies of the general public; crisis and risk communication research; and content analysis of media coverage of these incidents. However, this has created a situation where longer-term issues such as political discourses surrounding national energy and climate policies are for the most part overlooked in the literature. There are missed opportunities in looking at the changes in the multifaceted public debate on nuclear energy over time when research narrowly focuses on the short-term issues. A shift away from the analysis of nuclear accidents to focus more on longer-term issues is

needed. One study has looked at media coverage over several years, and analyzed shifts in risk/benefit emphasis across phases of the coverage, comparing coverage before and after the Fukushima accident (Kristiansen, 2017). This and similar longer-term studies can serve as points of reference for future studies.

Another research gap lies in the conceptualization of how risk is characterized in media coverage and in other forms of communication about nuclear energy. Kristiansen (2017) suggests a multidimensional risk definition that captures the benefits, adverse effects, the probability, uncertainty and impact of risks. This detailed analysis of the risk discourse provides a more comprehensive picture of the types of risk dimensions discussed, the extent to which they are emphasized, and the point in time in which they most salient. This detailed analysis also allows for easier comparisons of discourses across different contexts, countries and times (see Kristiansen, 2017 for more details).

Despite the popularity and heavy use of social media and digital born media organizations, there is a clear dearth of research that analyses online discourses about nuclear energy. Currently, there are only two empirical works which have examined public discourse about the Fukushima accident on Twitter (Binder, 2012; Li et al., 2016), and one study evaluating nuclear energy-related tweets from the computational science perspective (Satapathy, Chaturvedi, Cambria, Ho, & Na, 2017). This is in stark contrast to the substantial number of studies that have focused on traditional content analysis of news coverage of nuclear energy and survey-based public opinion studies (e.g. Arikawa, Cao, & Matsumoto, 2014; Bird et al., 2014; Culley, Ogley-Oliver, Carton, & Street, 2010; Gamson & Modigliani, 1989; Visschers & Siegrist, 2013). Moreover, one of the unique affordances of social media lies in its open and interactive nature that enables bottom-up communication and participation from the public. More notably, netizens have the liberty to select the social groups and perspectives that they most prefer. The important questions to investigate are: Do echo-

chambers, where social media accentuate ideological or sociocultural segregations, exist in the political debates around nuclear energy? On the other hand, is there evidence to suggest that social media facilitate diverse exposure to opinions and support pluralistic debates? The evidence is at best mixed at this juncture, and more empirical findings are needed to answer these competing questions.

Notwithstanding the large body of literature that focuses on discourses about nuclear energy in North America, Europe, and to a lesser extent East Asia, there is a shortage of research in certain geographic regions, such as the Middle East and Southeast Asia. A recent comparative study based on focus group discussions conducted in Southeast Asian countries such as Indonesia, Malaysia, Singapore, Thailand, and Vietnam found that although citizens from these countries are generally exposed to nuclear energy through a combination of communication mediums, large variations still exists in how people use the media channels and in how they perceive the credibility of the local news media in conveying information about nuclear energy (Ho, Leong, Looi, & Chuah, 2019). In addition, inter-generational differences in terms of perceived credibility of the communication mediums, as well as trust in potential stakeholders in managing a nuclear power plant were detected in a recent study based in Singapore (Ho, Looi, Chuah, Leong, & Pang, 2018). Such studies examining countries that are at the nascent stages of nuclear energy development remained scant. Discourses about nuclear energy are likely to manifest in different ways, depending on the political systems and culture of a specific country. Such nuances could only be captured if studies undertake a more holistic approach of analyzing public opinion and discourses in understudied contexts and in countries where nuclear energy are at an early stage of development.

On a more pragmatic side, science communication practitioners and policymakers around the world have sought to use an information-dissemination strategy to enhance the

knowledge among their citizenry about nuclear energy. This is on the premise that a scientifically literate citizenry will be more favorable towards nuclear energy. However, empirical support for this premise has been mixed. While some studies find that people with higher levels of science knowledge tend to think more positively about nuclear energy than those with lower levels of science knowledge (Stoutenborough et al., 2013), other studies show that knowledge has almost no effect on public perceptions toward nuclear energy (Park & Ohm, 2014; Perko, Adam, & Stassen, 2015). In fact, several studies have suggested that individuals' beliefs, values, and other heuristic predispositions might play a bigger role than science knowledge in shaping public perceptions of nuclear energy. This is exacerbated by a lack of conclusive findings and systematic empirical quantification of the factors shaping public perceptions of nuclear energy. This calls for a need for a systematic review to comprehensively examine the relationships among the variables in order to solve the puzzle. This will inform science communication practitioners and policymakers alike on whether a straightforward information-dissemination approach is still the way to move forward.

Relatedly, policymakers are often faced with the dilemma of whether to provide comprehensive risk information (that might have the unintended effect of triggering fear and anxiety among the public) or to withhold information from the public (that might trigger a loss of trust and credibility among the public). Although there are many studies that looked at public opinion in the aftermath of a nuclear accident, there is a lack of studies that examine pre-crisis emergency preparedness with respect to a potential nuclear crisis.

In general, the field needs more studies that are comparable across countries, time, and types of media. Scholars also tend to use different concepts and measures or focus on a diversity of facets, which hinders direct cross-national comparisons. Kristiansen (2017) discusses this issue and gives ideas to inspire scholars to tie the field together to expand our knowledge about how this technology is discussed globally.

Presenting the special issue: broadening the scope of research in communicating nuclear energy and the environment

The current special issue tackles some of these challenges and seeks to address some of these gaps. Not only do the contributions broaden our horizons by examining the issue of communicating nuclear energy and the environment from a global perspective, they also offer deeper insights into the media and public discourse of nuclear energy in specific countries such as Australia, Spain, and Switzerland. A variety of perspectives, methodological designs, and analyses were used in these studies to probe further into the nuclear energy debate in both online and offline settings, thus allowing us to fill in the research gaps.

The study by Arlt, Rauchfleisch, and Schäfer (2018) attempts to provide empirical evidence to answer the question of whether social media acts as an echo-chamber that polarizes public opinion or as an enabler for diverse discussion across different online communities. Departing from traditional social science methodological approaches, they analyze communication on Twitter about the Swiss Nuclear Withdrawal Initiative using new analytical approaches from computational science. By identifying seven communities on Twitter (from “Conservative Mainstream” community to “Green-Left” community), they show that these communities differ in terms of their relative magnitude, political inclination, communicative activity and the way they discuss the initiative. More importantly, the study reveals active discourses and interactions both within and across these seven diverse communities. In addition to politicians, they also show that news reporters, scientists, and members of environmental organizations and the energy community actively participated in the online debates taking place via Twitter. Unlike other studies that found evidence for echo-chambers on social media, the study by Arlt et al. (2018) therefore points to the prospect of Twitter to facilitate the co-existence and debate of diverse viewpoints across different ideological lines in the Swiss nuclear energy context.

Based on a meta-analysis of 34 empirical studies over the past two decades, Ho et al. (2018) systematically identify and examine the relative effect sizes of 19 factors on public perceptions of benefits, risks, and acceptance of nuclear energy. Although science knowledge has a positive impact on the public acceptance of nuclear energy, they show that the size of the effects of other predictors including sex, education, public perceptions of benefits, risks and costs regarding nuclear energy, and trust on public acceptance of nuclear energy were substantially larger. The results reveal the limited explanatory power of the science literacy model in explaining public attitudes toward nuclear energy, while highlighting the key roles of value predispositions and heuristic cues in shaping public attitudes. In addition, their analyses demonstrate that public perceptions of benefits, risks, and acceptance of nuclear energy vary by where and when the data were collected, further underscoring the need for future studies to conduct cross-cultural comparative studies as well as to take a longer-term perspective in their research instead of a short-term approach.

The contribution by Oshita (2018) fills a gap in existing studies by examining the effects of emergency preparedness communication on public trust, emotions, and acceptance. Oshita provides practical insights for institutions that might be in the midst of deciding the degree of emergency preparedness that they would like to convey to the general public with regard to nuclear power plants within their countries. Using an experimental approach, the study shows that emergency preparedness communication enhances people's trust, which in turn enhances their acceptance of nuclear energy. However, emergency preparedness communication could heighten people's negative emotions, in turn putting a dent on public support for nuclear energy. The findings suggest that science communicators should openly communicate risks with the public so as to increase their trust rather than attempting to alleviate public's negative emotions.

A legal perspective informs Calyx and Jessup's (2018) study of a nuclear citizens jury

in Australia. The paper looks at the discussion about a nuclear waste storage in the southern part of Australia, that has one of the biggest uranium mines in the world. The state does not have any other nuclear energy-related activities. In particular, the authors investigate the members of the citizens jury's perspectives about the suggested nuclear waste storage and how the deliberation enfolded. The purpose of this jury was to fulfill the South Australian Government's aim to create and lead a deliberation on the decision about nuclear waste storage. Although the deliberation did not end in a consensus decision being made, the authors conclude that this did not lessen the relevance of the democratic deliberation. An interesting and potentially controversial ending to the policy unfolded: Despite the fact that a majority of the jurors decided against the expanded commitment in the nuclear fuel cycle, the Australian Government continued to proceed with the nuclear waste storage plans.

Bauer, Gylstorff, Madsen, and Mejlgaard (2018) paper investigates the Fukushima effect on the global perception of nuclear energy. They use two models to explore public perception – the event-and-effect model and the challenge-and-response model. Based on data from more than 20 countries between 1996 and 2016, they demonstrate that the event-and-effect model showed little explanatory potential for shifts on people's opinion. They argue that perception and opinions are influenced by cultural memories and therefore introduce their own model, the challenge-and-response model. They conclude that prior responses to nuclear accidents are able to explain opinion shifts more so than recent accidents. For example, if a country's population expressed strong negative reactions to the 1989 Chernobyl accident, then that country's public was prone to be more negative in their reactions to the Fukushima nuclear incident, as compared to the population of a country expressing less concern over the original Chernobyl event.

The contribution by Perko et al. (2018) looks at media coverage of Fukushima through the prism of Chernobyl. They analyze media coverage in Belgium, Italy, Norway,

Russia, Slovenia and Spain two months after the Fukushima accident. Their results show that the Chernobyl accident was an ever present reference in coverage of Fukushima. In every third article, the Fukushima accident was put in perspective or compared to the Chernobyl incident. The authors point out that this happened despite the fact that the audiences of the newspaper articles they analyzed had no direct exposure to ionizing radiation from Fukushima. Interestingly, countries without nuclear energy (Norway and Italy) referred less to the Chernobyl accident in their media coverage of the Fukushima accident, compared to countries with nuclear energy (Spain and Russia). Simply put, in countries with more negative public perception of nuclear energy, the Chernobyl accident was more often referred to in the media coverage of the Fukushima accident. Consistent with Bauer et al., the authors conclude that the influence of the historical memory of Chernobyl accident continues to influence news coverage of nuclear energy catastrophes and public understanding of nuclear energy accidents.

News frames, sources, and editorial lines in the Spanish media coverage of the nuclear energy debate from 2008 to 2012 were investigated by Mercado-Saez, Marco-Crespo, and Alvarez-Villa (2018). The authors observed that that nuclear energy was not often covered from an environmental perspective, that politicians' views were prominently highlighted in the coverage and that the views of interest groups were more often mentioned than those of the general public, scientific experts, or ecologists. Nuclear energy was most often covered in the international sections of the studied newspapers, because of the accident in Fukushima and because nuclear policies of other countries were frequently a focus. The authors therefore conclude that the Spanish press does not play an important role in the public deliberation of nuclear energy in Spain. They call for a media coverage in which multiple sources are present, to allow for a democratic deliberation.

Trajectories for future research

The seven articles in this special issue broaden our perspectives and deepen our understanding of research about communicating nuclear energy and the environment, addressing several important research gaps. Not only have these contributions provided new insights, they have also spurred us to think further about new research territories. Moving forward, what are the new research trajectories for the discourse on nuclear energy that could make valuable contributions to communication theories and practice?

As a highly controversial topic, nuclear energy will certainly continue to fan heated debates among different segments of the public on social media. Arlt et al.'s (2018) study has added to a small but growing body of research that examines nuclear energy discourse on social media. Echoing Arlt et al.'s (2018) suggestions, more comparative research on the social and political discourse around nuclear energy on social media is needed. So too is research on the social and political factors shaping social media discursive patterns. For example, is the nuclear energy debate on social media and in digital born media different from the one in legacy media, or are these channels just duplicating and continuing the debate as it was held in traditional media? Moreover, it will be worthwhile for future studies to examine public opinion expressed via online forums and social media, given the possible wide range of viewpoints and interactive nature of communication. More advanced data analytic approaches could also be leveraged to examine online social discourses. For instance, sentiment analysis of past Twitter data can shed light on the proportion of positive and negative sentiments, and emotions toward nuclear energy at one point in time as well as over-time. This can reveal the wax and wane of support over time, and help in the development of a sentiment analysis algorithm to allow for more accurate prediction of online sentiments.

New communication phenomena, such as the widespread dissemination of fake news

and misleading information on social media, could also impact public discourse and perceptions about nuclear energy. Research has shown that fake news gets amplified and travels faster than positive news on Twitter (Vosoughi, Roy, & Aral, 2018). Would lies and fake news dissemination promote distrust and perpetuate misconceptions toward nuclear energy? Independent fake news debunkers such as Snopes.com have already sprang into action by correcting fake news about nuclear energy, ranging from fake news stories about radiation from the Fukushima nuclear accident causing mutations in plants and animals to hoaxes related to new nuclear disasters. Are fake news debunkers useful in correcting the alarm and misconceptions that fake news has caused in public perceptions? We call for more empirical studies in this area to overcome the challenges that are posed by these new communication phenomena.

Another key research trajectory is to adopt a cross-cultural approach to studies of nuclear energy discourse. As pointed out in Ho et al.'s (2018) meta-analysis, a majority of the public perception studies were confined to certain regions of the world, and therefore more research is needed in other parts of the world including Africa, South Asia, and the Middle East. This is echoed by the Oshita's (2018) study that highlighted that additional comparative studies on emergency preparedness communication of nuclear power plants are needed as most studies are currently based in the US and Europe. In addition to cultural and geopolitical variations, these countries may also differ in terms of their levels of nuclear dependency. By examining specific countries in greater depths, such research may offer a kaleidoscopic view of the cultural nuances that are unique to each country when it comes to public and media discourse about nuclear energy. One question worth investigating is: what triggers different nations to take such vastly different approaches on nuclear energy? Why do some countries decide to phase out nuclear energy after a severe accident, and why, at the same time, do some countries build new ones? If we could get behind these cross-country differences, we

would learn a lot about what influences public risk perceptions of risky technologies. This is relevant not only to this field, but take for example, the different approaches to genetically modified foods across different countries, where some countries have banned them and in other countries these products are widely available and consumed by the public. Are the main differences due to demographics, economic dependence, energy dependence, historical climate, closeness to nuclear energy accidents, media framing effects or other considerations? Conducting cross-cultural research will also enable us to compare and contrast public and media discourse toward nuclear energy across different nations.

To better enable cross-cultural studies and comparisons over time, we call for more studies using the same methods and theoretical backgrounds. As Kristiansen (2017) suggests, the field could benefit from studies examining the same facets using the same measures. Longitudinal studies will enable us to better understand how societies remember and develop nuclear energy opinion. Since severe nuclear energy accidents have a very low probability of occurring, longitudinal studies are needed to able us to observe trends and changes over time. As Bauer et al. (2018) were able to show, the memory of historical nuclear accidents carry a lot of explanatory power as to how different countries deal with current nuclear accidents.

Nuclear energy is only one energy source and it co-exists with other energy sources. Therefore, we argue that it is important not to look at nuclear energy in a vacuum, but to include other energy sources in comparisons of news coverage and public opinion. This will assist in the understanding of why nuclear energy is dealt with in a certain way. If, for example, nuclear energy trade-offs are focused a lot upon, maybe the benefits of solar energy are weighing up for that in a certain context. Without knowledge about how other energy sources are treated, it will be more difficult to put into context how nuclear energy is treated.

Besides this, we need more research that balances between providing practical insights to relevant stakeholders in nuclear energy, and contributing to theory building. We

often see application of theories, with slight enhancements, to the context of communicating about nuclear energy. We need, perhaps a broader theory in science and risk communication that allows us to not only examine social phenomenon in the specific context of nuclear energy, but also to other types of renewable energies and controversial scientific advances.

In a time when mass media and social media mix real information and misinformation about nuclear energy and the environment that might shape people's perception of the controversial technology, many challenging questions remain. While our special issue has helped to partially resolve some of these questions, we call for more research studies to join our effort in answering those questions.

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