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Insights from China for a global perspective on a responsible science–society relationship

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Abstract

Ensuring that science meets the needs of society and does so responsibly is a key aim of current European policymaking. Under the label of 'responsible research and innovation', European Union projects, such as the NUCLEUS project, have been funded to both study and stimulate practices for the development of responsible science–society relationships. The NUCLEUS project aims to define a broader cultural, international and enriched perspective on what a responsible science–society relationship entails. In this paper, findings from a comparative case study in China are presented. Practices are analysed at the conceptual, governmental, institutional and individual levels. Our findings show that social responsibility is the key to the science–society relationship, and that science popularization is a means to enhance scientific literacy.

Key words

Responsible research and innovation, science popularization, science–society relationship, social responsibility

1. Introduction

Responsible research and innovation (RRI) has been addressed frequently in recent years. Within the European context, this academic discourse has often included calls for greater attention to science communication as part of building a more responsible relationship between science and society. During the 2000s, a debate on a new science–society relationship emerged from the nanotechnology field. A report published by the British Royal Society and the Royal Academy of Engineering (RSRAE, 2004) discussed emerging nanotechnologies and possible strategies for dealing with them in the future. Interestingly, a prominent place was given to the identification of social and ethical issues involving nanotechnology, and the authors recommended that societal aspects be included when new technologies are developed. They also argued for the promotion of a wider dialogue about

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nanotechnologies and provided suggestions for how to organize it. They called for the responsible development of nanotechnologies. The phrase RRI—now widely used in the European context—was not yet in use.

According to Rip (2014), RRI can be seen as a social innovation that considers new roles and responsibilities for the actors involved. Rip argues that the word 'responsible' obtained its meaning during the late 18th century and that the current phrase, RRI, might be indicative of a next phase in the social contract between science and society or, more specifically, between scientists and citizens. According to Rip, notions such as the responsible development of new technologies and RRI have emerged because it has become clear that scientists cannot leave it to others to consider social, ethical and political issues. Debates in Europe, for example in the 1970s concerning nuclear energy and in the 2000s concerning biotechnology and the environment, made this clear. In addition, current debates in the public domain, for example about climate change, also show that science and society are connected. The phrase RRI developed quickly and within a few years found its place in academic literature (Rip, 2014). In Europe, RRI became synonymous with meeting the needs of society, as, for example, Von Schomberg (2013), Stilgoe et al. (2013) and the European Commission (2017) have pointed out in their individual definitions of RRI.

The work presented in this paper is based on research conducted for the NUCLEUS project, which is a Horizon 2020 project funded by the European Union.[1] The project deals with the practice of RRI and runs from 2015 until 2019. It aims to support academic institutions and researchers in implementing RRI, offering clear recommendations grounded in philosophical analysis and empirical study.[2] Therefore, in the first phase of the project, various studies explored practices of RRI from several perspectives. One of the studies consisted of a cultural adaptation study that looked at the intercultural contexts of RRI, particularly those in China and South Africa (Dijkstra et al., 2017). The research questions for the cultural adaptation study focused on how RRI and other relevant concepts are implemented in those international contexts; what barriers and successes affect the future implementation of RRI; and what can be recommended for the future implementation of RRI in academic settings and research institutes. In this paper, results from the cultural adaptation study of China are presented to promote a greater understanding of RRI.

The remainder of the paper is organized as follows: first, the methodology of the study is discussed; following this, contextual information about China is given; then the findings from the study are presented; and, finally, the findings are discussed in relation to the European context from which the concept of RRI originates.

2. Methodology: a multimethod approach

In order to collect data that could provide enriched insights into RRI, a multimethodological and qualitative approach was decided upon for the study. According to Greene et al. (2001) and Patton (2002), the use of various qualitative methods allows for enhanced validity and credibility of inferences and leads to a more insightful and diverse understanding of a topic. In other words, the collection of data via multiple methods allows for a broader cultural perspective on RRI (Bauer, 2015). The findings, therefore, can lead to a greater understanding of RRI in China compared to that in the European context, and of arguments and motivations relating to RRI practices in China. However, there are also limitations to the chosen methodology. For instance, qualitative research can never be statistically representative, and conclusions should be seen from that perspective.

2.1 Literature review and interviews

For the cultural adaptation study, both a literature review and interviews were conducted.

The literature review involved the analysis of multiple sources of information. Findings have been derived from sources such as academic literature; reports and news articles; policy documents, including regulations and statistical reports; survey results; personal communications; and presentations. A part of the larger NUCLEUS project involved field trips, which aimed to gain insights into the best practices on location. Indeed, the focus was restricted to one particular aspect of RRI per location. The field trip to China looked at public engagement in Beijing. Therefore, the report of that field trip was also included as a source (Mordan and Skeldon, 2016). Another key publication in China and available in English was the book *Communication and Popularization of Science and Technology in China* by Ren and Zhai (2014).

Semi-structured interviews were conducted with the aim of obtaining further insights into practices in China. The questions for the interviews were based on the interview protocol for the European study within the NUCLEUS project, which was developed by researchers from Bielefeld University (Böger, 2017). The questions were adapted after testing. Questions probed for background information; challenges for research and society; engagement; impacts of research on society; governance of research; changes foreseen in current practices and policies; responsibilities; and support wanted or needed. One final question asked what respondents expected from Europe regarding RRI.

2.2 Procedure and respondents for the interviews

Thirty interviews were conducted in China with researchers from various research institutes and universities. The interviews were conducted in the Chinese language and were supervised by one of the authors of this paper. A report was made and translated into English (CRISP, 2017). The recordings of the interviews served as the basis for the analysis. The respondents were given the background of the NUCLEUS project and the purpose of the interview, which was presented as identifying factors that shape the relationship between research and society in universities and research institutes. The interviews lasted for about one hour each. The respondents (19 male and 11 female) were scientists in leading positions, such as professors, associate professors, deans and directors. Their ages ranged from 29 to 76 years. Twenty-two respondents worked at universities, while eight worked in research institutes in Beijing. Their fields of research varied and included statistics, robotics, seismology, water resources, education, stem cell research, transportation and agriculture.

2.3 Analysis at different levels

As already stated, various definitions of RRI have been used. Definitions of RRI used by Von Schomberg (2013) and the European Commission (2017) emphasize an approach in which societal actors are stimulated to work together during the whole research and innovation process. According to the European Commission (2017), this can include engaging society more broadly in research and innovation practices; increasing access to scientific results; enhancing gender equality both in the research process and in research content; paying attention to ethical aspects in research; and promoting formal and informal science education.

This study specifically used the definition provided by Von Schomberg (2013):

> Responsible research and innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical)

> acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society). (p. 19)

Von Schomberg's definition was used in conjunction with the ideas of the European Commission (2017) concerning RRI and guided the analysis. As a result, specific attention was also given to equality and diversity rather than to gender alone. Furthermore, science education, outreach and open access (which were considered part of research and innovation), stakeholder and public engagement, ethics and broader impacts were considered. In the case study, information about practices was collected and analysed at four levels: conceptual, governmental, institutional and individual. The analysis was executed as an iterative process. The findings from the literature review and the interviews are described together. The analysis at the four levels provided a framework for obtaining deeper insights into how RRI, and thus the science–society relationship, are shaped in China in comparison to Europe as described by, for example, Rip (2014).

3. A context for RRI in China

This section provides a brief outline of how the relationship between science and society in China has developed over time.

China became an upper-middle-income country (Cao, 2016) with a mixed economy following reforms in the 1980s and 1990s. While economic growth in the 1990s was on average almost 10% per year, by 2016 it stabilized at a rate that became known as the 'new normal'. China became the world's second largest economy in 2010 (as measured by gross domestic product). However, according to Cao (2016), China is also facing several challenges relating to inclusive and green development, an ageing society and the middle-income trap. Therefore, an ambitious reform agenda with a strong focus on innovation through science and technology (S&T) has been proposed, as set out in China's 13th Five-Year Plan (Cyranoski, 2016; Xin, 2016).

For many years, China has invested considerably in science, technology, innovation and education (OECD, 2015; IMF, 2018). Attitudes towards S&T and innovation have been positive since 1978. This is partly because the Chinese people have witnessed and experienced the power of S&T, which have greatly changed their lives and the world around them, and partly because of long-term advocacy that has established a positive image for S&T among the people. Nowadays, public attitudes to S&T have become more and more objective, but social expectations of S&T are still strong. Chinese people trust in science, which forms a favourable environment for the development of technology. According to the central government, China should now focus on integrating innovation with socio-economic development and constructing a favourable environment for innovation by, among other things, opening up and engaging in international cooperation. This also means that research should contribute to economic growth rather than remain a purely academic endeavour—a move that has been described as weaving together 'two layers of skin'. This is important because, according to Cao (2016), China still depends partly on input from abroad for innovation. Innovation alone, therefore, is not enough; among other things, stimulating scientific literacy is considered important to strengthen development.

4. Results

In this section, results from both the literature review and the interviews are presented. After presenting findings about the RRI concept and findings relating to the different practices of RRI at the governmental, institutional and individual levels, it examines the question of what Europe can or should do in RRI.

4.1 RRI at the conceptual level

According to Turnheim et al. (2014), the phrase 'responsible research and innovation' has only recently begun to be used in China. Indeed, a search for Chinese academic papers using the term returned only 18 results. This does not necessarily mean that practices do not align themselves with the idea of a responsible science–society relationship. A more cautious interpretation could be that the practice of RRI in other cultural settings, such as in China, is conceptualized in other terms.

For example, for years the Chinese Government has encouraged scientists to involve themselves in science popularization and communication as part of their social responsibility. The purpose has been to establish a long-lasting relationship between research and science popularization, thus enhancing scientific literacy (Ren and Zhai, 2014). This means that every researcher is responsible for communicating their research (Cheng and Shi, 2008; Yin, 2016). In the interviews, most respondents agreed that the purpose of research is to serve society and lead societal progress. This applied to all disciplines, since this purpose is independent of the type of research. Only a few respondents thought that research could not involve social responsibility. Those respondents stated that only by using research could right or wrong be done; therefore, they believed that responsibility lay with the users (CRISP, 2017).

Science popularization refers to a kind of activity or tool, rather than to a theory, and is the main concept used in China, according to Xu et al. (2015). In the literature, the focus has been on notions such as scientific popularization, scientific literacy, popular science publishing and science communication (Jia and Liu, 2014; Wu and Qiu, 2013; Xu et al., 2015; Zhang, 2015). Public engagement was seen as influencing decision-making and, more broadly, as influencing engagement in science communication activities, in which large groups were actively participating. Xu et al. (2015) concluded that a shift from public understanding to public engagement was taking place, but that China might not have kept pace with such developments internationally. Environmental issues and biotechnology, according to those authors, were topics about which engagement was happening spontaneously.

Turnheim et al. (2014) stated that related concepts, such as responsible research, research ethics and S&T studies, have been discussed for some time now. They indicated that science and innovation policy and, similarly, research and innovation are driven strongly by economic development. Furthermore, S&T are considered to be the driving forces behind economic and social development. Finally, according to Turnheim, China is governed by a top-down decision-making system with a strong state, but changes have been observed as the public has become more aware of risks and rights and more interested in social and ethical questions to do with innovation and technology. In addition, the government is trying to involve more parties in distributing the benefits of science and innovation in such areas as health, the ecological and environmental sciences and public security. They noted that researchers are becoming more aware of research ethics and integrity. According to Turnheim et al. (2014), major Chinese S&T institutions have issued codes of conduct to tackle scientific misconduct (see also Hvistendahl, 2015). The Chinese Government is also taking steps to prevent fraud. Finally, the development of RRI is stimulated by international projects such as Global Ethics in Science and Technology and Promoting Global Responsible Research and Social and Scientific Innovation, which are collaborations with the Chinese Academy of Science and Technology for Development and the Chinese Academy of Social Sciences (Turnheim et al., 2014).

In addition, according to Li Zhenzhen and Leng Min (2016, personal communication), engagement in China is mainly in the style of

science popularization and communication. Recently, scientists have become more active and reflective, which is shown by two examples. First, in 2008, citizens were shown to be capable of contributing in a significant way to a consensus conference on the topic of genetically modified food. Second, in a role-change event in which scientists and journalists swapped roles, both parties learned a lot from each other's experiences. From the interviews, it emerged that respondents expected people's desire to engage with research to increase with greater levels of literacy (CRISP, 2017).

4.2 RRI at the governmental level

Attention to science popularization and science communication has increased rapidly during the past 30 years. The popularization of S&T is part of a national strategy that is reflected in various policy documents. For example, the *Law of the People's Republic of China on the Popularization of Science and Technology* was introduced in 2002. It is the only law concerning this topic and aims to promote science and innovation through science popularization. This law has been a driver for programmes and outlines for science popularization and communication, which have doubled in number since its introduction. To further stimulate science and innovation, it is expected that this legislation will be reformed in the future (Ren Fujun, 2016, personal communication).

In addition, in 2006, the *Outline of the National Scheme for Scientific Literacy (2006–2010–2020)* was issued. The outline emphasized the great importance of scientific literacy for the development of citizens and for the building of Chinese society (State Council, 2006). As Cheng and Shi (2008) stated: 'Science researchers and organizations, partly through their involvement in science communication, should take up their social responsibility to engage in science education.' (p. 161). The outline described missions and measurements to stimulate improvements in the quality of science, to promote technological education and training, to develop resources for dissemination via mass media and to build infrastructure for science popularization. Various groups in society are addressed, particularly young people, farmers, the urban workforce, leading cadres and public servants (Ren and Zhai, 2014).

An important recent policy document is *The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China*, which was launched in 2016 (CCTB, 2016; Cyranoski, 2016; Xin, 2016). It emphasizes the roles of S&T and science popularization in helping to foster innovation. S&T and science popularization are the 'two wings' needed to achieve innovation and development. Various respondents from the interviews pointed to these policy measures. The plan includes efforts to promote research integrity and ethics as well as training researchers on the topic (CCTB, 2016; Yin, 2016). Finally, in 2014, the government document *Guiding Opinions about Establishing the Reporting System of S&T Projects* required state-funded S&T projects to report summaries of projects, which are to be available for open access.

The respondents mentioned various policy documents that they believed would help tackle some of the current challenges for research. *Proposals on Implementing the National Strategy of Innovation Driven Development* shows the importance of innovation in science research (CRISP, 2017, p. 10). *A Scheme to Stimulate the Transformation of Technological and Scientific Achievements* (issued in May 2016) aims to stimulate the application of scientific results to society. *Proposals on Further Improving National Financial Administration of Science Research Policies* (issued in July 2016) will ease administrative tasks and, therefore, could help to tackle the administrative burden and problems such as plagiarism. Finally, respondents

expected positive changes such as equal access to universities and policies that will enhance research so that it can become more open to society.

4.3 RRI at the institutional level

At the institutional level, RRI is reflected predominantly in science popularization and communication, which aim to increase scientific literacy. A systematic approach to science education and training is described in the *National Scheme for Scientific Literacy*, for example in the section on the project for S&T education and training (State Council, 2006). As a result, many organizations have established their own bureaus or departments for science popularization and communication, the duties of which are to communicate and disseminate science. For example, the Chinese Academy of Sciences has founded the Bureau of Science Communication.

Various activities are organized at the national, community and local levels. At the national level, two big science popularization events take place each year. In the third week of September, science festivals, of which the biggest is the Beijing Science Festival, are organized all over the country. This effort includes National Science Day. To stimulate professional development and increase knowledge about the festivals, a training programme and evaluations are organized by the coordinating body, the Beijing Association for Science and Technology (BAST). They include a round-table conference, where knowledge and experiences of science festivals all over the world are exchanged. In addition, each May the countrywide Science and Technology Week is organized. In 2015, according to the Ministry of Science and Technology, this event involved more than 177,000 activities and attracted 157 million visitors. At the community and local levels, multiple activities are organized throughout the year, such as lectures, open-door labs, 'big-hands, small-hands' events, summer and winter camps, anniversaries and other public engagements.

Furthermore, science museums, parks, popular science education bases and mobile S&T exhibitions show how science popularization and communication are institutionalized. According to Ren and Zhai (2014), in 2009, China was home to 618 S&T museums, which have a flagship role in educating and engaging the public. Mobile facilities are popular in remote areas. Ren and Zhai also emphasized that the importance of public participation through interactive activities is recognized and that, increasingly, many facilities now include hands-on experiences, which members of the public consider to be highly attractive.

Television and newspapers were the main media channels for science popularization in 2011 (CRISP, 2011), when China Central Television was broadcasting more shows and programmes on S&T than ever before. However, internet-based science communication and popularization are increasingly gaining attention due to communicators' ability to use multimedia—with their high speed, large capacity and high degree of interaction—to inform and to explain policy. Ren and Zhai (2014) stressed the importance of setting up mechanisms that train scientists in science communication and teach journalists how to use the knowledge of scientists.

According to those interviewed, universities as institutions have a responsibility to provide researchers with, for example, communication platforms from which they can conduct science communication. Online courses and training programmes are also appreciated. Furthermore, universities should also support their researchers in communicating their findings and help them to popularize their results. Experiences and ideas could be exchanged on an internal platform, while interdisciplinary collaboration could give researchers the chance to learn about the effects of science communication. Implementing relevant policies at

universities could also encourage researchers to publish the negative impacts of their research for educational purposes. Some respondents were also keen to help students balance their research and educational tasks (CRISP, 2017).

4.4 RRI at the individual level

A survey of Chinese citizens in 2010 showed that they strongly supported S&T (74.8%), even if it does not bring immediate benefits (CRISP, 2011). They agreed that research that adds to knowledge should be supported (77.0%) and that government should enable public participation in decision-making about S&T (72.6%). The respondents also agreed that scientists should participate in science communication (70.9%).

The results from 2011 were confirmed by the interview findings analysed in this paper. Respondents agreed that researchers should contribute to science communication (CRISP, 2017). They also believed that researchers have a responsibility to popularize their findings through various means, for example via lectures, social media or contributions to discussions in locations where top research is conducted. In addition, respondents believed that researchers should translate their research and address, for example, leaders and cadres who can serve as intermediaries between the public and policymakers. In this way, researchers should try to influence decision-makers. Respondents also believed that both multidimensional and transdisciplinary research should be stimulated at various levels, which would provide further opportunities for researchers. However, a few respondents disagreed, arguing that this should not be a task for researchers and that professional communicators should assume responsibility for it (CRISP, 2017).

In addition, respondents believed that the administrative and managerial process for research needed improvements so that researchers could spend their time both conducting and communicating their research. For a sustainable relationship between science and society, researchers are responsible for keeping up standards of good conduct and research ethics. Government should guide researchers by issuing regulations, for example. Ethics training and education would make researchers more aware of good scientific conduct. Furthermore, the awarding of monetary prizes could not only stimulate research but also promote science communication, thus enhancing a socially responsible role for science.

4.5 Expectations of European RRI

Respondents were also asked about their expectations of European RRI. One view was that European responsibility should not be restricted to Europe only, but extended to the rest of the world. It was believed that open access and the practice of sharing scientific results with researchers in developing countries should be considered. Respondents thought it was important that research results be communicated, for example, when they concerned results from environmental research, such as that concerning air pollution. Insights could be shared in a repository or library, which would contain examples of how research could help develop society in a positive way. However, it was believed that controversial research findings should also be included, so that lessons could be drawn from them (CRISP, 2017).

For the future, some respondents expected less governmental guidance and more market-driven research. However, they unanimously agreed that scientific research into human safety, such as studies in medical cloning technology and transgenic research, should be conducted only under strict regulations. Respondents also expected science communication to increase considerably and believed that researchers should be allowed the time and conditions to put their efforts into it (CRISP, 2017).

5. Conclusions and discussion

This study aimed to provide an enriched understanding of what responsible science–society relations entail. In other words, as Rip (2014) stated, it sought to determine what roles and responsibilities actors have in the science–society relationship. In particular, the research questions sought to understand how RRI and other relevant concepts are implemented in international contexts, based on the example of China; what barriers and successes affect the future implementation of RRI; and what can be recommended for the future implementation of RRI in academic settings and research institutes. Therefore, this project collected data on practices of RRI in China at the conceptual, governmental, institutional and individual levels, in addition to information about expectations of European RRI.

At the conceptual level, RRI is a relatively new concept in China. The term 'social responsibility' is preferred, which in practice can be translated into science popularization and communication. An important aim is to increase levels of scientific literacy. Most respondents agreed that they have a responsibility to society to popularize and communicate S&T, while a minority disagreed, considering this to be the task of professional science communicators. Examples show that there are more and more public engagement activities, the main aim of which is to raise public scientific literacy through popularization and communication, allowing the public to become more skilful and confident when faced with science-related issues.

At the governmental level, policies focus strongly on innovation with the aim of fostering the economy. Science education inside and outside schools is a means to achieve innovation, and increasing scientific literacy is considered to be an important component of this. In various policy documents, such as the *Law on the Popularization of S&T*, the *National Scheme for Scientific Literacy*, the *13th Five-Year Plan* and state policies, plans for science popularization are detailed for various groups in society. In newer plans, research integrity and ethics are also promoted, along with training for researchers to allow them to become more aware of the importance of good conduct. According to the respondents, governmental policies should help researchers to fulfil their tasks of conducting research, translating the outcomes to society and communicating their results. Fewer administrative tasks and more training in communication and support via awards would also help. Respondents supported the development of S&T and agreed that government should stimulate public participation in research.

At the institutional level, science popularization and communication are institutionalized via official activities such as science festivals and initiatives such as Science and Technology Week, and also through science museums and media channels. In addition, many activities at the local level are supported institutionally. National institutes such as BAST and CRISP are helping to stimulate science education and a greater understanding of science. Many organizations, such as the Chinese Academy of Sciences, have their own offices for science communication. According to the respondents, research institutes and universities should help researchers to fulfil their responsibility to society by reducing the administrative burden of academic positions, providing platforms on which experiences can be exchanged, and offering training programmes to enhance skills in science education.

At the individual level, respondents agreed that their role could be interpreted as a responsibility to society. They would also appreciate support via policy measures and training.

For European researchers, some lessons can be learned. Above all, their responsibility should also include a broader social responsibility towards the world. Sharing results and best practices with developing countries is

regarded as valuable and helpful. RRI can take shape in different ways, as can be seen in the concepts, policies and practices in China. According to practical experience, responsibility includes openness towards societal influence and, for researchers, should be more than a checklist of elements.

To conclude, the results of this study have provided an enriched insight into aspects that play a part in the science–society relationship. The case of China shows that RRI can be, and is, labelled differently from RRI in Europe. In China, RRI is framed as a social responsibility, with an emphasis on science popularization and communication. China's policy measures strongly focus on innovation that benefits the country. For example, scientific literacy programmes and science popularization are methods to achieve this. Recently, ethical conduct has gained more attention, and researchers now expect support from governmental policies and their own institutions. This could be offered through the creation of platforms for knowledge exchange, training programmes and training awareness. Respondents also believed that controversial research should be communicated for educational purposes. Therefore, researchers are actively involved in fulfilling their socially responsible role. Overall, the results from the study can be considered insightful. However, qualitative findings such as these can never be conclusive. Further research and comparisons with the European situation are therefore recommended.

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Notes

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[2] NUCLEUS proposal, p. 10.

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Author biographies

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