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When it is unfamiliar to me: Local acceptance of planned nuclear power plants in China in the post-fukushima era

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ABSTRACT

Many contributions have been made in the studies of the factors that influence public acceptance of nuclear power. However, previous studies seldom focused on nuclear power plants in the planning stage. Actually public perception is usually more sensitive at the preliminary planning stage of a nuclear power station. Mainly utilizing questionnaire survey and focus group methods, we have identified the factors that are correlated with local acceptance of planned nuclear power plants in China. We conducted our survey in two cities, Huludao, Liaoning province in northern China, and Shanwei, Guangdong province in southern China, where the local government was planning to build its first nuclear power plant. We find that people who live closer to the plant sites are less willing to accept nuclear power than those who live farther away. As for "surface psychology" factors, perceived benefits and risks significantly influence local acceptance. As for "deep psychology" factors, emotional identification and social trust can significantly influence local acceptance, while perceived knowledge cannot. When citizens are unfamiliar with nuclear power plants, they are more inclined to evaluate the benefits and risks through emotional identification and social trust, rather than through pure rational deduction based on concrete facts.

1. Introduction

Nuclear energy is being promoted as a type of clean energy in many countries around the world, and it has become one of the main alternative solutions for transforming the global energy structure and reducing the greenhouse effect. According data from World Nuclear News website, by the end of December 31st, 2015, there were 439 units spread over more than 30 countries in the world with the total installed capacity of 382.2 GW. And the number of units under construction is 64 with the capacity of 67.8 GW. Based on the forecast from International Atomic Energy Agency, global nuclear power still maintains a long-term and long-term growth prospect, and concentrates in Asia, especially China. China's nuclear power development began in the mid-1980s. As of Januray 2016, there are 33 nuclear reactors that are in operation with a capacity of 27 GW and 24 that are under construction with a capacity of 27 GW in mainland China. According to the Long-term Nuclear Power Development Plan (2011–2020), by the year 2020, the installed nuclear power capacity in service and under construction should be 58 GW and 30 GW respectively in China.

However, nuclear power development has not always been a smooth process around the world, including in China, and it has been especially affected by recent catastrophic nuclear accidents, such as the Fukushima nuclear accidents. Previous studies have concluded that nuclear accidents can significantly change public perceptions of nuclear energy (Huang et al., 2013; Kim et al., 2013; Visschers and Siegrist, 2013). The Fukushima nuclear accident led to a global phenomenon of public panic about potential nuclear crises; China has also been affected by this issue. Due to fears of ongoing radiation from Japan since the disaster, there has been a surge in Chinese citizens' purchase of salt, which has been fueled by the belief that iodine is effective in fighting against the effects of radiation. When China re-initiated its nuclear power production efforts in 2013 after a two-year hiatus, the Chinese government faced civic unrest and social protests over its ambitious plans to build more nuclear power plants. For example, on July 12, 2013, within the announcement period of the *China National Nuclear Cooperation (CNNC) Longwan Industrial Park Project Social Stability Risk Assessment*, public protests in resistance against the local construction of nuclear fuel factory erupted in Heshan, which is a county-level city in Jiangmen in the southern part of Guangdong Province. The government eventually canceled the project. In 2014, the Standing Committee of the People's Congress of Fangchenggang City in the Guangxi Autonomous Region passed the *Fangchenggang City People's Congress Standing*

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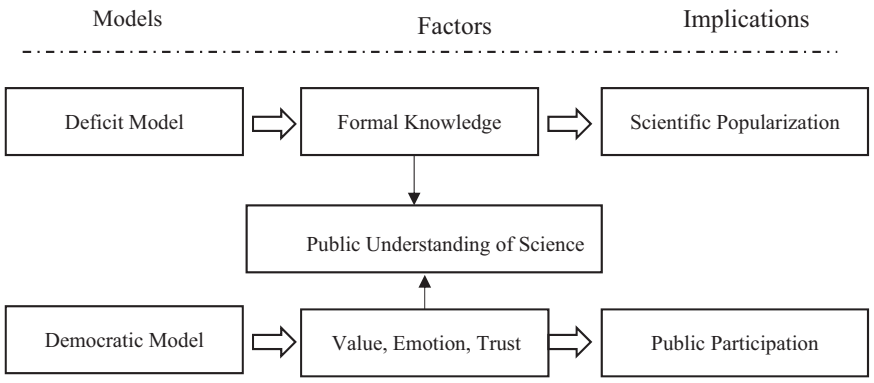

Fig. 1. The theoretical framework based on the perspective from public understanding of science.

Committee's Resolution on Jiangshan Peninsula Tourism Resort Tourism Resource Development and Protection. A request was submitted for the local government to terminate the Bailong Nuclear Power Project, which was being planned at that time. Most recently, a public protest movement occurred in Lianyungang City in August 2016 to resist the nuclear cycle project, which led the local government to suspend preliminary work on the site.

The cases above show that public acceptance has become an important factor that affects the promotion of nuclear power technology in China, and it can even determine whether planned nuclear power facilities are stably and successfully completed. To our best knowledge, previous empirical studies have focused more on the public acceptance of the specific nuclear power plants that were in operation (e.g., Venables et al., 2012; Huang et al., 2013; He et al., 2013; Ho et al., 2013), and public's general perception of nuclear energy with wide ranges-sampling (e.g., Visschers and Siegrist, 2013; Sun and Zhu, 2014; Stoutenborough et al., 2013; Siegrist and Visschers, 2013). This study therefore attempts to supplement the existing literature by focusing on the public acceptance of planned nuclear power in the early stages of development, and it aims to explore some of the factors that affect the public acceptance of planned nuclear power when it is unfamiliar to the public.

2. Literature review

2.1. Understanding the public acceptance: perspective from public understanding of science theory

"Public acceptance" has been widely used as a term to understand public perceptions and behavior towards energy, environment and climate change. In fact, the studies on public acceptance can be traced back to the theory of the public understanding of science (PUS). The public understanding of science became a watchword of the 1980s and quickly gained attraction among scholars.

The deficit model, the most important theoretical framework of PUS, assumes that public have "deficient" knowledge while scientists possess "sufficient" knowledge (Wynne, 1991; Gross, 1994). Because of lack of knowledge, the public are always hostile to new technologies (Wynne, 1991; Sturgis and Allum, 2004; Stoutenborough and Vedlitz, 2016). The deficit model regards knowledge as the most important factor in explaining public understanding of science. As a result, the implication of deficit model is that public scientific literacy should be improved to achieve greater public understanding and awareness of science.

In the subsequent academic literature, the deficit model has been criticized on theoretical and empirical grounds for oversimplifying the factors influencing public understanding of science (e.g. Wynne, 1991; Ziman, 1991; Evans and Durant, 1995; Durant, 1999). Durant (1999) pointed out that it was limited to view formal knowledge as the only key to the relationship between science and the public, and proposed the democratic model of the public understanding of science, focusing on a wider range of factors, including knowledge, values, and relationships of power and trust. The democratic model regarded scientists and non-scientists and as equals, and highlighted the effects of public participation on promoting the public acceptance of science and technology (Durant, 1999). The deficit model deemed "formal knowledge" as one of the most crucial elements in the relationship between scientists and the public, while the democratic model underlined more influencing factors, such as either group's relationships with knowledge, value, power and trust. Based on the evolution of public understanding of science theory, we build up a theoretical framework to support to propose analytical model (Fig. 1).

2.2. Perceived benefits and risks: factors that directly influence local acceptance of nuclear power

It is commonly believed that the perceived benefits and risks of nuclear power directly determine the degree of public acceptance (Bird et al., 2014; De Groot and Steg, 2010; Fang, 2013; Huang et al., 2013; Visschers et al., 2011; Visschers and Siegrist, 2013). Previous studies have proposed that the promotion of nuclear power technology has the potential to reduce not only energy prices but also the levels of carbon emissions that are created from traditional energy sources and to improve local ecological environments (De Groot and Steg, 2010; Huang et al., 2013; Visschers et al., 2011; Visschers and Siegrist, 2013), which is more easily perceived and judged by the public. In addition, the construction and operation of nuclear power plants may be regarded as a type of industry that generates more jobs and taxes, boosts economic development and even facilitates development in the quality of life at the local level (Culley et al., 2010). As a result, the perceived benefits and public acceptance of nuclear power share a positive correlation (Bird et al., 2014; Frewer et al., 1998). Although the probability of a nuclear accident occurring may be minimal, the perceived risk of nuclear power is still the most important factor that influences public acceptance. Many empirical studies have noted that perceived risks of nuclear power plants is negatively correlated with the acceptance of nuclear power technology (Visschers et al., 2011). One effect of nuclear disasters on public opinion has been a decrease in the public acceptance of nuclear power based on a parallel increase in the perceived risks (Bird et al., 2014; Ho et al., 2013; Huang et al., 2013; Visschers and Siegrist, 2013).

2.3. Knowledge, emotions and trust: factors that indirectly influence local acceptance of nuclear power

The brief literature review above focuses on "surface psychological factors", namely the perceived benefits and risks that are treated as factors that directly influence the public acceptance of nuclear power in this study. However, given the different propensities of each individual, other factors that can be categorized as "deep psychological factors"