The Effects of Social Trust on the Public's Trust in Nuclear Power Organizations, Benefit and Risk Perceptions, and Acceptance of Nuclear Energy

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1. Introduction

Public acceptance is essential for a national policy to be developed and implemented successfully in a society. Research has shown that trust is one of the key factors that influence public acceptance. A series of researchers have analyzed the relationships among the public's trust level regarding nuclear energy, related risk and benefit perceptions, and acceptability of residents in the vicinity of NPPs (e.g., Shim, 2009) [1]. Other studies also show that the public's trust in diverse Nuclear Power(NP)-related organizations is linked to acceptance of nuclear energy (Wang & Kim, 2017) [2]. Through this study, we further examine how social trust influences the public's trust levels in diverse NP-related organizations, which in turn influence their NP benefit and risk perceptions, and acceptance of nuclear energy.

2. Literature Review

A series of studies have investigated the variables that affect the level of public acceptance of nuclear energy. In particular, Shim (2009) stated that the public's trust in NPP, perceived risk and perceived benefit have a significant impact on acceptance of NPP [1].

The role of trust is significant as it is not easy for public not only to acquire knowledge of certain science field of nuclear energy, but also to decide whether to construct a nuclear power plant, which involves diverse benefits and risks. In general, people rely on trust for convenience in decision making when there is a lack of knowledge (Siegrist, 2000) [3]. Cha (2000) defines trust as a level of confidence in the organization that provides and manages information about the risk [4].

Trust has been studied extensively in recent social science research. Recently, Wang and Kim (2017) claim that the concept of trust is abstract, and thus its multiple dimensions should be respectively examined in a more concrete level [2].

In the context of nuclear power applications, there are various organizations that determine the public's risk and benefit perceptions regarding nuclear energy. For example, it was found that trust in regulators influences risk perceptions, which is a determinant of acceptability (Siegrist, 2000)[3]. Wang and Kim (2017) also demonstrated that trust in diverse organizations, such as institutions, academic research institutes, and operating agencies responsible for research and regulation of nuclear power, affect nuclear acceptance [2].

Meanwhile, another line of researchers and practitioners noted the role of social trust (a.k.a. generalized trust) in determining the level of public acceptance of a given policy. Social trust is defined as the belief that others in society can generally be trusted (Sztompka, 1999) [5]. North (1998) refers to it as established systems or beliefs prevalent in a society [6]. The cross-country differences in social trust have been empirically demonstrated by a series of global surveys including the recent data from the World Values Survey (WVS) [7]. According to the survey, the three Nordic countries and Canada are the top of the social trust scale, while Republic of Korea is ranked as one of the lowest group. Based on such results, some practitioners in nuclear energy field have questioned if the different level of social trust in different countries would influence the level of public acceptance of nuclear energy. The current study investigates this area of research. Specifically, we aim to integrate the previous findings on particularized trusts (i.e., trust in diverse dimensions) with the concept of generalized trust (i.e., social trust) in the context of public acceptance of nuclear energy. Thus, this study sets and proposes the following research questions and hypotheses.

RQ1: Will the level of social trust negatively influence the level of acceptance of nuclear energy?

RQ2: Will the level of social trust positively influence the level of trust in specific dimensions related to nuclear energy (i.e., (a)nuclear energy technology; (b)nuclear energy experts; (c)NPP operator(KHNP); (d)NP-related governmental organizations)?

H1: There will be a positive relationship between the level of trust in specific dimensions related to nuclear energy (i.e., (a)nuclear energy technology; (b)nuclear energy experts; (c)NPP operator(KHNP); (d)NP-related governmental organizations) and the level of benefit perceptions of nuclear energy.

H2: There will be a negative relationship between the level of trust in specific dimensions related to nuclear energy (i.e., (a)nuclear energy technology; (b)nuclear energy experts; (c)NPP operator(KHNP); (d)NP-related governmental organizations) and the level of risk perceptions of nuclear energy.

H3: There will be a positive relationship between benefit perceptions of nuclear energy and acceptance of nuclear energy.

H4: There will be a negative relationship between benefit perceptions of nuclear energy and acceptance of nuclear energy.

3. Methods

3.1. Procedure of survey

This study conducted a survey to investigate the hypotheses and research questions described above. The first independent variable is social trust. The dependent variables include trust in nuclear technology, trust in nuclear experts, trust in KHNP, trust in NP-related governmental organization, benefit perceptions of nuclear energy, risk perceptions of nuclear energy, and acceptance of nuclear energy.

Participants of the survey were recruited from Seoul citizens aged 19 and over. A professional research institute sent a link to the survey site to 1,000 Seoul citizens. Of the total 448 participants whose responses were included in analysis, 50.0% were males. The age distribution was 25.0% in 20s, 25.0% in 30s, 25.0% in 40s, and 25.0% in 50s.

To analyze the data, this study employed Structural Equation Modeling (SEM), using AMOS 21 software program.

3.2. Measures

To check the reliability of each construct's measurement, we carried out reliability analyses using *Cronbach Alpha* values as criteria. The *Cronbach Alpha* values of main constructs are as shown in Table I. To measure variables, we use a five-point Likert scale: 1 for "Strongly disagree" to 5 for "Strongly agree".

3.2.1 Social trust

We used the mean of the responses to the four questions developed based on International Social Survey Programme (ISSP), which is carried out in 39 countries around the world annually: "I can trust most people", "I can trust our society", "I can trust my government", I can trust my country's media." (*Cronbach Alpha* = .820) (M = 2.29, SD = .72)

3.2.2 Benefit perceptions of nuclear energy

We used the mean of the responses to the three questions: "Nuclear power is an economically efficient energy resource," "Nuclear power is greater than its losses", "Nuclear technology is helpful for national economic development" (Han & Kim, 2013) [8]. (*Cronbach Alpha* = .775) (M = 2.75, SD = .87).

Table 1. Cronbach Alpha value of each construct

Constructs	*Cronbach Alpha*
Social Trust	*.820*
Benefit perceptions of nuclear energy	*.775*
Risk perceptions of nuclear energy	*.803*
Acceptance of nuclear energy	*.910*

3.2.3 Risk perceptions of nuclear energy

We used the mean of the responses to the three questions: "Nuclear energy is likely to be an accident, such as an explosion or a radiation leak" "Nuclear energy can cause bad results", "I feel uneasy when I think about nuclear energy" (Kim, Kim, & Kim, 2013) [9]. (*Cronbach Alpha* = .803) (M = 3.85, SD = .79).

3.2.4 Acceptances of nuclear energy

We used the mean of the responses to the four questions: "I agree that my country uses nuclear energy as one of the power supply methods," "My country should continue to use nuclear energy," "My country needs to construct more nuclear power plants in the future," "My country should continue to develop the nuclear industry in the future," (Lee, Jung, & Park, 2014) [10]. (*Cronbach Alpha* = .910) (M = 2.90, SD = .97).

3.2.5 Trust in nuclear technology

We used a statement "I trust in the whole technology related to nuclear power plants in Korea" on a five-point *Likert* scale (Park, 2013) [11]. (M= 2.72, SD= .946).

3.2.6 Trust in nuclear experts

We used a statement "I trust experts who develop nuclear power technology" on a five-point *Likert* scale (Park, 2013) [11]. (M= 2.99, SD= 1.002).

3.2.7 Trust in KHNP

We used a statement "I trust KHNP that operates nuclear power plants" on a five-point *Likert* scale (Park, 2013) [11]. (M= 2.55, SD= .989).

3.2.8 Trust in NP-related governmental organizations

We used a statement "I trust governmental organizations that manage, monitor and control the entire nuclear power generation" on a five-point *Likert* scale (Park, 2013) [11]. (M= 2.10, SD= .974).

4. Results

As shown at Table 2, the model fit indices indicates that model has a reasonably good fit. Chi-square = 246.044; d.f. = 108; p < .05; RMSEA = .053 (< .06); NFI =.952(>. 90); CFI = .972 (>. 90); GFI = .943 (>. 90); AGFI = .910 (> .90); RMR = .042 (<. 05). In other words, the results of model testing this current study exceeded the general criterion for model's goodness of fit.

Table 2. Model fit indices with recommended values (N=448)

Statistic	Recommended value	Obtained value
X^2		246.044
d.f.		108
RMSEA	.05~.08	.053
NFI	>.9	.952
CFI	>.9	.972
GFI	>.9	.943
AGFI	>.9	.910
RMR	<.05	.042

Figure I shows the model with the research questions and hypotheses this study proposed. As a result of SEM analysis, it is found that there was no direct effect from social trust to acceptance of nuclear energy, so RQ1 was rejected. Rather, social trust influences particularized trusts (i.e., the levels of trust in diverse dimensions such as nuclear technology, nuclear experts, KHNP, and NP-related governmental organizations), answering RQ2.

The analyses for hypotheses testing were performed through SEM. As shown at Table 3, the hypotheses were tested by estimating the model such as standardized coefficients, standardized errors, and p-values.

First, <H1> predicted a positive relationship between benefit perceptions of nuclear energy and the levels of trust in diverse nuclear dimensions. The results show that there is a positive relationship between benefit perceptions and trust in nuclear technology, nuclear experts and KHNP. That is, H1(a), H1(b), and H1(c) were supported. However, there was no statistically significant relationship between benefit perceptions of nuclear power and trust in NP-related governmental organizations.

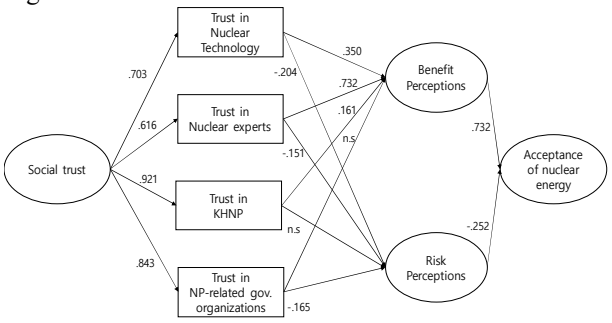

Figure I. Research model (standard regression coefficients)

Table 3. Results of hypotheses verification

Hypothesis	Standardized Coefficients	Standard Error	Results
H1(a)	.228*	.044	Adoption
H1(b)	.176*	.040	Adoption
H1(c)	.101*	.043	Adoption
H1(d)	-.010	.039	Dismissal
H2(a)	-.169*	.060	Adoption
H2(b)	-.119*	.055	Adoption
H2(c)	-.050	.059	Dismissal
H2(d)	-.135*	.055	Adoption
H3	.931*	.097	Adoption
H4	-.252*	.042	Adoption

*p < .05

Next, <H2> predicted a negative relationship between risk perceptions of nuclear power and trust in diverse nuclear dimensions. The results show that there is a significant negative relationship between risk perceptions of nuclear energy and trust in nuclear technology, nuclear experts and NP-related governmental organizations. That is, H2(a), H2(b), and H2(d) were supported. However, there was no statistically significant relationship between risk perceptions of nuclear energy and trust in KHNP.

Finally, the higher benefit perceptions of nuclear energy, the higher acceptance of nuclear energy, as proposed in H3, and the higher risk perceptions of nuclear energy, the more negative acceptance of nuclear energy, as proposed in H4. In other words, benefit and risk perceptions were significantly associated with the acceptance of nuclear energy. Thus, H3 and H4 were supported.

5. Conclusion

This study analyzed the relationship among social trust, trust in diverse nuclear-related dimensions, benefit and risk perceptions, and acceptance of nuclear energy. It empirically demonstrated that the greater benefit perceptions tend to increase the level of acceptance of nuclear energy, while the greater risk perceptions tend to reduce the level of acceptance of nuclear energy, as suggested in previous studies. In this current study, we further elaborated whether/how the public's levels of trust in diverse nuclear-related dimensions influence on their risk and benefit perceptions, and how social trust impacts on the acceptance of nuclear energy.

The results show that the higher level of social trust was associated with the higher levels of trust in diverse nuclear-related dimensions, whereas it was not directly associated with the level of acceptance of nuclear energy. Specifically, these findings suggest the

following implications on nuclear energy policy and communication.

First, social trust does not directly influence the public's acceptance of nuclear energy. That is, the general tendency of "low social trust" in Korea would not necessarily lead to the low level of public acceptance of nuclear energy. This finding should be noted because it keeps the nuclear industry and relevant bodies from falling for a deterministic view (e.g., "the efforts for public acceptance may not be useful or needed, as people would have such cultural dispositions not to believe what we say").

Second, the findings of this study suggest that, in order to improve the acceptance of nuclear energy, it is important to work to earn the public's trust in diverse dimensions. Specifically, this study showed the significant effects of trust in nuclear power technology, nuclear power experts, nuclear power plants operator (KHNP), and nuclear-related government bodies on public acceptance of nuclear energy. This finding suggests that each nuclear-related organization should continuously try to earn the public's trust through effective nuclear communication programs..

Finally, it is also noteworthy that each of the diverse nuclear-related dimensions influences the public's benefit and risk perceptions in different mechanisms from each other. For example, the level of trust in nuclear-related government bodies significantly influences the public's risk perceptions, but not benefit perceptions; the level of trust in KHNP significantly influences the public's benefit perceptions, not risk perceptions regarding nuclear energy. The mechanisms behind how the public's benefit and risk perceptions are formed should be further examined by considering the different roles of different organizations in the nuclear power field. Future studies in this area will provide more practical implications for developing effective nuclear energy communication programs for publics.

REFERENCES

[1] Shim, J. S. (2009). Trust in Nuclear Power Plant, Perceived Risk and Benefit, and Acceptance. The Korean Association for Policy Studies, 18(4), 93-123.

[2] Wang, J. S., & Kim, S. Y. (2017). Changes in Nuclear Energy and Trust: Influence of Trust in Objects and Attributes. Institute of Governmental Studies, 23(1), 193-222.

[3] Siegrist, M. (2000). The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk analysis, 20*(2), 195-204.

[4] Cha, Y. J. (2000). Risk perception in Korea: a comparison with Japan and the United States. *Journal of Risk Research, 3*(4), 321-332.

[5] Sztompka, P. (1999). Trust: A sociological theory: Cambridge University Press.

[6] North, D. C. (1998). Economic Performance Through Time. The New Institutionalism in Sociology, 247.

[7] WVS (2009). World Value Survey 1981-2008 official aggregate v.20090901, 2009.World Values Survey Association (www.worldvaluessurvey.org). Aggregate File Producer: ASEP/JDS, Madrid.

[8] Han, D. S., & Kim, H. I. (2011). [Risk and Communication: Communication Effects on Social Acceptance of Nuclear Power]. Crisisonomy, 7(2), 1-22.

[9] Kim, C. S., Kim, D. H., & Kim, J. H. (2013). Analysis of Awareness of Radiation and Nuclear Power Plants after Fukushima Nuclear Accident. The Korea Contents Asso;ciation, 13(9), 281-287.

[10] Lee, M. J., Jung, J. S., & Park, K. S. (2014). The Influence of the Perceived Risk, Perceived Usefulness, and Transparency in the Development of Nuclear Power on Public Acceptability: Using the Trust of Korea Hydro and Nuclear Power(KHNP) Company as a Mediator. KOREAN CORPORATION MANAGEMENT REVIEW, 56(-), 253-279.

[11] Park, W. K. (2013). A Study on Message Credibility Regarding Nuclear Power Plant Issues on Twitter and Facebook Accounts Messages]. Korea Speech, Media & Communication Association, 20(-), 89-112.