

Factors Affecting Acceptance of Nuclear Power Generation after the Fukushima Nuclear Disaster: A Comparison of Japanese and U.S. College Students

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The Fukushima nuclear power plant disaster in 2011 had a significant impact on nuclear power energy policies in many countries. It is essential to understand the public acceptance of nuclear power for decision making and policy implementation about the energy policies in the post-Fukushima era. In this study, the acceptance of nuclear power was investigated by using data from Japanese and U.S. college students. Questionnaire surveys were conducted both in Japan ($N=108$) and the United States ($N=71$), and the determinants of general and local acceptance of nuclear power were examined. The results show that the economic benefits of nuclear power plants were positively related to the acceptance of both Japanese and U.S. students. The trust in nuclear-related organizations was also positively among Japanese, while the risk of nuclear wastes was negatively related to the acceptance of nuclear power generation among U.S. students.

Key Words: nuclear power, acceptance, college students

INTRODUCTION

The purpose of this study was to investigate the determinants of the acceptance of nuclear power among Japanese and U.S. college students.

On March 11, 2011, Japan experienced a great earthquake and tsunami in the east of Honshu. The Magnitude 9.0 earthquake and huge tsunami caused the Fukushima nuclear disaster. After those events, many countries such as Japan and Germany witnessed a decline in public acceptance of nuclear power and had to reexamine their nuclear policies.

Understanding public acceptance of nuclear power gen-

eration is essential for the establishment and implementation of energy policies, especially in the era of the post-Fukushima nuclear disaster.

Public acceptance refers to laypeople, end-users, or the general public's approval to use new technologies. This concept is often used in the context of the discussion about public survey results. Researchers have defined three types of public acceptance of new technologies (Wüstenhagen et al., 2007). Namely, social-political acceptance, community acceptance, and market acceptance. Here, social-political acceptance refers to the public's general acceptance of a specific technology; community acceptance refers to the acceptance by the people, such as residents in the nearby area of a nuclear facility who are directly related to or influenced by the technology; and market acceptance refers to the companies' willingness to undertake the business or end-users will pay for the products.

Studies, including those conducted in Japan, have shown that a number of factors influence the acceptance of nuclear power. Below, we will briefly explain these predictors.

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Perceived risk, perceived benefit, and trust

Perceived risk and benefit of nuclear power generation, trust in people, companies, and government agencies related to nuclear power have been shown as predictors of the acceptance of nuclear power.

For example, Tanaka (1995) examined major factors to enhance public acceptance of a variety of technologies and products, including nuclear power generation. He found the following three factors positively related to public acceptance: the necessity, the benefits (or “beneficialness” as he used) to the global environment, and trust in the enterprise related to the technologies or products.

Tsunoda (2001) conducted surveys in Tokyo and other Japanese cities before and after a nuclear criticality accident occurred in 1999. He reported that nuclear acceptance strongly correlated with higher levels of perceived efficiency and trust in nuclear power operation, as well as lower levels of perceived accident likelihood.

Kimura & Furuta (2003) investigated if living areas and the degree of knowledge about nuclear power influence the acceptance of nuclear power. They found that a respondent’s acceptance differs from areas near and far from nuclear facility sites, but not the degree of knowledge on nuclear power. They also confirmed that the acceptance was related to perceived benefit and risk of nuclear power, as well as trust in nuclear power.

After the Fukushima nuclear disaster, some people changed their opinion from supporting nuclear power to opposing it or becoming undecided. Siegrist et al. (2014) examined the reason for this change, using a Swedish sample. They found that changes in benefit perception after the Fukushima nuclear disaster strongly influenced the acceptance of nuclear power.

Nakayachi (2015) showed that trust in risk-managing organizations for nuclear plants decreased significantly in Japan after the Fukushima nuclear disaster. He claimed that the decline in trust might be one of the most important reasons for the reduced acceptance of nuclear power in Japan.

Interest in nuclear energy

Tsunoda (2001) reported a positive relationship between interest in nuclear energy and the acceptance of nuclear power in his study. However, if people have a stronger interest in nuclear power, and experienced a major nuclear accident, this relationship might change to negative. It is necessary to confirm this if we want to know the situation after the Fukushima nuclear disaster.

Interest in global climate change, perception of global climate change risk, and mitigation effect by nuclear power use

Global climate change has become one of the most urgent issues facing humanity today, and the leading cause of this change is CO₂ emission. Because most of the CO₂ emission comes from fossil fuels, using more nuclear power and fewer fossil fuels has been considered one of the most effective countermeasures for global climate change. For this reason, people who have a higher interest in and higher risk perception of global climate change may show more acceptance of nuclear power use.

Visschers et al. (2011) investigated the determinants of acceptance of nuclear power stations using a set of data collected in Switzerland before the Fukushima nuclear disaster. They measured acceptance, benefit perception for climate mitigation, benefit perception for secure energy supply, risk perception, trust, and emotion about nuclear power. Their results show that benefit perception of secure energy supply and, to a lesser extent, benefits perception of climate mitigation positively, and risk perception negatively related to acceptance of nuclear power stations.

Pidgeona et al. (2008) examined a set of data from a U.K. national survey on nuclear power and climate change. They found that people see both nuclear power and climate change as problematic in terms of risks. Furthermore, they also found that people expressed only a ‘reluctant acceptance’ of nuclear power as a ‘solution’ to climate change. They argued that it is difficult for people to undertake a simplistic risk-risk tradeoff between nuclear energy and climate change.

Pro-ecological worldview

The pro-ecological worldview has also been examined as a predictor of acceptance of nuclear power. The pro-ecological worldview or pro-environmental orientation is a set of beliefs about humans and their environment. This worldview has been measured in many studies with the New Ecological Paradigm (NEP) Scale (Dunlap et al., 2000).

People with a high pro-ecological worldview prioritize benefits and interests based on the ecosystem and the biosphere as a whole, rather than merely on interests of humans. Moreover, these people also show more concerns about environmental problems, including global climate change, and a positive attitude toward environmental protection.

Studies have examined the relationship between the pro-ecological worldview and the acceptance of nuclear power. For example, Tsujikawa et al. (2016) analyzed survey data collected before and after the Fukushima nuclear disaster. They examined how the factors influencing public acceptance of nuclear power changed after the disaster. They found that the pro-ecological worldview was positively related to perceived risk and negatively related to trust only after the disaster. They also confirmed that perceived risk and perceived benefit were related to acceptance both before and after the disaster, but the significant trust effect on the acceptance was confirmed only after the disaster.

On the other hand, Wang et al. (2019) reported a positive relationship between the pro-ecological worldview (they used the term “environmental beliefs”) and the acceptance of nuclear power in their internet survey study conducted in China in 2017. However, in their study, the respondents had “experience in the public participation activities in Chinese nuclear power plant projects.” It is possible that those participants received more information about the benefits and less information about the environmental destruction caused by nuclear-related accidents such as the Fukushima nuclear disaster through such activities. As a result, the participants who had a higher pro-ecological worldview showed stronger acceptance of nuclear power.

Nuclear power could mitigate global climate change, but it also might worsen the environmental situation by nuclear plant accidents or nuclear waste disposal. It seems that the relationship between pro-ecological worldview and the acceptance of nuclear power might vary in different situations or in different countries.

Energy situation

Among studies on risk perception and acceptance of new technologies, some are dedicated to the comparison between different countries. These kinds of studies have provided evidence to the universality and uniqueness of risk perception and acceptance in different countries and will help us to understand more deeply the attitudes and behaviors related to nuclear power.

For example, Hirose et al. (1993) examined the difference between Japanese and U.S. college students in risk perceptions. They used risk items about environmental risks, technological risks, epidemics, natural disasters, societal risks, and political-economic risks. Their results showed that both Japanese and U.S. respondents rated the

nuclear plant accident high among the risks for which it was most urgent to avoid harm.

Wang & Kim (2018) examined public attitudes toward nuclear power across 27 European countries using public survey data collected in 2009 by Eurobarometer. They explored individual level (sociodemographic factors and perception factors) and country-level (energy factors, environmental factors, cultural factors, and economic factors) factors on attitude toward nuclear power. They found that at the individual level, attitude was influenced by perceived benefit, perceived risk, and trust. This tendency is common across countries. At the country level, the ratio of nuclear power generation in energy supply, environmentalism, and ideology were the factors that influenced the acceptance of nuclear power.

The above findings suggest that the different situations of energy resources in different countries may influence the acceptance of nuclear power. For example, Japan and the United States, like many other countries, use three types of primary resources for electricity generation, namely, fossil fuels (petroleum, natural gas, and coal), nuclear energy, and renewable sources of energy. The energy self-sufficiency ratio of Japan was only 9.6% in 2017 (Ministry of Economy, Trade, and Industry, 2018), while energy production in the United States equaled about 95% of the country’s energy consumption in 2018. Furthermore, Japan lacks natural energy resources, but in the United States, about 80% comes from fossil energy sources, including oil, coal, and natural gas (U.S. Energy Information Administration, 2019). Therefore, Japanese people may think that nuclear power is more important or has a more significant economic benefit than U.S. people do.

Kim et al. (2014) reported results of analyzing a set of data collected in 2005 from 19 countries, including Japan and the United States, about the acceptance of nuclear power. In their findings, “strong,” and “reluctant” acceptances of nuclear power ratio were 20.7% and 61.0%, respectively, among Japanese respondents, but 45.8% and 30.4%, respectively, among U.S. respondents, respectively, showing that U.S. respondents’ acceptance of nuclear power is higher than the Japanese. In terms of risk perception, 79.5% of Japanese and 56.3% of U.S. respondents consider nuclear power as risky.

Impacts of nuclear accidents and others

Another factor that may influence the acceptance of nuclear power in different countries may be direct and indirect information about nuclear-related accidents. Accord-

ing to the framework of social amplification of risk, social and economic impacts of an adverse event are determined by both direct physical consequences of the event and the interaction of psychological, cultural, social, and institutional processes. Both physical consequences and media coverage about the risk events influence risk perception (Renn et al., 1992). After the Fukushima nuclear disaster, many residents of nearby areas of the nuclear power station had to evacuate from their homes because of the radioactive contamination. There have been a lot of media reports on this evacuation and other damages by the disaster in Japan. It is reasonable to say that people who live in Japan have experienced more media reports and exposure to much more information about the disaster, and hence they have a higher risk perception of nuclear power than people who live in other countries.

Besides the influence factors on the acceptance of nuclear power mentioned above, two more factors might also be related. The first is the perceived social norm, which refers to the perception of the majority's attitude or behavior about nuclear power in the country. That is, people's acceptance of nuclear power may be influenced by their perception of other people's attitudes towards nuclear power.

The second factor is the judgment of the weight of local opinions on nuclear facilities. Studies show that people often support technology or service in general, but oppose it if related facilities would be built nearby in their neighborhood. This phenomenon is called the NIMBY (Not In My Back Yard) syndrome (Kraft & Clary, 1991). Therefore, in this study, we chose to measure two different acceptances: general acceptance and local acceptance of nuclear power. The former refers to the acceptance of nuclear power generation in the county and the world, while the latter refers to people's acceptance of nuclear facilities in their neighborhoods. The weight of local opinions should be more important in considering local rather than general acceptance of nuclear facilities.

Based on the studies mentioned above, we measured the acceptance of nuclear power with a Japanese and a U.S. student sample. We examined the following independent variables as influence factors on the acceptances: interests in nuclear power and global climate change, perceived risk of environmental problems, economic and environmental benefits of nuclear power, risks of nuclear power and nuclear wastes, trust in nuclear-related scientists and organizations, pro-ecological worldview, perceived social norm of nuclear power, and weight of local

opinions.

METHOD

Participants

Japanese students (108 students: 52 males and 56 females) at a private university in Chiba prefecture participated in the study. The students majored in health sciences, nursing, and risk management. The average age was 20.2 years. The experimenter asked the students to take part in the study, but also told them that there would be no disadvantage in their academic evaluations if they chose not to participate.

U.S. students (71 students: 26 males, 43 females, and 2 unidentified) at a private university in Ohio state participated in the study. The students majored in science, pharmacy, business, health sciences, or psychology, and they were in their first to seventh years at university. Their average age was 24.9 years. The experimenter or the professors who were teaching a class invited the students to take part in the study. They also told the students that there would be no disadvantage in their academic evaluations if they chose not to participate.

Measurements

There were 35 items used for measuring the perception of nuclear power generation, global climate change, and pro-ecological worldview. Based on Tsunoda (2001), we used questionnaire items about perceived risks and benefits of nuclear power generation and trust in nuclear power generation (researchers, companies, government). We also used items about the perceived risk of climate change and interests in climate change. Finally, we adopted five items from the New Ecological Paradigm Scale (NEP) by Dunlap et al. (2000) for the measurement of the pro-ecological worldview.

For these items, 5-point Likert scales were used (1: Strongly Disagree; 5: Strongly Agree). Demographic information, including age, sex, years at college, and major was also collected.

The questionnaires were prepared both in English and Japanese languages. The English version was constructed first for the U.S. sample, and then it was translated into Japanese by the authors and used for the Japanese sample.

Procedure

The survey for the U.S. students was administrated on the web survey platform of Survey Monkey, while for the Japanese students, Microsoft Office365 Forms was used

as the survey platform.

Participants accessed the survey web page with their PCs or smartphones. Surveys were administered on the U.S. students from April to July 2018, and on the Japanese students in July 2018.

The research ethics committee in the first author's university approved this study.

RESULTS

Rating scores on questionnaire items

Table 1 shows the average rating scores for each questionnaire item by Japanese and U.S. students. Independent-samples t-test was also conducted to compare the rating scores between Japanese and U.S. students on question items. Significant differences between Japanese and U.S. students were found in 19 out of 35 items, showing that Japanese students having higher scores on risk and benefit of nuclear power, stronger interests in nuclear power, and a stronger tendency in pro-ecological worldview than U.S. students. However, U.S. students showed more acceptance of nuclear power generation.

Rating scores on clusters of items

Questionnaire items were grouped into the following clusters according to each item's meaning (Table 1): Interests in nuclear power and climate change, the benefits of nuclear power (economically and environmentally), the risks of nuclear power and nuclear wastes, trust in nuclear power, pro-ecological worldview, social norm for nuclear power, weight of local opinions, and acceptance of nuclear power (general and local).

Cronbach's alphas for the clusters with two or more items were calculated separately for Japanese and U.S. students, and the values were in the range of .463 and .873 (Table 1). Because these clusters are easy to explain, and even most of the alpha values were smaller than 0.800, we decided to continue our data analyzing using these clusters.

Japanese and U.S. students' average scores on these clusters are shown in Table 2. Independent-samples t-test was conducted to compare the average scores between Japanese and U.S. students on each cluster. The results showed that compared with Japanese students, U.S. students' general acceptance and local acceptance of nuclear power were high. Notably, the average score of general acceptance (3.24) was higher than 3, which means a positive attitude toward nuclear power. U.S. students also

showed a high interest in global climate change and the environmental benefit of nuclear power. On the other hand, Japanese students showed higher scores on the perceived risk of environmental problems, the economic benefit of nuclear power, the risk of nuclear power, and the weight of local opinions. Furthermore, local acceptances were significantly lower than general acceptances in both Japanese and U.S. samples, $t(107)=7.635, p<.001$; $t(70)=4.706, p<.001$, respectively.

Multiple regression analysis

Multiple regression analyses were conducted separately using both Japanese and U.S. students' data to determine the best linear combination of independent variables for predicting general and local acceptances of nuclear power generation. For the convenience of comparison between the two sample groups, the forced entry method was used so that all the 11 independent variables were examined.

Table 3 shows the results of predicting the general acceptance of nuclear power generation by Japanese and U.S. students. The significant beta values showed that economic benefit was positively related to the general acceptance, while risk of nuclear waste was negatively related, in both Japanese and U.S. students. For Japanese students, interest in global climate change and trust in nuclear power were also positively related to general acceptance. On the other hand, for U.S. students, a higher rating score of the environmental benefit of nuclear power leads to a stronger tendency of general acceptance.

Table 4 shows the results of local acceptance. Different factors influenced Japanese and U.S. students' local acceptance of nuclear power. For Japanese students, the economic benefit and trust in nuclear power positively influenced the local acceptance of nuclear power, but the weight of local opinions was negatively related to acceptance. However, for U.S. students, only two factors significantly related to the local acceptance positively – namely, interest in nuclear power and environmental benefit.

Table 1 Mean Rating Scores and t-test Results of Question Items in Japanese and U.S. Students

Items	Japanese		U.S.		t
	M	SD	M	SD	
General Acceptance (Cronbach's alpha Japanese=.854, U.S.=.873)					
1. Nuclear power should be used in many countries for generating electricity	2.64	1.04	3.28	.91	-4.25***
2. Nuclear power should be used in the US (Japan) for generating electricity	3.12	1.07	3.38	.96	-1.65
3. If there is referendum for the promotion of nuclear power, I will strongly vote for it.	2.79	1.10	3.10	.93	-1.92
Local Acceptance					
4. I strongly welcome construction of nuclear power plants or nuclear-related facilities in the city in which I live	2.14	1.12	2.79	1.15	-3.76***
Interest in Nuclear Power (Cronbach's alpha Japanese=.782, U.S.=.755)					
5. I am interested in the subject of nuclear power	3.42	1.09	3.39	1.01	.14
6. I often watch TV news and read news about nuclear power	3.38	1.15	2.35	1.03	6.09***
7. I know about nuclear power better than the average person	2.28	1.07	2.52	1.17	-1.44
8. I know the Fukushima Nuclear Disaster occurred in 2011 in Japan better than the average person	2.77	1.10	2.56	1.01	1.26
Interest in Climate Change (Cronbach's alpha Japanese=.851, U.S.=.779)					
9. I am interested in the subject of climate change	3.07	1.18	3.83	1.01	-4.49***
10. I often watch TV news and read news about climate change.	3.22	1.17	3.20	1.23	.14
11. I know about climate change better than the average person.	2.52	1.08	3.10	1.21	-3.35***
Risk of Climate Change					
12. Climate change is a real and extremely serious threat.	4.24	.73	3.97	1.01	2.06*
Economic Benefit (Cronbach's alpha Japanese=.666, U.S.=.772)					
13. We can use electricity at a low price with nuclear power	3.71	.90	3.49	.94	1.58
14. Nuclear power generation is efficient	3.87	.96	3.72	.96	1.03
15. The use of nuclear power can ensure our country's energy supply	4.05	.89	3.49	.92	3.99***
Environmental Benefit (Cronbach's alpha Japanese=.554, U.S.=.463)					
16. The use of nuclear power can reduce the dependency on coal and other fossil fuels	3.94	1.02	4.17	.84	-1.54
17. The use of nuclear power can mitigate climate change	3.20	1.10	3.62	.98	-2.61**
Risk of Nuclear Power (Cronbach's alpha Japanese=.496, U.S.=.559)					
18. Nuclear power plant accidents occur frequently	3.37	1.04	2.37	.96	6.52***
19. A severe accident at a nuclear power plant will eventually occur in the US (Japan) as well	4.17	.93	3.42	1.01	5.06***
20. If a nuclear power accident happens, the danger could be catastrophic	4.69	.62	4.18	.76	4.93***
21. We can easily stop the operation of nuclear power generation when we find safety problems(R)	2.79	1.16	2.75	.92	.24
22. Generally speaking, I think nuclear power generation is safe (R)	2.21	1.09	3.17	1.06	-5.80***
Risk of Nuclear Wastes (Cronbach's alpha Japanese=.664, U.S.=.754)					
23. Nuclear waste constitutes a continuous threat for future generations	4.25	.82	3.86	.91	2.98**
24. Storage of nuclear waste may lead to wide-ranging environmental effects	4.22	.82	3.90	.93	2.42*
Trust in Nuclear Power (Cronbach's alpha Japanese=.845, U.S.=.712)					
25. The government openly provides the public with information about nuclear power	2.95	.93	2.24	1.02	4.83***
26. We can trust government's nuclear policy and regulations governing nuclear reactor and nuclear material safety	2.69	.98	2.75	1.04	-.36
27. We can trust nuclear energy companies without anxiety	2.54	1.06	2.52	.95	.13
28. We can trust nuclear scientists without anxiety	2.74	1.08	3.35	.94	-3.89***
Pro-ecological Worldview (Cronbach's alpha Japanese=.579, U.S.=.646)					
29. We are approaching the limit of the number of people the earth can support.	3.73	.97	3.38	1.10	2.24*
30. Humans have the right to modify the natural environment to suit their needs (R)	2.69	1.32	2.76	1.02	-.36
31. When humans interfere with nature, it often produces disastrous consequences	4.32	.76	3.80	.86	4.21***
32. Despite our special abilities, humans are still subject to the laws of nature	4.07	1.04	4.20	.73	-.92
33. Humans are severely abusing the environment	3.87	.96	4.11	.95	-1.66
Social Norm for Nuclear Power					
34. I think that most of American (Japanese) people support the use of nuclear power generation	2.44	.81	2.65	.96	-1.60
Weight of Local Opinions					
35. We need to listen to community members who live around nuclear power plants or facilities in making decisions on the use of nuclear power	4.43	.81	4.04	.75	3.20**

Note. Reversed items are indicated with (R). *: $p < .05$, **: $p < .01$, ***: $p < .001$.

Table 2 Mean Rating Scores and *t*-test for Clusters of Items in Japanese and U.S. Students

Items	Japanese		U.S.		<i>t</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
General Acceptance	2.78	1.02	3.24	.85	-3.16**
Local Acceptance	2.14	1.12	2.79	1.15	-3.76***
Interest in Nuclear Power	3.12	.92	2.92	.82	1.51
Interest in Climate Change	2.96	1.05	3.42	.98	-2.93**
Risk of Climate Change	4.24	.73	3.97	1.01	2.06*
Economic Benefit	3.87	.79	3.59	.82	2.24*
Environmental Benefit	3.83	.89	4.08	.75	-1.98*
Risk of Nuclear Power	3.82	.65	3.24	.64	5.84***
Risk of Nuclear Wastes	4.39	.71	4.01	.90	3.10
Trust in Nuclear Power	2.82	.82	2.80	.77	.16
Pro-ecological Worldview	3.88	.69	3.73	.68	1.37
Social Norm for Nuclear Power	2.44	.81	2.65	.96	-1.60
Weight of Local Opinions	4.43	.81	4.04	.75	3.20**

Note. *: $p < .05$, **: $p < .01$, ***: $p < .001$.

DISCUSSION

Rating scores

In this study, we examined the acceptance of nuclear power generation among Japanese and U.S. college students and found differences between the two sample groups, both in the acceptance itself and the factors influencing this acceptance.

We used the same questionnaire items and 5-point *Likert* scales for measuring Japanese and U.S. students' attitudes towards nuclear power, even though there would undoubtedly be some effects due to the translation between the languages, but it is reasonable to compare the rating scores between Japanese and U.S. students.

Because the Fukushima nuclear disaster occurred in Japan, there has been much television and newspaper coverage about the disaster, radiation damage, resident evacuation from the nearby restricted areas, and leak of radiation-contaminated water caused by the disaster. These kinds of negative information may influence the risk and benefit perceptions about nuclear power generation. Therefore, we assumed that Japanese students might have a higher risk perception, lower benefit perception, and lower acceptance than their U.S. counterparts. The results

of rating scores on the risk perception items (Table 1) and average ratings on clusters of these items (Table 2) confirmed this assumption.

As mentioned earlier, because the energy self-sufficiency ratio of Japan in 2017 was only 9.6% (Ministry of Economy, Trade, and Industry, 2018), and due to lack of natural energy resources, nuclear power has been considered as one of the essential primary energy sources in Japan. On the other hand, in the United States, energy production equaled about 95% of U.S. energy consumption in 2018, and about 80% comes from fossil energy sources, including oil, coal, and natural gas (U.S. Energy Information Administration, 2019). Because of such a difference in energy situations, in Japan and the United States, Japanese students may think that nuclear power is more important or has a more significant economic benefit than U.S. students. The results here confirmed this assumption (Table 2).

As for climate change, Japanese students rated higher on the perceived risk of global climate change, but U.S. students showed more interest in the topic. The reason for this difference is not yet clear but may come from the different kinds of environment-related education in the two countries.

Table 3 Multiple Regression Analysis Summary for Predicting General Acceptance of Nuclear Power

Variable	Japanese			U.S.		
	B	SEB	β	B	SEB	β
(Constant)	2.193	.991		2.108	1.051	
Interest in Nuclear Power	.091	.108	0.085	.094	.132	0.090
Interest in Climate Change	.217	.099	0.222*	-.130	.139	-0.149
Risk of Climate Change	-.070	.117	-0.049	.013	.115	0.015
Economic Benefit	.330	.112	0.255**	.346	.120	0.333**
Environmental Benefit	.130	.094	0.115	.300	.119	0.264*
Risk of Nuclear Power	-.063	.144	-0.04	-.157	.166	-0.119
Risk of Nuclear Wastes	-.277	.131	-0.179*	-.283	.114	-0.299*
Trust in Nuclear Power	.377	.115	0.296**	.028	.112	0.025
Pro-ecological Worldview	-.171	.128	-0.111	.048	.142	0.038
Social Norm for Nuclear Power	.044	.100	0.035	-.076	.086	-0.086
Weight of Local Opinions	-.196	.104	-0.158	.092	.109	0.08
	$R^2=.552; F(11,96)=9.507***$			$R^2=.560; F(11,70)=6.820***$		

Note. *: $p < .05$, **: $p < .01$, ***: $p < .001$.

Table 4 Multiple Regression Analysis Summary for Predicting Local Acceptance of Nuclear Power

Variable	Japanese			U.S.		
	B	SEB	β	B	SEB	β
(Constant)	2.362	1.197		1.648	1.328	
Interest in Nuclear Power	.078	.130	0.066	.585	.167	0.421***
Interest in Climate Change	.055	.119	0.052	-.150	.175	-0.129
Risk of Climate Change	-.230	.141	-0.147	-.213	.146	-0.189
Economic Benefit	.314	.135	0.222*	.272	.151	0.195
Environmental Benefit	.009	.113	0.007	.303	.150	0.199*
Risk of Nuclear Power	-.269	.174	-0.154	-.386	.209	-0.216
Risk of Nuclear Wastes	.059	.158	0.034	-.144	.144	-0.114
Trust in Nuclear Power	.297	.139	0.213*	.086	.142	0.058
Pro-ecological Worldview	.073	.155	0.044	-.147	.179	-0.087
Social Norm for Nuclear Power	.203	.120	0.151	-.087	.108	-0.073
Weight of Local Opinions	-.394	.126	-0.290**	.235	.137	0.153
	$R^2=.454; F(11,96)=6.437***$			$R^2=.610; F(11,70)=8.405***$		

Note. *: $p < .05$, **: $p < .01$, ***: $p < .001$.

Multiple regression analysis

In this study, several variables, including risk and benefit perceptions, trust about nuclear power, interests in nuclear power and climate change, and pro-ecological worldview, were investigated for conforming their contributions to predicting general and local acceptance of nuclear power generation.

As for general acceptance, the results showed that for the Japanese students, the most considerable contribution comes from trust, followed by economic benefit, interest in climate change, and less risk perception of nuclear wastes. After experiencing the Fukushima nuclear disaster, Japanese students' general acceptance of nuclear power is most influenced by the trust in nuclear-related scientists, companies, and the government. However, for U.S. students, the most influencing factor in general acceptance is the economic benefit gained from nuclear power generation.

The significant contributing variables to local acceptance of nuclear power, namely acceptance of nuclear power facilities in one's neighborhood, were different between Japanese and U.S. students. Among Japanese students, the weight of local opinions, or the need to hear from local people's opinions, was the most influential factor, but in U.S. students, interests in nuclear power and the benefit of mitigation of global climate change by using nuclear power significantly influenced local acceptance.

The result of local acceptances was significantly lower than general acceptances in both Japanese and U.S. students, supporting the NIMBY syndrome. Moreover, the influencing variables for general and local acceptance are different, but there are some common influencing factors: trust and economic benefit in Japanese students, and environmental benefit in U.S. students. The results that the environmental benefit of nuclear power contributes to U.S. students' acceptance are consistent with the results reported by Truelove and Greenberg (2013). They analyzed a set of U.S. survey data collected in 2010 and found that the belief that nuclear power is an insignificant contributor to global climate change influences whether a person had become more open to nuclear power.

In this study, we also examined whether the pro-ecological worldview related to the acceptance of nuclear power. There are two possibilities. One is that people with a stronger tendency of pro-ecological worldview may consider that nuclear power is an alternative way to reduce the use of fossil energy and mitigate climate change.

Therefore, they would show a higher acceptance of nuclear power. The other possibility is that since the risk of a nuclear accident involves the risk of nuclear waste causing severe environmental disasters, they would be against nuclear power from the viewpoint of protecting the environment. The results showed no significant contributions by the pro-ecological worldview to both general and local acceptance of nuclear power in Japanese and U.S. students. The two possibilities mentioned above may offset the effect of the pro-ecological worldview.

To summarize, the main results are as follows.

- 1) Japanese students' acceptance of nuclear power is weaker than that of U.S. students.
- 2) Local acceptances were significantly lower than general acceptances in both Japanese and U.S. students.
- 3) For the general acceptance of nuclear power, among Japanese students, the most significant contribution comes from trust, followed by economic benefit, interest in climate change, and risk of nuclear wastes. However, among U.S. students, the most influencing factor in general acceptance is the economic benefit gained from nuclear power generation, followed by economic benefit and less risk perception of nuclear wastes.
- 4) For the local acceptance of nuclear power, among Japanese students, the economic benefit of nuclear power and trust in nuclear power positively influenced the local acceptance of nuclear power, but respect for local opinions was negatively related to the acceptance. On the other hand, among U.S. students, interest in nuclear power, and the environmental benefit of nuclear power significantly related to the local acceptance positively.

LIMITATIONS

The data collected from Japanese and U.S. college students were analyzed in this study. Due to the limitation of resources, the sample sizes were small. As for the difference in acceptances and their determinants between Japanese and U.S. students, it is necessary to confirm the reasons for these differences in future studies.

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