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Searching for New Directions for Energy Policy: Testing the Cross-Effect of Risk Perception and Cyberspace Factors on Online/Offline Opposition to Nuclear Energy in South Korea

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Abstract: In the internet age, a considerable amount of information about risk events and objects is shared in cyberspace. Since online and offline spaces are not discrete, there is a cross-effect in which perceptual or attitudinal factors in cyberspace influence offline actions, while offline attitudes affect online actions. However, few studies have examined this cross-effect. In the present study, the intention to engage in online or offline behaviors opposing nuclear energy was the dependent variable. The independent variables included risk perception factors (i.e., perceived risk, perceived benefit, trust, knowledge, and stigma) in the risk perception paradigm, and cyber factors (i.e., self-efficacy in cyberspace, involvement on the internet, trust in cyberspace, conformity to online opinion, and belief in online rumors) in the cyberpsychology paradigm. Our findings offer evidence for the cross-effect of online or offline predictors on online/offline behaviors opposing nuclear energy. All the variables in the cyberspace paradigm influenced offline opposition, while those in the risk perception paradigm affected online opposition. Moreover, the five online-related risk perception variables played a significant role in moderating the relationships of predictors in the risk perception paradigm with offline opposition.

Keywords: acceptance of nuclear power; risk perception paradigm; risk perception; cyberpsychology

1. Introduction

Today, the discourse in cyberspace influences every aspect of social life. Specifically, the online discourse has a greater impact on issues related to nuclear energy than the offline discourse does because many individuals construct such a discourse through participation in discussions and dissemination of information in the virtual space, rather than in real life. Li et al. [1] showed that, after the Fukushima nuclear disaster, although the public attitude toward nuclear energy changed from a negative to a neutral one over time, the emotions expressed on Twitter became negative. Anderson et al. [2] reported that the public receives information on science and technology, including nuclear energy, mainly from the internet, and through social media (particularly through tweets, blogs, etc.). Moreover, Friedman [3] showed that the distribution of online information is much more extensive and diverse than that of traditional media [3].

The increased impact of the internet on real life is mainly due to the increase in internet users. In June 2017, 54.4% (41.6 billion of 76.3 billion) of the world population had internet access [4], and an estimated 3.2 billion individuals used the internet in 2015, which was roughly half of the world's population [5]. Figure 1 shows the number of internet users per 100 population, according to the

International Telecommunication Union [6]. In 2017, 81% of the individuals in developed countries used the internet. Considering that this figure was 11% in 1997, the 2017 data represent a tremendous increase. Internet access rates in developing countries are lower than those of developed countries, where 40% of the individuals use the internet. Considering an increase of over 30% over the past decade, 80% of the individuals in developing countries are expected to be internet users within the next 10 years. Of course, although the internet and social networks are ubiquitous and important, their use could continue to increase in certain groups, e.g., among the middle-aged and elderly population [7].

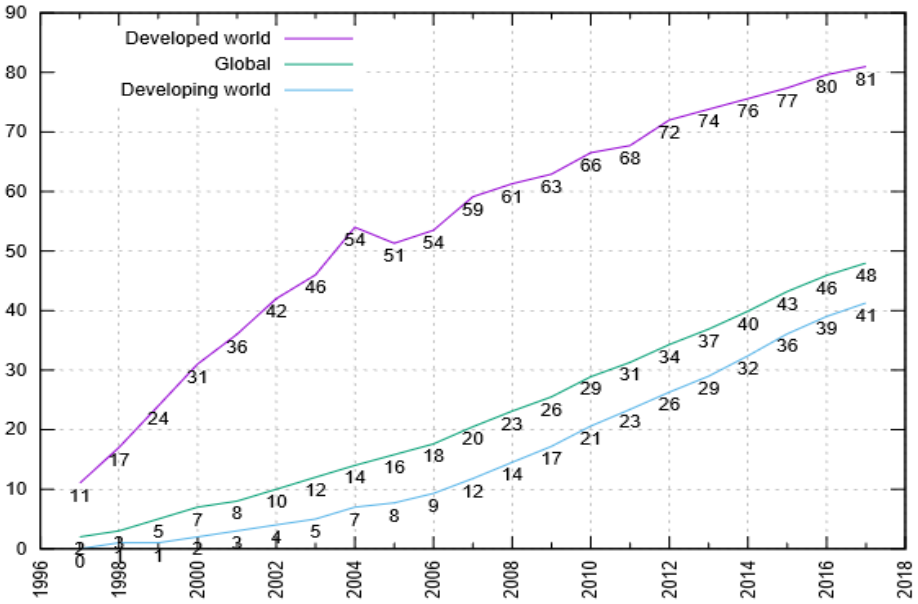

Figure 1. Percentage of internet users. Source: International Telecommunications Union [6].

The rapid spread of the internet depends not only on the development and deployment of physical infrastructure for information communication technology but also on the invisible basis for creating internet-centered lifestyles, such as the diversity of internet media and culture. Moreover, activities on the internet are replacing various real-life activities, e.g., online shopping (selling and buying goods and services), online payments, social networking, and staging political protests.

In recent times, the internet has become a space for receiving, forming, disseminating, and sharing public opinions. In a survey study conducted in 2017, Kurečić et al. [7] reported that online media constitutes the public's primary source of information, with 8% attributable to television, 2% to radio, 1% to publications (papers), 18% to online publications, 37% to internet portals, and 34% to social networks. Furthermore, they reported that most respondents actively participated in discussions on the internet portals and/or forums, with 93% of them answering "Yes" to a question about their participation in such activities.

In addition to facilitating information gathering, the internet is a means for learning and teaching. Blair [8] showed that Twitter provides an important communication channel that encourages learning and teaching among its users. Dahlgren [9] argued that the internet has obvious positive consequences; for example, it extends and pluralizes the public sphere in several ways.

Similarly, the online discourse plays a critical role in forming, directing, and changing attitudes toward nuclear energy. After the Great East Japan Earthquake of March 11, 2011, by integrating social investigation and behavioral log analysis, Miyata et al. [10] demonstrated that the homogeneity of opinions of a personal network on Twitter influenced a majority group to speak out about nuclear energy.

Since the impact of the internet on public attitudes is increasing, there has been a rapid increase in research on this topic. However, few studies have examined the cross-effect in which online perceptual

or attitudinal factors influence offline attitudes or actions, and offline attitudes affect online attitudes or actions. Therefore, we investigated two main research questions about the cross-effect. The first concerned whether offline factors in risk perception studies influence online behaviors opposing nuclear energy and whether online factors in the cyberpsychology influence offline opposition behaviors. We examined this "cross-effect" using survey data. The second concerned how online variables moderate the relationship between the offline predictors and offline opposition actions. In this work, we used the intention to engage in online or offline behaviors opposing nuclear energy as the dependent variable. The independent variables included five variables from the risk perception studies and five from cyberpsychology or cyberspace paradigm.

The research model presented in Figure 2 shows the conceptual model for the cross-effect of the online and offline independent variables on the online and offline behaviors opposing nuclear energy. Each traditional offline related risk perception factor and online related cyberpsychology perception one has five variables as shown in Figure 2.

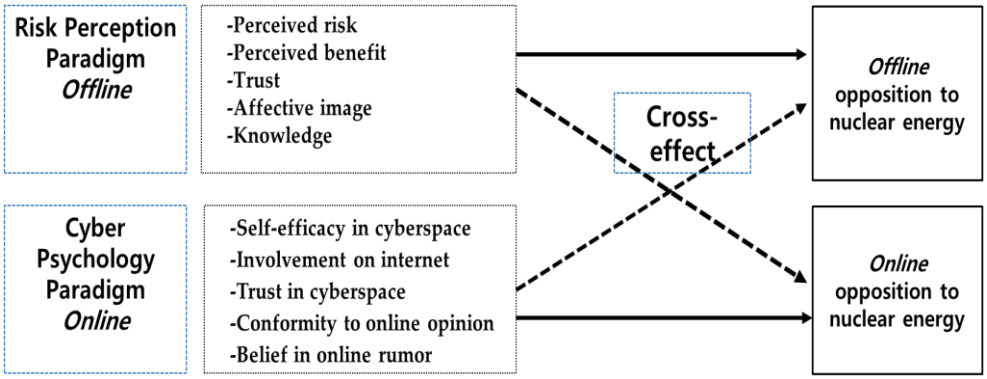

Figure 2. The research model.

2. Theoretical Background and Hypothesis

2.1. Risk Perception Paradigm versus Cyberpsychology

Research on risk has been actively done since risk has become an important issue in everyday life. Research on risk shows different directions depending on the research focus. Visshers and Siegrist [11], (p. 63) distinguished the risk research into two parts: "(1) research on the psychometric paradigm, which explains variations between the perception of different risks and (2) research on factors that may determine an individual's perception of a risk (i.e., perceived benefits, trust, knowledge, affective association, values, and fairness)".

The first line of research focused on finding differences between the perception of different hazards. Fischhoff et al. [12] found 'dread and unknown' as the main characteristics of qualitative risk. This paradigm was developed to address the research question "why do individuals perceive hazards differently?". Fischhoff et al. [12] developed the concepts of dread risk and unknown risk as two factors for measuring the magnitude of risk. Dread risk is defined as the potential of dread or fatal consequences and a perceived lack of control over novel technologies, whereas unknown risk refers to the perceived novelty, scientific knowledge, and delay of effects associated with an activity or technology [13–15]. These two variables are widely used and applied in psychometric risk research [16,17]. After Fischhoff et al.'s original work [12], many scholars have developed the psychometric paradigm and extended its conceptual components to measure risk. Fischhoff et al. [18] used a psychometric procedure to examine risk-benefit perception and risk acceptance for each of the 30 risk-related activities and technologies. Although Fischhoff [19,20] acknowledges the debate over the psychometric paradigm in measuring public perceptions of risk, many of his studies have used measurement techniques based on psychometric paradigm.

The second line tries to answer why certain individuals perceived risks in certain ways and why such perceptions may vary between people. As we followed the second tradition of research, we adopted the perceived benefit, perceived risk, trust, affective image, and knowledge as causal factor which influence individuals' judgment. Those five variables have empirically verified [21,22].

Research using the cyberpsychology paradigm focuses on the human mind and behavior in cyberspace and the influence of the culture of technology, specifically virtual reality, and social media on the human mind and behavior [23]. Research in cyberpsychology has applied psychological theories to explain how individuals interact in cyberspace and how these interactions affect individuals' offline lives [24] (p. 1). According to Kirwan [25], cyberpsychology emphasizes the study of human interactions on the internet, mobile computing, mobile phones, game consoles, virtual reality, artificial intelligence, and any other technologies that have demonstrated the ability to alter human behavior (p. 69). The basic premise of cyberpsychology is that cyberspace is a psychological space. Therefore, cyberspace is a space "out there" where the minds of the self and others converge, and where individual and collective minds extend [26]. In cyberspace, another online self appears, which relates to but is different from the offline self. New identities are built in cyberspace through social interactions.

Since research in cyberpsychology or cyberspace has assumed that online and offline attitudes and behaviors differ, many studies have focused on how the internet and cyberspace have a different impact on online behavior, differing from offline one. However, such a clear distinction between offline and online spaces has dismissed the interactive dynamics between the two. Since offline and online spaces influence each other, the cross-effect between them (the impact of online spaces on offline ones and vice versa) must be considered. The cross-effect can be defined as the impact of attitudes and behaviors in online and offline spaces on different spaces (online influences offline and vice versa).

Nevertheless, only a few studies have examined this cross-effect. For example, Yee et al. [27] showed that behavioral changes stemming from the virtual environment transfer to subsequent face-to-face interactions. Moreover, interactions on social networking sites (SNS) have a positive impact on interpersonal relationships. Online interaction has also been found to contribute to developing personal relationships and enlarging individuals' social categories. This finding conflicts with those of previous studies showing that online interactions diminish personal relationships. According to Zhou and Moy [28], online discussions play a critical role in making local discourse into national discourse offline, which contributes to forming a base for offline discussions. On the other hand, offline media discussions adjust online frames, if needed. Thus, perception and behavior in online or offline space are not independent of each other but interact with each other. The cross-effects of online-offline variables can also be applied to issues pertaining to nuclear energy because nuclear energy-related information and discussions are actively conducted online.

The risk perception paradigm and cyberpsychology paradigm are concerned with subjective variables, but both prioritize different variables. Specifically, while the risk perception studies focus on offline technology and the individuals responsible for it, the cyberpsychology paradigm focuses on the psychological factors related to online behaviors.

2.2. Risk Perception Paradigm

The risk perception paradigm stresses on the subjective side of human judgment instead of the objective side. Therefore, it seeks to identify variables that enable us to determine risk judgment more effectively, from the subjective perspective [10,11]. Previous studies have frequently adopted the five variables discussed below as determinants of risk judgment, and these five variables may influence the opposition or acceptance of nuclear energy.

First, perceived benefit and perceived risk represent the two sides of attributes related to risk. Risk has negative aspects, but it can have benefits if it is utilized effectively. However, risks and benefits are incompatible properties. The first generally enhances opposition behavior toward risky objects, whereas the second reduces such behavior. For example, Visschers and Siegrist [29] demonstrated

that, among Swiss participants, perceived benefits and risks had different impacts on the acceptance of nuclear energy stations, both before and after the Fukushima disaster.

With reference to perceived risk, perceptions of a meltdown are expected to reduce support for an increase in the use of nuclear energy [30]. Moreover, using a sample from Korea, Roh and Jin [31] showed that the relative effects of different types of perceived risks of nuclear energy generation have varying effects on its acceptance. Perceived risk from radioactive waste management produces stronger negative effects on the local acceptance of nuclear energy plants than does the perceived risk from nuclear energy plants. On the other hand, the former has a greater influence on the national acceptance of nuclear energy than on the latter.

In terms of benefits, many studies have shown that perceived benefits increase the acceptability of risk objects. Therefore, perceived benefits conflict with perceived risk with reference to the acceptance of nuclear energy. Alhakami and Slovic [32] observed that risks and benefits tend to be inversely correlated in individuals' calculations. A higher perceived benefit is related to lower perceived risk, whereas a lower perceived benefit is linked with higher perceived risk. After dividing perceived benefits into three levels—individual, local, and national—Kim and Kim [33] showed that different benefits have a significant impact on local and national acceptance of nuclear energy. Since perceived risks induce opposition actions against nuclear energy, while perceived benefits reduce opposition actions, we suggest the following hypothesis:

H1: *Perceived risks increase online opposition to nuclear power energy.*

H2: *Perceived benefits decrease online opposition to nuclear power energy.*

Second, trust has been analyzed as a main variable influencing the acceptance of nuclear energy, and it has been found to have a positive impact on the same. Previous studies have shown that trust in actors related to risk influences the acceptance of them [30,34]. For example, trust in the government is a critical determinant of public support for policies that promote the increased use of nuclear energy [30]. Different kinds of trust, i.e., trust in the government and in regulations, also affect the perceived risk and acceptance of nuclear energy [34]. Moreover, Yang and Cho [35] showed that the effect of trust varies according to the trusted object. For instance, trust in the media (broadcasting), local government, and NGOs has a positive impact on perceptions toward nuclear energy, whereas trust in the medical profession, the central government of South Korea, health policy, and society has a negative impact on it.

Moreover, trust indirectly influences perceived risks and benefits, which are antecedents of acceptance. For example, Siegrist et al. [36] demonstrated that social trust decreases the perceived risks and increases the perceived benefits of a technology. On the basis of longitudinal survey data (N = 790) obtained in Switzerland, Visschers and Siegrist [29] showed that trust had a significant impact on benefit and risk perceptions before and after the Fukushima disaster. Trust increases acceptance by lowering the perceived risk to a particular object. Based on these previous studies, the following hypothesis can be suggested.

H3: *Trust will have negative impact on online opposition to nuclear power energy.*

Third, affect contrasts with rationality. According to Peters and Slovic [37], affect seems to play a role as an orienting mechanism that helps individuals navigate a complex, uncertain, and sometimes dangerous world. Their empirical research demonstrated that affect-laden imagery is highly predictive of perceptions of risk regarding nuclear energy. Therefore, as affect becomes more negative, support for nuclear energy decreases. When Slovic et al. [38] aimed to determine what may drive perceptions, they found that affect related to images of stimuli was related to risk judgments and preferences. Stigma, a so-called affective image, is a by-product of affective imaginal thinking. Kasperson et al. [39] defined it as a mark placed on a person, place, technology, or product, which was associated with a particular attribute that identified it as different, deviant, flawed, or undesirable (p. 19).

Slovic et al. [40] show that stigmatized affective images associated with the nuclear energy facility at Yucca Mountain might engender negative economic impacts on the local economy of Las Vegas and the state of Nevada. Alhakami and Slovic [32] found that the inverse relationship between perceived risks and benefits was linked to individuals' reliance on general affective evaluation. Specifically, a favorable affective evaluation induced high benefit perceptions and low risk perceptions, whereas an unfavorable affective evaluation induced low benefit perceptions and high risk perceptions. Negative affect induces antipathy toward certain objects, which can lead to opposition action toward them. Based on these arguments, the following hypothesis can be suggested.

H4: *Negative affective image will have positive impact on the online opposition to nuclear power energy.*

Fourth, when individuals engage in decision-making, they need knowledge or information to make more precise and accurate decisions. With increasing uncertainty, decision-makers tend to seek more knowledge. Therefore, knowledge consistently influences public perceptions of nuclear energy. According to the knowledge deficit model (KDM), experts have a better understanding of certain issues than does the public. Since a greater understanding leads to a greater likelihood of identifying solutions to a problem, experts are more likely to succeed in problem-solving. Hence, as the knowledge gap between experts and the public decreases, attitudes between these two groups will converge.

Cobb and Macoubrie [41] demonstrated that greater knowledge critically influences risk judgments about new emerging technologies. After evaluating US public support for nuclear energy one year after the Fukushima nuclear accident, Stoutenborough et al. [30] demonstrated that individuals who are more knowledgeable of energy issues are more supportive of nuclear energy. On the other hand, according to Kuklinski et al. [42], more knowledge engenders, more opposition toward the operation and construction of nuclear energy stations. Moreover, Kim and Kim [43] showed that more knowledge related to diseases decreases individuals' perceived risk of disease. A high knowledge lowers the perceived risk to a particular object, which in turn reduces the opposition behavior to it. Therefore, the following hypothesis can be suggested.

H5: *Knowledge will have negative impact on online opposition to nuclear power energy.*

2.3. Cyberpsychology Paradigm

Cyberpsychology stresses the role of psychological factors in cyberspace. Our study focused on the five variables discussed below.

Firstly, self-efficacy refers to an individual's perception of her or his competence in successfully performing a behavior [44]. Recent developments in risk communication research have shown the important role of self-efficacy in the public's response to risk. According to Ter Huurne and Gutteling [45], self-efficacy is associated not only with information sufficiency and preference but also with affective response and institutional trust. For example, those with higher levels of self-efficacy reported higher information sufficiency, and therefore they had a lower need for information about what individuals can do to reduce possible harm. Moreover, those with high self-efficacy had less strong negative feelings. Improving perceived self-efficacy for risk reduction can help decrease risky behaviors. According to Kim and Kim [46], although efficacy does not have a direct impact on behaviors opposing nuclear energy, it moderates the relationships between knowledge, source credibility, negative feelings, and opposition behavior. Those who with higher efficacy have higher confidence in their behavior, which lowers negative emotions for certain objects. As a result, high efficacy reduces the opposition to a particular object. This logic suggests that efficacy can facilitate the acceptance of risky nuclear energy, in our case.

H6: *Self-efficacy in cyberspace will have negative impact on offline opposition to nuclear power energy.*

Secondly, involvement refers to the degree of personal relevance and importance that a person holds toward objects, i.e., messages, products, and issues. Persuasive messages can have personal

importance because they are related to a variety of self-relevant constructs, such as values, goals, individuals, and objects [47] (p. 368). Our study focused on issues involvement on the internet among the various types of involvement. Petty and Cacioppo [48] (p. 1915) defined issues involvement as "the extent to which the attitudinal issue under consideration is of personal importance."

In terms of its effects, more involvement in specific issues induces more systemic information processing. According to Chaiken [49], high involvement leads message recipients to employ systematic information processing, whereas low involvement leads recipients to use heuristic processing. Ryu and Kim [50] found that more involvement in nuclear energy-related issues has a positive relationship with perceived risk of nuclear energy. There is a tendency for the internet to be dominated by opinion of opposition to nuclear power. In such a situation, high involvement on online can lead to anti-nuclear behavior. Therefore, the following hypothesis can be suggested.

H7: *Involvement on the internet will have positive effect on offline opposition to nuclear power energy.*

Thirdly, trust in cyberspace facilitates communication between unknown internet users. According to source credibility theory, source credibility serves as a heuristic instrument for judging complex situations. Source credibility includes two key factors: source expertise and trustworthiness [51]. Source trustworthiness refers to the audience's degree of confidence and acceptance of an information source's honesty and integrity and the message content's accuracy [52]. Siegrist et al. [19] found a significant association between the public's credibility perceptions and attitudes toward nuclear energy.

The biggest issue with trustworthy or credible targets in cyberspace concerns the information, system, and individuals that netizens usually face in cyberspace. If online users have trust in others, they will be willing to share information and take an active position toward specific behaviors. Kim et al. [53] showed that trust in online tourism shopping, including transaction security, navigation functionality, and cost-effectiveness, affects repurchase intention. Chiang and Su [54] demonstrated that greater trust in internet environments engenders an increase in users' cognitive bias toward online behavioral responsibility and internet addiction. We expect that a high level of trust in cyberspace will raise risk perceptions of nuclear energy, finally inducing opposition behavior toward it. Based on these studies, the following hypothesis is presented.

H8: *Trust in cyberspace will have positive impact on offline opposition to nuclear power energy.*

Fourthly, conformity is defined as a behavioral pattern by which some individuals tend to match their attitudes, beliefs, and behaviors to others' norms or behaviors. According to the Group Conformity Theory [55–57], when individuals face information from the group that is contrary to their own understanding, they are likely to revise their opinion to match that of the group. Such conformity occurs more often when incorrect information is provided by the group members, and it is based on the individual's need for friendship, trust, and admiration, which they can receive through group membership [46]. Since cyberspace is another place in which individuals satisfy their needs, conformity is often observed. The impact of conformity on the internet may increase in the future as more individuals use it as a natural part of their everyday lives and as opportunities to comment on news articles, blogs, and video clips, and to answer online polls, increase [58] (p. 1593).

Smilowitz et al. [59] applied Asch's theory to computer-mediated communication (CMC). They showed that conformity in CMC shows a clear difference from that found in face-to-face groups. With the lack of the physical presence of others, the majority influence diminishes the pressure of the majority. Therefore, the power of conformity increases in cyberspace as compared with that in real life. Conformity induces a greater reliance on others. According to Kim and Yoon [60], conformity influences the perceived credibility and sharing intention of online rumors, when users use multiple media sources and receive supportive messages. Fox and Tang [61] showed that conformity to some types of dominant norms, e.g., the masculine desire for power over women and the need for heterosexual self-presentation, predicts higher scores on sexism.

In its basic form, conformity can be described as either compliance or conversion. Compliance relates to the public or behavioral level (we act to fit in), whereas conversion includes a private or attitudinal level (we believe it to be true) [62]. In the present study, we measured conformity by reflecting on the concepts of compliance and conversion. After the Fukushima nuclear accident, anti-nuclear opinion has become dominant discourse. In the presence of such a dominant opposition discourse, a high degree of conformity to online opinion can lead to an anti-nuclear behaviors. Based on those thoughts, we present the following hypothesis.

H9: *Conformity to online opinion will have positive impact on offline opposition to nuclear power energy.*

Fifthly, rumors are defined as "unverified and instrumentally relevant information statements in circulation that arise in contexts of ambiguity, danger, or potential threat and that function to help people make sense and manage risk" [63] (p. 273). Indeed, rumors influence a wide variety of human actions, expectations, and attitudes, including medical service demands, purchases of goods, and conflicts between groups [63].

From telephone interviews, with Baton Rouge residents, conducted two months after Hurricane Katrina, Thomas [64] demonstrated that collective efficacy facilitates the transmission of rumors. Such rumors then increase the personal and altruistic fear of victimization. According to Kim and Kim [65], belief in online rumors has a significant relationship with antecedents of nuclear acceptance; a negative association with perceived benefits, trust, and knowledge; and a positive association with perceived risk and affective image. Because rumors have a negative effect, it is hypothesized that the stronger the belief in rumors about nuclear power, the more individuals will deny the acceptance of nuclear energy, which in turn will lead to opposition. Based on these previous studies, the following hypothesis is presented.

H10: *Belief in online rumors will have a positive impact on offline opposition to nuclear power energy.*

2.4. Moderation Effect

Today, online factors have decisive influence on offline domain and vice versa. Kim et al. [66], showed that trust in online and offline channels is closely related. Moreover, they demonstrated customers' loyalty to the online channel has an effect on the trust of the offline channel as well as the trust of the online channel. Moreover, Lee et al. [67] showed the effects of negative online consumer reviews on consumer's attitude toward product. Based on comparative studies about the United States and Korea, Kim [68] showed that social media use not only directly has the positive impact on the offline and online public participation of youth but also indirectly interacts with the perceived political importance of social media, which finally influences the political action for youth. Those studies imply that online factors can not only directly influence the offline behaviors but also indirectly do it. Since there are fewer studies about moderation effect of specific variables under cyberpsychology paradigm on each variable in risk perception paradigm, we suggested we proposed the next hypothesis which refers to overall relationship between two paradigms.

H11: *Online variables in cyberpsychology moderate the relationships between variables in risk perception paradigm and the offline opposition actions.*

3. Data and Measures

We analyzed social survey data (N = 1572) that were collected from Korean individuals through a web survey. Hankuk Research, a professional survey research company, collected the data from 13 to 21 April, 2016. The questionnaire was entirely designed considering the related literature. To enhance the reliability of measures, cognitive and pilot tests were executed. After 10 experts on nuclear energy and measurement scale methods reviewed the questionnaires, they provided suggestions for corrections. Subsequently, a pilot test was conducted with 30 university students. We checked the

content and reliability of the measures by providing them with evaluation sheets for each question. Table 1 shows the demographic information of the study sample. The social class measures the subjective class consciousness on a 10-point scale. Responses 1 to 4 are classified as low social class, 5 to 6 are classified as middle class, and 7 to 10 are classified as high social class. Ideologies were also measured on a 10-point scale, ranging from 1 to 4 to conservative, 5 to 6 to neutral, and 7 to 10 to liberal.

Table 1. Demographic information of the study sample.

Variable	Categories	Frequency	Percent (%)	Variable	Categories	Frequency	Percent (%)
Age	20–29	302	19.2	Gender	Male	813	51.7
	30–39	349	22.2		Female	759	48.3
	40–49	397	25.3	Social class	Low	562	35.8
	50–59	342	21.8		Middle	730	46.4
	Over 60	182	11.6		High	280	17.8
Household income	300 M.W.	493	31.4	Ideology	Conservative	335	21.3
	301–500 M.W.	628	39.9		Neutral	726	46.2
	Above 500 M.W.	451	28.7		Liberal	511	32.5

Note: M.W. (Million Won).

To ensure the representativeness of the sample, we adopted a random sampling method in which survey respondents were selected through proportional quota sampling. Gender, age, and region were adopted as quota criteria. To meet the quota, 17,578 e-mail survey questionnaires were sent to targeted respondents through the web survey management system. Among them, 5983 opened the e-mail, 2569 started the survey, and 1572 respondents finally completed it (26.3% response rate). In 2016, there were around 45 million internet users in South Korea [69]. On the basis of this figure, the sampling error was ±2.69 of the estimated statistics with a 95% confidence level.

To know the difference between actual demographics in Koreaand the data used in this survey, we compared the former with the latter in terms of gender and age, as shown in Table 2. The population data were based on the 2015 census survey executed by the Commissioner of Statistics Korea. The difference in percentages between the population and the sample appears in the last column in Table 2. There was a ±2% difference in gender. With reference to age, 2.6% were in their 20s, 3.3% in their 30s, 4.0% in their 40s, 1.7% in their 50s, and 11.5% over 60 years. There was a large difference in values over the age of 60 years. This difference in value was interpreted to be a result of the fact that the population database comprised all individuals in Korea, while our data was based on respondent pool for an internet survey.

Table 2. Difference between the population and the study sample.

		Population		Sample		Percent Gap (A–B)
Variable	Category	Frequency	Percent A (%)	Frequency	Percent B (%)	
Gender	Female	20,348,268	49.7	813	51.7	−2.0
	Male	20,572,715	50.3	759	48.3	2.0
	Total	40,920,983	100	1572	100	0.0
Age	20–29	6,796,396	16.6	302	19.2	−2.6
	30–39	7,738,472	18.9	349	22.2	−3.3
	40–49	8,726,984	21.3	397	25.3	−4.0
	50–59	8,220,296	20.1	342	21.8	−1.7
	Over 60	9,438,835	23.1	182	11.6	11.5
	Total	40,920,983	100	1572	100	0.0

Note: Population Data Source: Korean Statistical Information System (KOSIS).

The measures have been presented in Table 3. Except for affective image (stigma) and trust, all measures used a five-point scale (1 = strongly disagree and 5 = strongly agree). Stigma was measured by evaluating eight pairs of affect adjectives (e.g., 1 = clean and 5 = dirty). Respondents were asked to select points to represent their perception of nuclear energy. Trust was measured using a five-point scale (1 = strongly distrust and 5 = strongly trust).

When including multiple items in one composite scale, we used their means. Before creating the composite scale, we checked the reliability based on Cronbach's α. As shown in Table 3, the Cronbach's α for all measures met the standard of being higher than 0.60.

Table 3. Measures and reliability.

Theoretical Concept	Statement for Measurement	Reliability
Offline opposition behavior	-Q1. Despite the government's nuclear safety and regulatory policy, I am willing to participate in a signature campaign against nuclear power. -Q2. Despite the government's nuclear safety and regulatory policy, I intend to participate in a protest against nuclear power.	0.843
Online opposition behavior	-Q3. I am willing to participate in an online signature campaign against nuclear power. -Q4. I intend to write statements or comments on the internet against nuclear power.	0.817
Perceived risk	-Q5. I personally feel that my life is threatened by nuclear power generation. -Q6. Nuclear power generation produces hazardous waste. -Q7. Nuclear power generation is harmful to people's health. -Q8. Nuclear power plants are dangerous.	0.808
Perceived benefit	-Q9. Nuclear energy can now contribute to solving climate change problems. -Q10. Nuclear energy can contribute to solving environmental problems. -Q11. Nuclear energy can be supplied cheaply and stably. -Q12. Nuclear power contributes to national economic development.	0.835
Trust	-Q13. How much do you trust the nuclear safety and risk information provided by each of the following organizations? ① Government, ② President, ③ Ministry of Trade, Industry, and Energy, ④ Nuclear Safety and Security Committee	0.904
Affective image	-Q14. The following is pairs of words that contrast each other's feelings about nuclear energy. How does your feeling about nuclear power fall between 1 and 5? - bright ↔ dark - clean ↔ dirty - progressive ↔ retrogressive - good ↔ bad - positive ↔ negative - warm ↔ cold - hopeful ↔ pessimistic - friendly ↔ unfriendly	.892
Knowledge	-Q15. I know institutions that regulate nuclear safety in our country. -Q16. I know the law system related to nuclear safety regulation. -Q17. I can explain issues related to nuclear power to other people well. -Q18. I am well aware of the policies and issues related to nuclear energy.	0.893
Self-efficacy in cyberspace	-Q19. If I write about nuclear power on the internet, it will be helpful to those who see this information. -Q20. If I share an article about nuclear energy on the internet, it will be helpful to those who see this information.	0.877
Involvement on the internet	-Q21. I am interested in discussions related to nuclear power energy on the internet. -Q22. I think that debates about nuclear power on the internet are related to my personal interests.	0.685
Trust in cyberspace	-Q23. Internet users are generally trustworthy. -Q24. Most internet users are honest.	0.816
Conformity to online opinion	-Q25. If my opinion is different from opinions many people hold, I tend to conform to them. -Q26. I tend to change my opinion to match others' opinion.	0.754
Belief in online rumors	-Q27. The majority of the rumors about nuclear power on the internet are mostly true. -Q28. Negative rumors related to nuclear power that spread via the internet are often facts.	0.802

Moreover, we checked the reliability of measures by randomly split groups (N = 814 and 591) and compared them with the full sample group (N = 1572). As shown in Table 4, the response rates changed slightly according to sub-sample groups. However, the value remained within the sample error ($\pm$2.46). Table 4 shows that online opposition action is easier than offline one.

Table 4. Test of response consistency according to sub-sample groups (N = 1572, 814, and 591).

Concept	Question	N. of Sub-Samples.	Response					
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Offline opposition behavior	Q1	N = 1572	11.4%	27.0%	40.9%	16.9%	3.8%	100%
		N = 814	11.4%	25.4%	42.8%	16.6%	3.8%	100%
		N = 591	10.5%	29.4%	41.6%	14.6%	3.9%	100%
	Q2	N = 1572	17.2%	34.2%	38.6%	8.5%	1.5%	100%
		N = 814	17.2%	34.2%	38.2%	8.6%	1.8%	100%
		N = 591	15.6%	34.7%	39.6%	8.8%	1.4%	100%
Online opposition behavior	Q3	N = 1572	9.5%	23.1%	42.9%	20.5%	4%	100%
		N = 814	9.7%	21.7%	44.2%	20.8%	3.6%	100%
		N = 591	9.1%	24.7%	43.5%	18.3%	4.4%	100%
	Q4	N = 1572	13.9%	34.7%	39.6%	10.1%	1.7%	100%
		N = 814	13.8%	34.8%	38.6%	10.7%	2.2%	100%
		N = 591	12.5%	34.7%	42.6%	8.3%	1.9%	100%

4. Analysis and Findings

4.1. Basic Structure

To understand respondents' attitudes to offline and online opposition to nuclear energy, we calculated the mean value of online and offline opposition, according to socio-demographic variables. Figure 3 shows the results. Table 5 is result for ANOVA-test about group difference.

First, the average value of online opposition behavior was higher than that of offline behavior. This is interpreted to indicate that the cost of online opposition behavior is lower than that of offline one. Regarding gender, women were more likely to engage in opposition behavior than men were. The difference between women and men may be because women are more sensitive to risky objects, leading to more opposition against nuclear energy. Previous research has found that females show more opposition toward the construction of nuclear energy stations than males do [70].

By age group, the group that was aged 30 years or older was more likely to show opposition than the group that was younger than 30 years. Opposition was higher among those in their 40s than among those in their 30s. However, the likelihood of opposition behavior decreased in groups aged over 50 years. The low level of opposition for these young and old groups may be explained by various reasons. For instance, since younger and older individuals have relatively fewer resources, they will be less likely to assume the burden of the cost of engaging in opposition behavior. Moreover, older individuals have a less conservative ideology, which decreases the possibility of opposition, and younger individuals show less political interest, which may lead to less opposition engagement.

With reference to education, the higher one's education level, the higher was the likelihood of opposition behavior. It was interesting that, compared with university graduates, respondents with middle school education or less show a greater gap between online and offline opposition. The latter group shows fewer actions toward offline opposition than the other two groups. This tendency reflects the higher cost required for less educated groups than for more educated groups when the former group engaged in opposition action.

Finally, offline opposition behavior increased with lower income. However, in the case of online opposition, the highest level of opposition was found in the middle-income class. The overall pattern showed that the opposition was lower for the higher income group than for the lower income group. This result is presumed to indicate that those who have higher incomes are ideologically conservative because they have considerable vested interest. Conservatives tend not to protest because they do not want to change their current state. Moreover, education and income represent kinds of resources. Benford et al. [71] indicated that resources are an important buffering instrument for deferring an expected loss and a realized harm. Therefore, if subjects do not have resources to protect themselves against risk, they have greater risk perceptions and show greater intention to oppose risky objects.

One of the consistent patterns that was same across all demographic variables was the higher level of offline opposition as opposed to online opposition. This suggests that cyberspace can be a key source and place to yield future anti-nuclear movements.

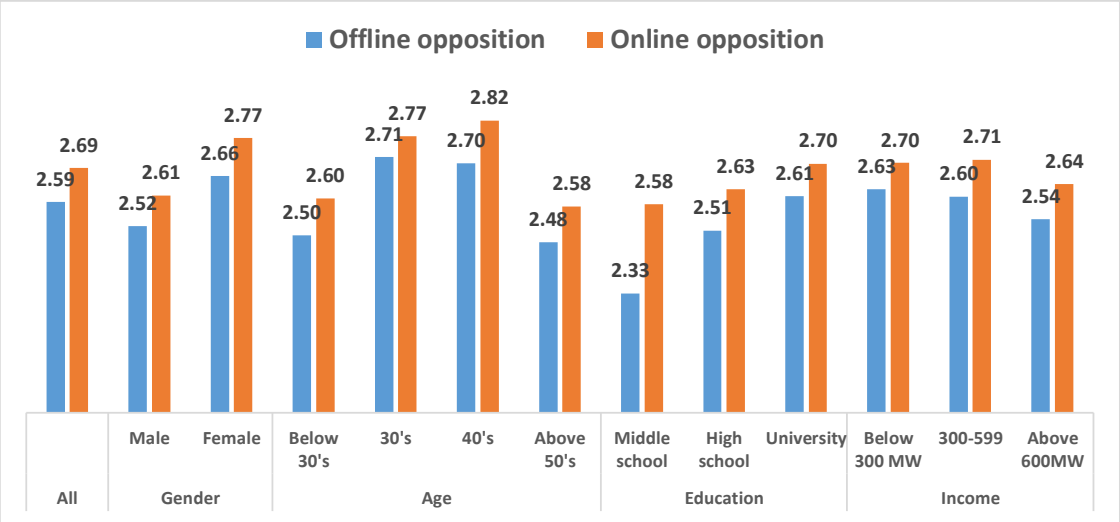

Figure 3. Means for sociodemographic variables.

Table 5. ANOVA-test.

	Gender		Age		Education		Income	
	F-Value	***p*-Value**	**F-Value**	***p*-Value**	**F-Value**	***p*-Value**	**F-Value**	***p*-Value**
Online opposition	13.59	0	8.09	0	0.73	0.48	0.87	0.42
Offline opposition	9.83	0	8.25	0	1.62	0.20	0.95	0.39

To determine the basic relationships between variables, we calculated correlation coefficients, as shown in Table 6. In this table, the third row shows the relationship between offline opposition and online opposition. The higher positive coefficient (= 0.821) indicates a great extent of interactive effects and shared attributes between offline and online opposition.

Two kinds of opposition variables had the same direction in their relationships with the variables in the risk perception and cyberpsychology paradigms. Specifically, they had positive relationships with perceived risk, affective image, and knowledge in the risk perception studies; and efficacy in cyberspace, involvement on the internet, trust in cyberspace, conformity to online opinion, and belief in online rumors in the cyberpsychology paradigm. It is interesting to note that all the cyberpsychology variables had a positive relationship with the two opposition behaviors. This suggests an existence of negative culture concerning nuclear energy in online spaces. The opposition behaviors had a negative association with perceived benefits and offline trust. We observed that two kinds of trust, i.e., offline trust and online trust, have different impacts on opposition behavior. The former reduces opposition behavior, whereas the latter enhances it. This suggests that both different kinds of trust influences attitudes to nuclear energy.

Offline opposition had the strongest association with affective image, followed by perceived benefits and belief in online rumors, but the weakest association with knowledge, followed by conformity to online opinion. On the other hand, online opposition had the strongest association with belief in online rumors, followed by affective image, involvement on the internet, and perceived benefit, but the weakest association with knowledge, followed by conformity to online opinion. These findings suggest that affective image and perceived benefits play key roles in affecting opposition behavior. Specifically, affective image influences both online and offline behavior, and belief in rumors is a very critical variable in online opposition.

Table 6. Findings of the correlation analysis.

		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Opposition	1. Offline opposition action	1										
	2. Online opposition action	0.82 ***	1									
Risk perception paradigm	3. Perceived benefit	−0.37 ***	−0.33 ***	1								
	4. Perceived risk	0.32 ***	0.32 ***	−0.34 ***	1							
	5. Trust	−0.28 ***	−0.26 ***	0.040 ***	−0.35 ***	1						
	6. Affective image	0.38 ***	0.34 ***	−0.54 ***	0.43 ***	−0.43 ***	1					
	7. Knowledge	0.14 ***	0.16 ***	0.15 ***	−0.06 *	0.14***	−0.11 ***	1				
Cyberpsychology paradigm	8. Self-efficacy in cyberspace	0.29 ***	0.31 ***	0	0.01	0.05	-0.01	0.35 ***	1			
	9. Involvement on the internet	0.30 ***	0.33 ***	0	0.12 ***	-0.01	0.02	0.35 ***	0.34 ***	1		
	10. Trust in cyberspace	0.26 ***	0.25 ***	−0.04	0	0.12 ***	0.03	0.18 ***	0.29 ***	.19***	1	
	11. Conformity to online opinion	0.15 ***	0.17 ***	0.08 **	−0.03	0.18 ***	-0.07 ***	0.06 **	0.12 ***	0.24 ***	0.24 ***	1
	12. Belief in online rumors	0.37 ***	0.37 ***	−0.29 ***	0.33 ***	-0.21 ***	0.30 ***	-0.03	0.14 ***	0.13 ***	0.19 ***	0.12 ***

Note: *p*-value: * < 0.1, ** < 0.05, *** < 0.01.

Furthermore, we compared the coefficients between online and offline behavior. Three of the five risk perception variables had a greater effect on "offline opposition," whereas three of the five cyberpsychology variables had an impact on "online opposition." This pattern of pairings (i.e., "risk perception paradigm → offline opposition," "cyberpsychology paradigm → online opposition") suggests that each paradigm has a unique explanation domain. Of course, these pairings do not exclude the cross-effect, because online opposition is associated with the risk perception paradigm whereas offline opposition is associated with the cyberpsychology paradigm.

4.2. Causal Structure

To identify the different determinant structures of opposition between online and offline behaviors, we used regression analysis. We used online or offline intention to engage in opposition behavior as the dependent variables. After controlling for sociodemographic factors such as age, gender, education level, and household income, we input risk perception variables such as perceived risk/benefit, trust, affective image, and knowledge, and cyberspace variables such as self-efficacy in cyberspace, involvement on the internet, trust in cyberspace, conformity to online opinion, and belief in online rumors.

Table 7 shows the different determinant structures of opposition behavior between online and offline. The main findings were as follows.

Model 1 shows the impact of demographic factors on offline opposition. The higher the age, females, and the higher the income revealed more offline opposition. Model 2 is a model that adds a risk perception factor to the demographic factors in Model 1. Perceived benefit and trust have a negative impact on offline opposition whereas perceived risk, emotional image, and knowledge have a positive one. Model 3 shows the determinants of the intention to engage in offline opposition behavior. This model, which is based on three factors, explained 38.8% of the variance in such behaviors. To determine how each of the three factors contribute to explaining the variance of the predicted variable, we calculated each Coefficient of Determination for the three factors by conducting a regression model separately for each factor. The risk perception paradigm explained 25.1% of the variance in offline opposition behavior, followed by the cyberpsychology paradigm at 24%. It is notable that the two values are nearly equivalent. This indicates that offline opposition behavior depends not only on offline but also on online factors, which suggests that there is a cross-effect between online (predictors) and offline (predicted) factors.

In Model 3, among the sociodemographic factors, only household income was significant. This means that, with greater wealth, individuals show less intention to engage in opposition to nuclear energy in the offline space. Previous research has indeed shown that income has a negative relationship with support for nuclear energy [65]. Further, all of the risk perception variables were significant. Specifically, perceived benefit and trust decreased offline opposition behavior, whereas perceived risk, affective image, and knowledge increased it. It is notable that greater knowledge induces opposition behavior, which is consistent with finding from previous research [72] showing that knowledge has a positive impact on acceptance of nuclear energy. On the basis of the beta coefficients, among the five independent risk perception variables, perceived benefits explained the largest amount of variance, whereas knowledge explained the least amount of variance.

Furthermore, all the cyberpsychology variables showed significant predictive ability to explain the variance in offline opposition behavior. Indeed, not only the offline independent variables but also the online independent variables had a significant impact on offline opposition. This demonstrates the existence of a cross-effect in which online factors influence offline opposition behavior. The five cyberpsychology variables also had a positive impact on opposition behavior. Among them, self-efficacy in cyberspace was the most critical variable for the intention to engage in behavior, whereas conformity to online opinion had the least influence. Considering the beta coefficients, belief in online rumors had the highest value, followed by efficacy, involvement on the internet, and trust

in cyberspace. DiFonzo and Bordia [62] showed that rumors influence a wide variety of events. Our study also showed the significant role of rumors in opposition to nuclear energy.

Among the fourteen beta coefficients in Model 3, perceived benefits had the highest value in explaining offline opposition, followed by self-efficacy, affective image, and belief in online rumors. The fact that self-efficacy and belief in online rumors influence offline opposition implies the existence of a cross-effect.

Model 4 demonstrated how demographic factors influence online opposition. The higher the age and females expressed the online opposition. Model 5 showed that perceived benefit and trust negatively influenced online opposition whereas perceived risk, affective image, and knowledge positively do it.

Model 6 showed the determinants of online opposition behavior. Among the sociodemographic variables, gender and income had a significant effect on online opposition behavior. Females showed more opposition behaviors than did males. Females' opposition to nuclear energy has already been observed in previous research [65]. Moreover, individuals with higher household income tended to exhibit more online opposition behavior. This impact is consistent with the pattern shown for offline opposition.

Among the risk perception factors, perceived benefits and trust decreased online opposition. However, perceived risk, negative image, and knowledge played contrasting roles. All five variables were classified as critical variables in offline behaviors; hence, this finding demonstrates the existence of a cross-effect from offline to online behaviors. Among the five variables, perceived benefits had the greatest impact on opposition behavior, followed by trust and affective image. All the cyberpsychology variables had a positive impact on the intention to engage in online opposition behavior. Among the five predictors, self-efficacy in cyberspace explained the largest amount of variance of online opposition, followed by involvement on the internet and belief in online rumors.

Among the fourteen beta coefficients in Model 6, self-efficacy had the largest value in explaining online opposition, followed by involvement on the internet, belief in online rumors, perceived risk, and trust. The significant impact of offline perceived risk and trust on online opposition can be interpreted as evidence of the existence of a cross-effect.

When comparing Models 3 and 6, we find a cross-effect that all variables in the cyberpsychology paradigm appeared to be significant in explaining offline opposition, whereas those in the risk perception paradigm were significant in explaining online opposition. At the variable level, self-efficacy and involvement on the internet in cyberpsychology explained offline opposition well, whereas perceived benefits and trust in the risk perception paradigm explained online behavior well. This is also indicative of a cross-effect.

However, our analysis showed that there are "corresponding effects" in which offline variables, e.g., perceived benefits, explain offline behavior well, whereas online variables, e.g., efficacy in cyberspace, explain online behavior well. Additional evidence of this effect can be found in the difference between Model 3, in which perceived benefits explained the largest variance in offline opposition behaviors, and Model 6, in which self-efficacy in cyberspace was the most significant predictor of such behavior. Moreover, to confirm such corresponding effects, we checked the R-square of each of the three factors in each regression model. Regarding offline opposition behavior, sociodemographic factors explained 1.4% of the variance, risk perception factors explained 25.1% of the variance, and cyberpsychology factors explained 24% of the variance. The risk perception paradigm offering offline factors had more power with respect to offline behavior than did the cyberpsychology paradigm with respect to online factors. On the other hand, Model 6 showed opposing trends. Cyberpsychology factors explained 26.2% of the variance in online opposition, whereas risk perception factors explained 22.9% of the variance in online opposition. These results show the existence of a corresponding effect.

Table 7. Regression analysis.

		Intention to Engage in Offline Opposition Action									Intention to Engage in Online Opposition Action								
		Model 1			Model 2			Model 3			Model 4			Model 5			Model 6		
		B	S.E.	Beta	B	S.E.	Beta	B	S.E.	Beta	B	S.E.	Beta	B	S.E.	Beta	B	S.E.	Beta
F1: Socio-demographic Factor	Constant	2.629	0.112		1.675	0.217		0.211	0.214		2.714	0.109		1.666	0.215		0.157	.210	
	Age	0.004 **	0.002	−0.053	0.002	0.002	0.030	0	0.001	0.005	0.003 *	0.002	−0.050	0.001	0.002	0.022	-0.001	0.001	−0.008
	Gender	0.141 ***	0.045	0.079	0.071 *	0.040	0.040	0.032	0.037	0.018	0.162 ***	0.044	0.093	0.108 ***	0.040	0.062	0.064 *	0.036	0.037
	Education level	0.097	0.065	0.039	0.007	0.057	0.003	-0.026	0.052	−0.010	0.069	0.063	0.028	−0.025	0.056	−0.010	−0.063	0.051	−0.026
	Income	0.000 *	0	−0.049	0 **	0	−0.050	−0.001 ***	0	−0.060	0	0	−0.030	0	0	−0.031	−0.001 **	0	−0.041
F2: Risk perception factor	Perceived benefit				−0.222 ***	0.027	−0.224	−0.182 ***	0.024	−0.184				−0.180 ***	0.026	-0.186	−0.140 ***	0.024	−0.145
	Perceived risk				0.159 ***	0.028	0.141	0.097 ***	0.026	0.085				0.179 ***	0.028	0.162	0.110 ***	0.026	0.100
	Trust				−0.080 ***	0.022	−0.095	−0.108 ***	0.020	−0.128				−0.083 ***	0.021	-0.101	−0.107 ***	0.020	−0.131
	Affective image				0.212 ***	0.033	0.179	0.182 ***	0.031	0.153				0.175 ***	0.033	0.150	0.146 ***	0.030	0.126
	Knowledge				0.218 ***	0.023	0.219	0.082 ***	0.023	0.083				0.233 ***	0.022	0.239	0.088 ***	0.022	0.090
F3: Cyber factor	Self-efficacy in cyberspace							0.175 ***	0.026	0.155							0.189 ***	0.025	0.172
	Involvement on the internet							0.162 ***	0.027	0.138							0.192 ***	0.026	0.168
	Trust in cyberspace							0.155 ***	0.027	0.127							0.119 ***	0.026	0.100
	Conformity to online opinion							0.121 ***	0.027	0.096							0.131 ***	0.026	0.107
	Belief in online rumors							0.177 ***	0.029	0.139							0.189 ***	0.028	0.151
	F-Value	5.462 ***			59.821 ***			70.549 ***			5.309 ***			53.088 ***			69.235 ***		
	R^2	0.014			0.256			0.388			0.013			0.234			0.384		
	Adjusted R^2	0.012			0.252			0.383			0.012			0.230			0.378		
	R^2 change	-			0.243			0.132			-			0.221			0.149		

Note: *p*-value: * < 0.1, ** < 0.05, *** < 0.001.

4.3. Interaction Structure

Until now, we examined the direct cross-effect of the risk perception and cyberpsychology paradigms on opposition behavior. Next, to determine how online factors intervene in the relationship of the risk perception variables with offline opposition behaviors, we analyzed the role of cyberpsychology variables as moderators.

To check the moderating effect of the cyberpsychology variables, we used interaction terms, where each risk perception variable was multiplied by each of the five cyberpsychology moderators. Then, we input the interaction terms into the existing model. To examine the moderating effects, we followed the procedure suggested by Baron and Kenny [73]. Among the 25 interaction terms, 12 moderating terms appeared statistically significant. We also performed a simple slope test to determine whether each group of the five moderators played a significant role as a moderator when it had a low, medium, or high value.

Figures 4–15 show the moderating effect of the cyberpsychology variables on offline opposition. In the figures, the X-axis represents the five independent variables in the risk perception paradigm, while the Y-axis represents offline opposition.

Figure 4 shows that perceived risk tended to increase offline opposition. This effect increased as conformity to online opinion increased, indicating that offline opposition behavior was linked to online factors. Figure 5 shows that the perceived benefit variable decreased offline opposition behavior. This detrimental effect by perceived benefits was activated under higher self-efficacy in cyberspace, suggesting that, although individuals have the same level of perceived benefits, those who feel higher self-efficacy in cyberspace from online activities show more offline opposition than do those who feel lower self-efficacy. This finding indicates the significant role of cyberpsychology factors in the real world. Figure 6 reveals the moderating effect of involvement on the internet in the relationships between perceived benefits and offline opposition. Perceived benefits decreased offline opposition behavior, and this effect was facilitated by higher involvement on the internet.

Likewise, such decreasing effects by perceived benefits were moderated by trust in cyberspace in Figure 7 and conformity in Figure 8. While higher trust in cyberspace suppressed the decreasing effect by perceived benefits, lower trust facilitated the decreasing effect of perceived benefits. This result was obtained while controlling for offline trust. Hence, it is evident that both offline trust and online trust play a very important role in determining offline opposition behavior. Further, higher conformity constrained the decreasing effect of perceived benefits on offline opposition, indicating that those with higher conformity tend to show dependent behavior in which their behaviors follow socially accepted conventions or standards. Therefore, they tend to show little change, even when there are greater perceived benefits.

Figure 9 shows that trust generally reduced offline opposition behavior. However, this effect depended on trust in cyberspace, and it constrained the power of offline trust, which decreased offline opposition. It is notable that the same trust played a different role in offline opposition. Table 6 shows a negative effect of offline trust and a positive effect of online trust on offline opposition. This contrasting role of trust engenders a contrasting effect between offline trust and online trust, with respect to opposition behavior.

Figure 10 shows the moderating effect of conformity on the relationship between trust and offline opposition. Trust rapidly decreased offline opposition under low conformity. Thus, the negative relationship between trust and opposition was strong when conformity was higher. This suggests that, although trust is an important positive propellant that decreases offline opposition, conformity in cyberspace suppress the negative effect of trust on opposition behavior.

Figures 11 and 12 show that a more negative affective image usually increased offline opposition. However, this increasing effect of opposition by affective image was dependent on the sense of self-efficacy and involvement in cyberpsychology. Both self-efficacy and involvement facilitated the negative effects of affective image. Thus, the negative relationship between affective image and opposition was stronger when the relationship between self-efficacy and involvement was greater.

However, in Figure 13, conformity weakened the negative effect of affective image on offline opposition. Three moderators consistently indicate their roles. In particular, self-efficacy and involvement facilitate the negative effect of affective image, whereas conformity blocks it. These results suggest that cyberpsychology does not always play the same role in moderating relationship between affective image and opposition behavior.

Figures 14 and 15 demonstrate that the effect of knowledge on offline opposition depended on conformity and belief in rumors. Generally, knowledge increased offline opposition. This effect was activated under higher conformity and belief in rumors, suggesting that a high level of conformity and belief in rumors fueled the efforts to increase the impact of knowledge on offline opposition.

In short, the five variables in the risk perception paradigm affected offline opposition. Their effects depended on cyberpsychology variables such as involvement on the internet (two times), self-efficacy in cyberspace (two times), trust in cyberspace (two times), conformity to online opinion (five times), and belief in online rumors (one time). Perceived benefits were frequently (four times) found to influence offline opposition through the cyberpsychology variables as moderators. Among the cyberpsychology variables, conformity to online opinion frequently (five times) intervened in the relationship between the risk perception paradigm and offline opposition.

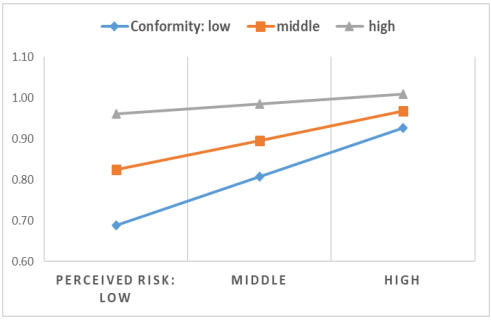

Figure 4. Perceived risk × conformity = offline opposition.

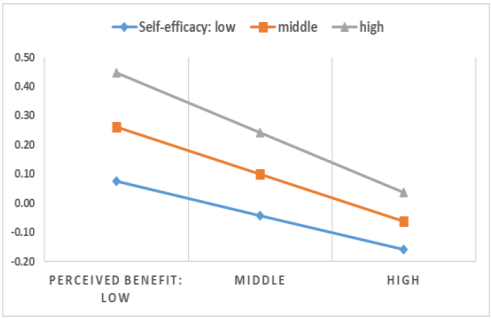

Figure 5. Perceived benefit × self-efficacy = offline opposition.

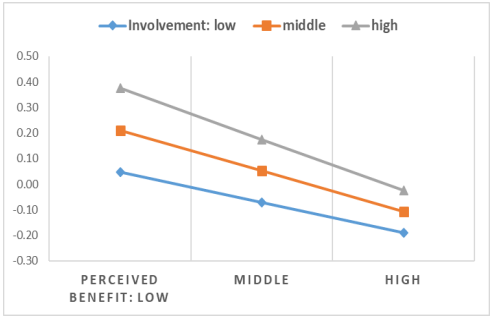

Figure 6. Perceived benefit × involvement = offline opposition.

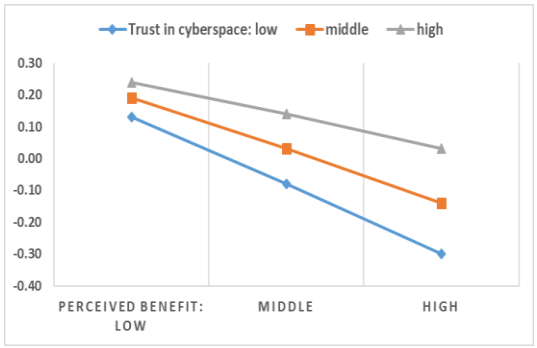

Figure 7. Perceived benefit × trust in cyberspace = offline opposition.

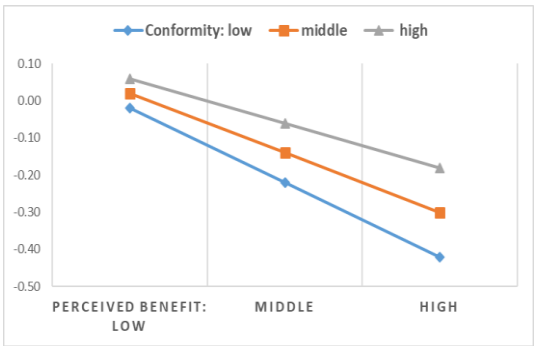

Figure 8. Perceived benefit × conformity = offline opposition.

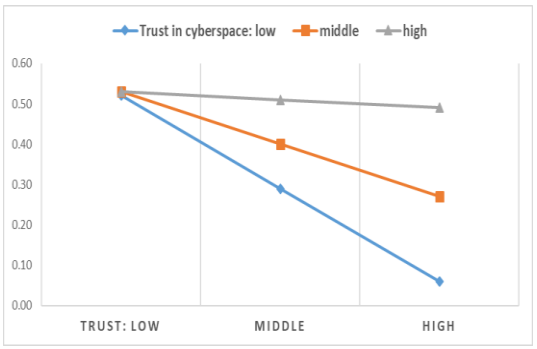

Figure 9. Trust × trust in cyberspace = offline opposition.

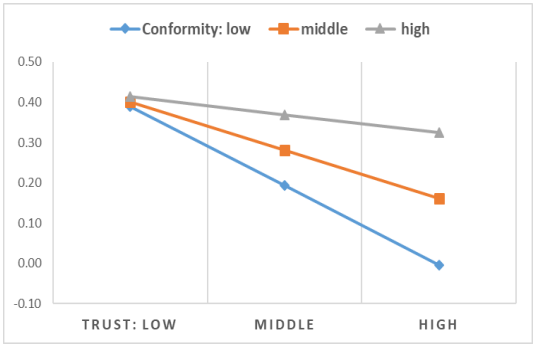

Figure 10. Trust × conformity = offline opposition.

Figure 11. Affective image × self-efficacy = offline opposition

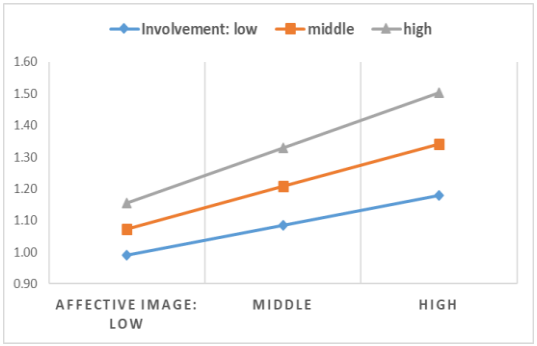

Figure 12. Affective image × involvement = offline opposition.

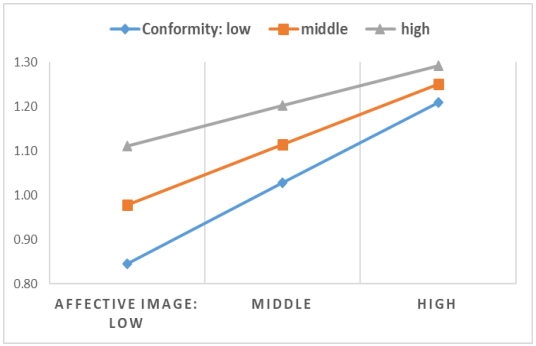

Figure 13. Affective image × conformity = offline opposition.

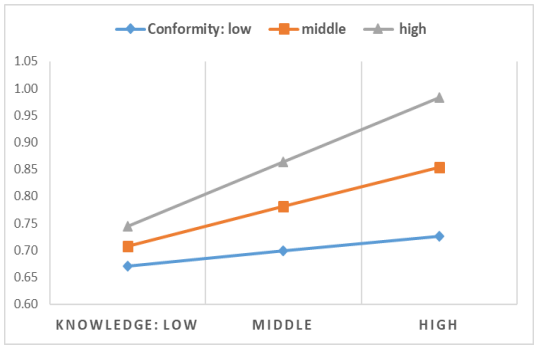

Figure 14. Knowledge × conformity = offline opposition.

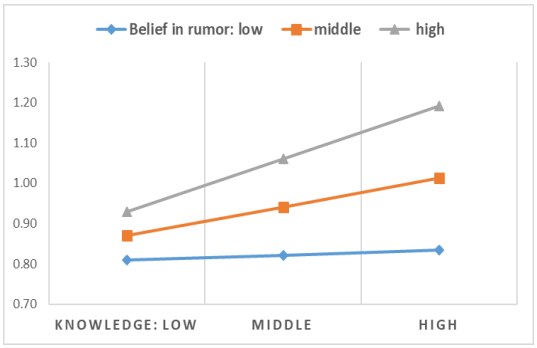

Figure 15. Knowledge × belief in rumor = offline opposition

5. Conclusions and Implications

5.1. Summary

Since the dissemination of the internet, online spaces have become a key place for social communication and life. It is expected that the internet's permeability in everyday life will never diminish. Therefore, cyberspace has been and will be a more important channel for creating social discourse. Critical decisions that are socially important, e.g., the phaseout of nuclear energy, are highly likely to be determined by the dominant discourse in cyberspace. Thus, it is very meaningful to examine the influence of cyberspace on real life and vice versa.

Our study aimed to analyze the cross-effect in which offline life influences online life and vice versa. We analyzed the impact of the risk perception and cyberpsychology paradigm on the intention to engage in online or offline opposition, a relatively unexplored research topic. Furthermore, to determine the power of cyberpsychology variables, we analyzed their moderating effects. The important findings of our study are as follows.

First, as evident in Table 4, online opposition action was easier than offline one. According to Figure 2, females showed a greater intention to engage in offline opposition behavior than males did. This may be because women are more sensitive to risk objects than men are. Additionally, richer individuals tended to show less supportive behavior toward nuclear energy. Indeed, rich individuals' conservative ideology and abundant resources seem to make them passive to opposition behavior.

Second, the regression analysis revealed the determinant structure of online/offline opposition. Among the predictors, perceived benefits (−), self-efficacy in cyberspace (+), and affective image (+) considerably influenced offline opposition, whereas self-efficacy in cyberspace (+), involvement on the internet (+), and belief in online rumors (+) had a considerable effect on online opposition. Compared with sociodemographic variables, risk perception and cyberpsychology predictors explained a large part of the variance in opposition behavior.

Third, our analysis showed a cross-effect using the risk perception and cyberpsychology paradigms on online/offline opposition. Table 8 showed the results for hypothesis results.

Eight out of ten hypotheses related with cross-effect are accepted. At the paradigm level, the risk perception paradigm influenced online opposition, whereas the cyberpsychology paradigm influenced offline opposition. At the variable level, perceived benefits and trust decreased online opposition behavior, whereas perceived risk, affective image, and knowledge increased online opposition behavior. On the other hand, the five variables in the cyberpsychology paradigm influenced offline opposition. These findings evidence the cross-effect from offline/online to online/offline opposition.

Fourth, in addition to the cross-effect, we found a *corresponding effect* in which offline factors explained offline behavior well whereas online factors explained online behavior well. At the variable level, we found that perceived benefits explained the largest variance in offline opposition, whereas self-efficacy did so for online opposition. Moreover, at the paradigm level, the risk perception paradigm explained 25.1% of offline opposition, compared to 24% for the cyberpsychology paradigm, whereas

the cyberpsychology paradigm explained 26.2% of online opposition, as compared to 22.9% for the risk perception paradigm.

Table 8. Result of the hypothesis testing.

	Hypothesis *	Reference **	Result *	Accept/Reject
H1: Perceived benefit → online opposition	−	**−0.140/0 in Model 6**	−	**Accept**
H2: Perceived risk → online opposition	+	**0.110/0 in Model 6**	+	**Accept**
H3: Trust → online opposition	−	**−0.107/0 in Model 6**	−	**Accept**
H4: Affective image → online opposition	+	**0.146/0 in Model 6**	+	**Accept**
H5: Knowledge → online opposition	−	**0.088/0 in Model 6**	+	**Reject**
H6: Self-efficacy in cyberspace → offline opposition	−	**0.175/0 in Model 3**	+	**Reject**
H7: Involvement on the internet → offline opposition	+	**0.162/.00 in Model 3**	+	**Accept**
H8: Trust in cyberspace → offline opposition	+	**0.155/0 in Model 3**	+	**Accept**
H9: Conformity to online opinion → offline opposition	+	**0.121/0 in Model 3**	+	**Accept**
H10: Belief in online rumors → online opposition	+	**0.177/0 in Model 3**	+	**Accept**
H11: Online variables in cyberpsychology → offline opposition	**moderating**	12 out of 25 in interactions	**moderating**	Partially accept

Note: * '+'; positive influence: '−; negative influence. ** Except H11, figures in reference is unstandardized coefficients in regression/proved-value in significance.

Fifth, the five cyberpsychology variables played a role in moderating the relationships between the risk perception paradigm and offline opposition. Although the five variables in the risk perception paradigm affected offline opposition, this effect depended on the five cyberpsychology variables. Perceived benefits, in particular, influenced offline opposition through the moderating effect of cyberpsychology variables. Among the cyberpsychology variables, conformity to online opinion frequently (five times) intervened in the relationships between the risk perception paradigm variables and offline opposition.

In short, our analysis supported the existence of a cross-effect in which the risk perception paradigm explains online opposition behavior, whereas the cyberpsychology paradigm explains offline opposition behavior. Moreover, cyberpsychology variables play a significant role in moderating the relationships between risk perception paradigm variables and offline opposition.

5.2. Implications

Our analysis demonstrates that both the risk perception and cyberpsychology paradigm explained the variance in offline and online opposition sufficiently. These findings suggest that research models in studies on risk should extend from an offline-focused theme to an online-focused one. Moreover, cyberpsychology can extend the explanation domain from the online space to the offline space.

Furthermore, from a practical perspective, management of shareholders and issues regarding nuclear energy should devote attention to not only the offline space but also the online space. The importance of the cross-effect suggests that, when managing offline opposition, government should consider online variables, and that when managing online opposition, they should consider offline variables. Thus, government should implement strategies to strike a balance between online and offline variables.

In terms of management, our findings provide information on variables to which governments and other authorities should devote attention to attenuate the opposition to nuclear energy. The priority of management should be on perceived risk, perceived benefits, trust, and affective image to reduce offline opposition, whereas efforts regarding self-efficacy in cyberspace, involvement on the internet, and belief in online rumors can decrease online opposition.

5.3. Limitations

Although our analysis demonstrates the investigated cross-effect, it has some limitations. Firstly, although we found that various variables affect the acceptability of nuclear energy both online and offline, the present study adopted only a few variables. In future studies, not only value and normative variables but also various attitude variables should be adopted to validate our model on the cross-effect. Value variables such as ideology, environmentalism, and post-materialism should be considered in

future research. Kim [74], Wang & Kim [75], Kim & Kim [76] well showed the power of cultural bias on policy preference. On the other hand, online variables such as cyber identity, addiction, and interaction in cyberspace should be used to composite the tested model. Moreover, different kinds of credibility and trust are playing in accepting the nuclear power [34]. Secondly, in this study, five cyberpsychology variables were used as moderators. However, since offline variables can act as moderating variables, this moderating effect should be verified in the future. Thirdly, the acceptance of specific technologies depends not only on perception factors but also on structural factors [77]. Kim et al. [78] showed that the acceptance of technology in a country varies depending on post-materialism, specifically the gross domestic product and religiosity. Thus, the role of structural variables at the macro-level should be examined in future studies. Also, government's role and policy are still important factor at the macro-level [79]. Fourthly, although attitudes toward nuclear energy are changing on the basis of accidents [80], we did not cover this topic.

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