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Analysis of the Impact of Values and Perception on Climate Change Skepticism and Its Implication for Public Policy

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Abstract: Climate change is an unprecedented risk that humans have not previously experienced. It is accepted that people are generally worried about global warming. However, it is also a fact that there is a small but increasing number of climate change skeptics. These skeptics do not believe that there is any risk, nor are they concerned with other worrisome facts related to climate change. Skeptics regard the present scientific findings supporting climate change as false artefacts. Our study aimed to explore the factors that influence climate skepticism. In this work, to make a regression model, we established environmental skepticism as a dependent variable and included sociodemographic factors, values, and perception factors as the three independent variables. Also, to examine their roles indirectly, we regarded values as moderators. The results show that, in terms of values, ideology, environmentalism, religiosity, two kinds of cultural biases, and science and technology (S&T) optimism influence skepticism at the individual level, whereas, in terms of perception factors, perceived risk, perceived benefit, and negative affect have an impact. Also, values such as ideology, religiosity, environmentalism, and cultural biases play a moderating role that facilitates, buffers, or changes the effect of psychometric variables on an individual's skepticism.

Keywords: climate change; climate change skepticism; environmental skepticism; skeptics

1. Introduction

Climate change is one of the most urgent challenges humanity faces. According to a report issued by the Intergovernmental Panel on Climate Change (IPCC) [1], climate change caused by global warming is likely to be catastrophic if responsive actions for mitigation are not immediately taken on a global scale. IPCC [2] reported the state of climate change; the global average of combined land and ocean surface temperature data, as calculated by a linear trend, shows a warming of 0.85 (0.65 to 1.06) °C during the period from 1880 to 2012. This change in climate led to negative impacts on the earth; the atmosphere and ocean warmed, the quantity of snow and ice diminished, and sea levels rose (p. 2). In particular, it was reported that the annual mean Arctic sea-ice extent decreased during the period from 1979 to 2012, at a rate that was very likely in the range of 3.5 to 4.1% per decade, while the global mean sea level rose by 0.19 (0.17 to 0.21) m during the period from 1901 to 2010 (p. 4).

This haphazard situation prompts blame attribution, in which all involved ask the question, "who caused this unwanted result?". Scientific organizations generally attribute climate change to human activity. IPCC [2] commented that humanity's influence on the climate system is clear (p. 2). Anthropogenic economic and population growth increased greenhouse gas (GHG) emissions. GHG levels, which include concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide

(N_2O), rose in this period. In particular, cumulative anthropogenic CO_2 emissions in the atmosphere were 2040 $\pm$ 310 Gt CO_2 between 1750 and 2011 (p. 4).

This scientific evidence provides the basis for public beliefs about climate change. According to the Eurobarometer report [3], the majority of Europeans acknowledge that climate change is a serious problem. The overall average score for the European Union (EU) 28 stands at 7.3 on a scale of 1 to 10, where 10 means it is an "extremely serious problem" and 1 represents the belief that it is "not at all a serious problem." Moreover, half (50%) of all Europeans think that climate change is one of the world's most serious problems, and approximately one in six Europeans (16%) thinks it is the most serious issue (p. 5). Likewise, in the United States (US), the majority of Americans (63%) agreed that the weather in their local area this winter was warmer than usual. They believed that these abnormal temperatures were the result of human-caused climate change, as opposed to normal variations [4].

However, not everyone accepts the existence of climate change. Skeptical views toward climate change exist and are growing. Although the world is facing a climate change crisis today, many people are skeptical of the issue [5]. Climate skeptics try amplifying uncertainties or doubts about climate change. While outright rejection of environmental problems is relatively rare among the public, the number of people expressing some degree of skepticism is considerable. For some people, climate change is frequently regarded as a temporally distant phenomenon that primarily affects other places, times, or peoples [6]. Recently, several studies reported declines in the public's acceptance of the central arguments of climate science [7,8].

According to the Eurobarometer report [3], there was a decrease in the number of Europeans who think climate change is the most serious problem (−4 percentage points, compared with 2011). In the US, amidst reports that 2015 was Earth's warmest year on record, although the majority, i.e., 69%, believed it to be accurate, there were still 27% of individuals who did not. In other words, one in four persons is a skeptic [9]. Furthermore, Leiserowitz et al. [7] stated that nationally representative surveys conducted in 2008 and 2010 found significant declines in Americans' climate change beliefs, risk perceptions, and trust in scientists. In particular, there are greatly differing views between Republicans and Democrats. A total of 72% of Democrats attributed the changing temperatures to human-induced climate change, compared with 27% of Republicans [9]. Whitmarsh [10] found that, while complete rejection of human-induced climate change stands at between 10 and 20%, public uncertainty is significantly higher. This means that many people question the seriousness of climate change. Poortinga et al. [11] reported that skepticism and uncertainty about climate change increased in the United Kingdom (UK). They showed that public belief in climate change dropped significantly from 91% in 2005 to 78% in 2010. Also, Whitmarsh [10] reported that, between 2003 and 2008, the belief that claims about the issue are exaggerated doubled.

As skeptics do not support policies to address climate change, understanding the cause of the skepticism is an important theme for researchers. According to Akter et al. [12], in Australia, cause and mitigation skepticism play significant roles in determining public support for climate change abatement. Cameron [13] demonstrated that individuals willing to pay for climate change vary negatively with the skepticism. There are, however, a few studies that focus on skepticism about climate change or global warming in specific countries such as Australia [14], the UK [10,11], and the US [15–20].

However, since previous studies tended to focus on the concept and dimensions of skepticism itself, there are few studies that examine the effect of causal factors on skepticism. Furthermore, although there were previous studies that focused on causality, these studies had limits in that they only partially adopted a few variables among several, and lacked thoroughness and an integrated approach. Recently, van der Linden [21] thoroughly demonstrated that a model based on the integration of cognitive, experiential, and socio-cultural factors adequately explained climate change risk perceptions. Therefore, more comprehensive models are needed that include several variables to fully understand skepticism. Furthermore, although a number of studies gave attention to direct relationships between predictors and predicted variables, they did not fully consider the interactions between predictors and their impact on skepticism. For example, Islam et al. [5] empirically showed

that the extent of the skepticism was significantly affected by farmers' ages, economic status, education, experience, use of media, contacts with consultants, and values. Although this study facilitated our understanding of the role of specific variables, we still do not know the overall structure of the causal mechanisms between variables. Therefore, the interaction between predictors and their impact on skepticism needs to be specified and described.

In response to such limitations, we constructed our research model by adopting 10 variables to represent each value and perception factor. First, we compared the impact of each variable using two factors, as well as the impact of those two factors on climate change skepticism. Since value and perception have different characteristics, it was expected that they would have differing levels of impact on skepticism. The roles of values and perception in skepticism were separately analyzed in several previous studies [15,22–28]. Secondly, we analyzed the moderating role of values between the perception factor and climate change skepticism.

In this paper, we analyzed survey data obtained from a study on climate change skepticism among Koreans. The objectives of this study were to (1) show variations of the extent of climate change skepticism prevailing among Koreans; (2) identify, through the use of regression analysis, the factors that influence skepticism toward climate change; and (3) explore the moderating effect of values on skepticism. Understanding the public attitude toward climate change seems to be important for the implementation of appropriate and effective actions for responding to climate change. In the next section, we review (1) the literature on concepts related to climate change skepticism, and (2) empirical findings on values and perception factors as predictors of climate change skepticism.

2. Theoretical Background

2.1. Concepts of Climate Change Skepticism

In the literature, the term *skepticism* is used synonymously with *denialism*, *contrarianism*, and *cynicism* [11]. Poortinga et al. [11] note that skepticism is an imprecise term with multiple meanings, given the complex multi-faceted nature of the climate debate (p. 1016). Several scholars tried defining the concept of climate change skepticism. Climate change skepticism refers to a family of arguments and individuals that reject, dispute, or question the orthodox view of the climate issue [25] (p. 1). Skepticism is used to refer to doubts and uncertainty about physical and scientific aspects of climate change [22]. Furthermore, the term *skeptic* is used to refer to people who deny climate change and whose views are incongruent with scientific consensus on climate change [11].

Capstick and Pidgeon [22] (p. 390) argued that the notion of skepticism is not limited to a narrow frame but is more commonly extended to conceptualize doubts about a wide range of societal, political, and personal responses to climate change. Since skepticism is related to so many extensive abstract concepts, a few scholars defined it by using several dimensions. For example, Rahmstorf [21] identified three types of climate skepticism. Firstly, trend skeptics are people who deny the existence of climate change. Secondly, attribution skeptics do not believe that the reasons for climate change are anthropogenic. Thirdly, impact skeptics agree with the idea that the world's climate is changing because of anthropogenic factors, but refuse to accept that such changes pose significant risks. Also, Capstick and Pidgeon [22] (p. 389) determined the distinction between epistemic skepticism and response skepticism; the former refers to one's doubts about the status of climate change as a scientific and physical phenomenon, whereas the latter is related to doubts about the efficacy of action taken to address climate change. Whitmarsh et al. [10] categorized skepticism into categories: trend, attribution, and impact. Akter et al. [12] defined climate change "skepticism" in terms of three dimensions: a questioning of the "scientific consensus" that the global climate is changing, a questioning of whether human actions are responsible for the changes, and the belief that policy interventions are capable of limiting the changes (p. 736).

As our research aims to explore the effects of values and perception factors on climate change skepticism, the next section reviews previous research on these two factors.

2.2. Values Versus Perceptions

Values can be defined as fundamental *guiding* principles that are more specific and more stable than worldviews [21,29,30]. Furthermore, Wolf et al. [31] defined values as trans-situational conceptions of the desirable that give meaning to behavior and events, and influence the perception and interpretation of situations and events (p. 548). Sjöberg [32] argued that the function of values in risk perception is not sufficiently studied. Also, Wolf et al. [31] argued that values are crucial to shaping perceptions of climate impacts and one's adaptation to them. Such value-centered approaches regard perceptions as byproducts of the particular way individuals view the world and the value they assign to different objects [10]. After demonstrating the effects of right-of-center political views and low pro-environmental values on skepticism toward the reality and severity of climate change, Whitmarsh [10] argued that beliefs about climate change are fundamentally linked to existing values and worldviews (p. 697). This value-based approach focuses on subjective, qualitative dimensions of climate change that are of importance to individuals and cultures [33].

A value-centered approach stresses the differentiation of values from perceptions. In risk studies, the perception-centered approach heavily depends on a psychometric paradigm. Paul Slovic and his colleagues proposed the psychometric paradigm, in which the degree of risk is related with a subjective construct rather than an objective attribute [34]. In this paradigm, risk perception depends on people's subjective judgment. Against Starr's [35] stated preference, this paradigm focused on the expressed preference in risk perception and on the subjective construction of risk. Therefore, it firstly directly asked people to evaluate risk through a questionnaire characterizing the "personality of hazards" by rating them on various qualities or characteristics (e.g., voluntariness, catastrophic potential, controllability, and dread). Secondly, it used a variety of psychometric scaling methods to produce quantitative measures of perceived risk, perceived benefit, and other aspects of perceptions [36] (pp. 3–4).

What relationships exist between values and perceptions? A number of studies assumed that values prevail over perceptions. For example, Wolf et al. [31] showed how activated values influenced perception of the effects of an unusual winter. In other words, values shape intangible, subjective effects of climate change. Existing literature demonstrates that values of culture, ideology, and environmentalism influence perception. Kahan et al. [37] (p. 732) argued for the cultural cognition thesis, which holds that individuals, as a result of complex psychological mechanisms, tend to form perceptions of societal risks that cohere with values characteristic of groups with which they identify. Engels et al. [26] pointed out that the "specific composition of factors correlating with climate change skepticism depends strongly on the political and cultural context in which model is tested" (p. 1019). Whitmarsh [10] demonstrated that skepticism is strongly influenced by environmental and political values, rather than by education or knowledge. Leiserowitz et al. [7] argued that, when motivational reasoning plays a significant role in the evaluation of scientific evidence, *values*, *wishes*, and *preferences* provide the basis for those works. According to Leiserowitz et al.'s [7] empirical study, the loss of trust in scientists exists primarily among individuals with individualistic cultural biases or politically conservative ideologies.

Several studies focused on the moderating role of values in perception and climate change skepticism. Stevenson et al. [38] demonstrated an interaction effect of knowledge and worldview (individualism) on anthropogenic global warming (AGW). Even if more climate change knowledge is positively related with the acceptance of AGW, this relationship is stronger when respondents are individualists rather than communitarians. Hamilton et al. [17] showed that the effect of understanding climate change and its perceived level of threat depends on one's political affiliation. Democrats who believe they clearly understand global warming are more likely to believe that it poses a threat in their lifetimes. Conversely, Republicans who believe they clearly understand global warming are less likely to believe that it poses a threat.

2.3. Value Factor

2.3.1. Ideology

Previous empirical analyses show the extreme importance of political ideology as it relates to climate change beliefs and concerns. Corner [39] argues that climate skeptics do not base their views on scientific evidence but on ideology. Political conservatives value free-market competition and fewer government regulations, whereas liberals (or left-leaning individuals) are more likely to tolerate or even welcome a greater role of the government in promoting the public good [40] (p. 65). Since climate change requires governmental regulation, conservatives express less confidence in scientific evidence on global warming. As climate change skepticism weakens the need for environmental regulations, it is congruent with conservative ideals.

In the US, political affiliation influences the divide over skepticism. The number of Democrats who agree that global warming increased gradually over a 10-year period grew from 47% in 1998 to 76% in 2008, whereas the number of Republicans in agreement decreased from 46% to 41% during the same period [15]. Hamilton [16] showed that a relationship between understanding and threat appears when the political divide is taken into consideration. Concern about climate change increases with education among Democrats but decreases with education among Republicans. Leiserowitz [18] found that Democrats and liberals expressed stronger support for climate change policies than Republicans and conservatives.

According to Zhou [40], political orientation significantly affects the level of skepticism; political conservatives are more skeptical than their left-leaning liberal counterparts. Furthermore, Whitmarsh [10] showed that those with right-of-center political views appeared most skeptical about the reality and severity of climate change. These findings are presented with the following hypothesis:

Hypothesis 1 (H1). *Conservatives express more skeptical views toward climate change than liberals.*

2.3.2. Environmentalism

Environmental value is one of the most important factors of heterogeneity in climate change beliefs and attitudes [41]. According to Whitmarsh et al. [10], those with low pro-environmental values tend to be most skeptical about the reality and severity of climate change. In particular, those with the highest quartile New Environmental Paradigm (NEP) scores were eight times more likely to harbor high skepticism scale scores than those with the lowest quartile (p. 3). According to Ziegler's [41] comparative studies, environmental values are critical factors of beliefs in and attitudes toward climate change in all three countries (US, Germany, and China); thus, they play an even more dominant role than political orientation. Since environmentalism promotes belief in climate change, it may reduce skeptical views toward it [42]. By focusing on skepticism by country, Tranter and Booth [28] showed that, when skepticism in a given country is high, environmental concern is low. However, they demonstrated that climate skeptics are not merely anti- or non-environmentalists; for example, men and conservatives tend to be skeptics, but are not environmentally supportive.

Hypothesis 2 (H2). *More environmentalism tends to decrease climate change skepticism.*

2.3.3. Religiosity

Religious beliefs often compete with science over "moral, epistemological, and ontological issues" [43] (p. 171). Those with high religiosity have a lower level of confidence in science [43]. Lower levels of confidence induce skeptical views about the authenticity of scientific evidence on climate change. Denial of climate change is based on an anthropocentric view of the natural world, stemming from the Judeo-Christian perception that nature was created for human use [25]. Also, Ecklund et al. [44] showed the close links between religion and climate change skepticism; Evangelical Protestants show more skepticism toward both evolution and climate change, compared

with individuals who are religiously unaffiliated. Furthermore, Zhou [40] showed that a higher level of religiosity increases the level of environmental skepticism.

However, several studies present a different view. For example, Sun and Han [45] demonstrate that religious believers have higher risk perceptions of personal threat from climate change than non-religious people. This means that those individuals who are more religious tend to be less skeptical. Moreover, it is noticeable that the impact of religiosity varies with the national context. According to McCright et al.'s [46] review, the effect of religiosity on pro-climate views outside of the US is nearly insignificant (four out of six examined effects), whereas religiosity has a negative effect within the US (15 of 22 examined effects) (p. 183).

Hypothesis 3 (H3). *The higher the level of people's religiosity is, the higher the level of skepticism will be.*

2.3.4. Cultural Bias

Public perceptions of risks are influenced by individuals' cultural biases formed through social relations [47]. Based on two poles of a grid as regulation and group as identity, which represent the main attributes of sociality, Douglas and Wildavsky [47] suggested four cultural biases: hierarchy, individualism, egalitarianism, and fatalism. The first three are clearer in their attitudes toward environmental issues. For different reasons, hierarchy and individualism favor environmentalism less than egalitarianism. As hierarchy endorses the existing social values and order, it dislikes new ideas, e.g., environmentalism. Also, since individualism seeks market freedom, it does not favor government regulation to support the environment.

On another note, van der Linden [21] showed that socio-cultural factors explain climate change risk perception significantly more than either cognitive or sociodemographic characteristics. Rudiak-Gould [48] pointed out that climate change skepticism seems to come from cultural, rather than universal, human elements. Recently, Shi et al. [49] showed that cultural worldviews and climate-related knowledge are significantly related with people's concern about climate change; the former is a stronger predictor of concern about climate change than the latter. In particular, it is not the degree of knowledge but the type of knowledge that has an impact on public concern around climate change.

Furthermore, because of low endorsement of environmentalism, the presence of a hierarchy and individualism can be linked to higher skepticism. Leiserowitz [18] showed that egalitarians tend to think global warming is a serious risk and support various policies related to climate change, whereas individualists are predisposed toward considering it as nonexistent or low risk and oppose related policies. Those who have individualistic cultural worldviews appear to be more skeptical [50]. By reviewing previous research, McCright et al. [46] summarized that egalitarianism has a positive impact (six out of six examined effects), while individualism has a negative impact (six out of nine examined effects) on belief in climate change and concern about its effects. Tranter and Booth [28] confirmed that individualistic values are associated with higher levels of skepticism. Egalitarianism is associated with a higher global warming risk perception than individualism and hierarchy [18]. However, some researchers repeatedly argued that cultural theory is simply wrong [51] (p. 150) or that cultural worldviews have low explanatory power [52].

Hypothesis 4 (H4). *The presence of a hierarchy and individualism increase climate change skepticism, whereas egalitarianism decreases it.*

2.3.5. Science and Technology Optimism

Optimism is a healthy, desirable outlook that can produce useful personal outcomes and technological appreciation [53]. Science and technology (S&T) have two different functions; one provides scientific evidence to support the reality of climate change threats, while the other is a means of creating solutions. S&T optimism is related to the latter.

According to Dunlap and McCright's [25] examination of the historic roots of climate denial, climate denial started with a technologically optimistic worldview, prevalent in Western societies. From this dominant social paradigm, the politico-economic system was combined with S&T, resulting in economic growth and inevitable progress (p. 240). Enlightenment thinking emphasized human progress and improvement via the use of S&T to transform the environment into a useful resource (p. 241).

Costa-Font et al. [54] analyzed the impact of S&T optimism on the acceptance of five S&T-related topics. They found that optimism reduces the perception of risks of climate change. Excessive optimism can cause risks to be discounted, implying that optimism increases skeptical views of the risks associated with climate change. Zhou [40] demonstrated that trust in science is negatively related with environmental skepticism. Tranter and Booth [28] confirmed that a belief that science can solve environmental problems is associated with higher levels of skepticism.

Hypothesis 5 (H5). *S&T optimism increases climate change skepticism.*

2.4. Perception Factor

2.4.1. Perceived Risk and Benefit

The balance of perceived risks and tangible benefits from climate change is one of the factors that influence the acceptance and denial of climate change. In general, the public perceives the risk of climate change. According to Leiserowitz's [18] survey of Americans, a clear majority of respondents (68%) were most concerned about the impact of climate change on people around the world. Potential hazards arising for society from climate change are considered to be greater than individual threats [55].

After surveying midwestern US crop farmers, Mase et al. [56] showed that perceived risks from weather and climate influence farmers' decisions to adopt adaptation strategies. According to Akerlof et al. [57], the perceptions of positive outcomes from a national global warming policy are linked with more increased local risk perceptions than perceived negative outcomes. The impact of perception on climate change sometimes surpasses the experience. Using 2013 Taiwan Social Change Survey (TSGS) data (N = 2001), Sun and Han [45]) showed that it is not climate-related disaster experience but climate-related risk awareness that has a significant impact on the perception of global severity or personal impact. Poortinga et al. [11] demonstrated that a greater perception of risk is associated with a relative decrease in climate change skepticism.

Since climate change raises risk, actions against it are beneficial. Some benefits are linked with adaptation and mitigation policies to counteract climate change. In this case, the perceived benefits from climate change policy reduce skeptical views of the climate. According to Niles et al. [58], positive experiences with previous policies reduce the perceived risk of climate change.

Hypothesis 6 (H6). *Perceived risk decreases climate change skepticism.*

Hypothesis 7 (H7). *The perceived benefit of combating climate change also reduces climate change skepticism.*

2.4.2. Trust

Trust takes on the role of decreasing perceived risk and increasing the benefit of specific objects. According to Siegrist [59], people who trust private companies as institutions and professions perceive fewer risks and more benefits associated with biotechnology than people who do not. McCright et al. [46] reported that there was little empirical evidence to suggest that trust in scientists has a consistent effect on climate change views.

Why does trust matter? Siegrist et al. [59] pointed out the role of trust, which supplements the knowledge. If people lack knowledge, they cannot directly assess benefits and risks associated with different technologies. In this case, people depend on trust, which has the effect of reducing the complexity they must confront. Hmielowski et al. [60] demonstrated the role of trust as an important heuristic instrument. When people sense their own lack of knowledge, they use information related with trust.

Furthermore, according to Zhou [40], not only the degree of trust but also the kind of trust matters; trust in general society and science has a significantly negative effect on environmental skepticism, whereas trust in the government shows a significantly positive effect. Tranter and Booth [28] showed that those who have low levels of trust in government are more skeptical.

Hypothesis 8 (H8). *A low level of trust usually results in a higher level of climate change skepticism.*

2.4.3. Negative Affect

"Affect" is a subtle term for emotion, defined as a positive (like) or negative (dislike) evaluative feeling toward external stimuli [61]. Moreover, affect refers to a person's good or bad, positive or negative feelings about specific objects, ideas, or images [18] (p. 48).

According to Leiserowitz [18], the term global warming had negative connotations for nearly all respondents; alarming images of disaster brought out the strongest negative affect, while naysayers produced very low negative affect. Prior studies found that affect and affective imagery have a strong impact on public support for climate change. For example, Leiserowitz [18] showed that negative image affect has a positive impact on global warming risk perception.

Smith and Leiserowitz [62] found that discrete emotions were stronger predictors of global warming policy support than cultural worldviews, negative affect, image associations, or sociodemographic variables. They measured respondents' feelings when thinking about the issue of global warming; 65% said they felt "interested" in global warming, followed by "disgusted" (52%), "worried" (50%), "hopeful" (46%), "helpless" (45%), "angry" (44%), "sad" (43%), "afraid" (36%), "depressed" (26%), or "guilty" (25%).

Hypothesis 9 (H9). *The negative affect of climate change decreases skepticism.*

2.4.4. Knowledge

Climate change is a matter of scientific fact. To understand climate change, knowledge about complex scientific issues is required to a great extent. Dunlap [63] argued that the inevitable uncertainties involved in scientific research generate skepticism and denial concerning AGW (anthropogenic global warming).

Explaining the role of knowledge related to climate change is based on the familiar "knowledge deficit" model, which states that laypeople have limited concerns about climate change issues because they are poorly equipped with scientific information and/or the capacity for scientific thinking [64] (p. 1). Therefore, providing knowledge to the public enhances acceptance of scientific issues such as climate change. In this vein, Tranter and Booth [28] assumed that those who believe they understand how to solve environmental problems should be less concerned about climate change (p. 159).

In empirical studies, Hamilton et al. [17] found that higher science literacy scores are related to higher concern with regards to the impacts of climate change. Moreover, most environmental threats cannot be perceived or experienced directly; thus, people have to rely on secondhand knowledge to understand them [40] (p. 64). By analyzing General Social Survey data, Hamilton et al. [17] found that science knowledge had simple, positive effects on concern about the impacts of climate change. Based on the knowledge deficit perspective, Zhou [40] showed that self-assessed knowledge reduced individuals' environmental skepticism, while lack of such knowledge induced more skepticism. However, recently, the importance of knowledge for laypeople's understanding of climate change was doubted [49].

Hypothesis 10 (H10). *The more knowledge people have, the less climate change skepticism they demonstrate.*

Next, Figure 1 shows the research framework and hypotheses.

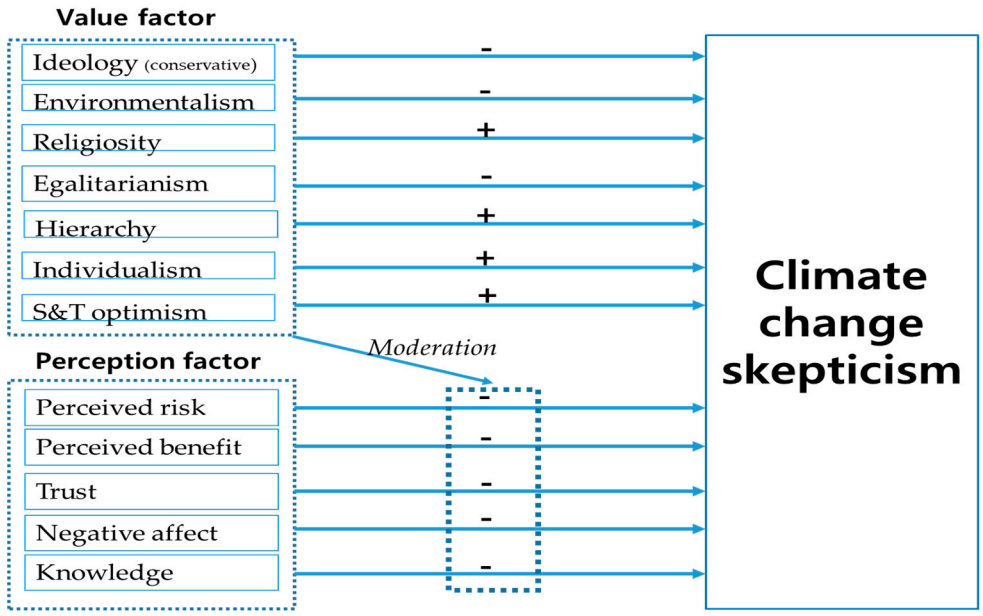

Figure 1. Research framework and hypotheses.

3. Sample and Measures

The survey was conducted in Korea via the web. The purpose of the survey was to measure the structure of attitude related to climate change. The survey data were collected from May 2017 by online random sampling via quota sampling that considered gender, age, and region. We distributed 12,977 emails to individuals on online survey lists, requesting their participation in the survey; 1873 individuals opened the email, and a total of 714 questionnaires were returned. The respondents were divided into several categories by gender, age, and education: 49.6% were male, 50.4% were female, 35.2% were younger than 40, 40.6% were between 40 and 59, and 24.3% were over the age of 60. The sample was divided into two equal groups based on education; 51.0% had an education level of high school or below, and 49.0% had a university-level education.

All variables were measured using a five-point Likert scale (disagree strongly (1) to agree strongly (5)). Affect was measured by asking the respondent's opinion about statements containing adjective scales (pleasant, favorable, or positive). To composite the multiple measures, we averaged the scores of the results. Before the analysis, we checked the scales' reliability and validity. The reliability of measures is shown in the rightmost column in Table 1. Except hierarchy and individualism, most values of reliability (Cronbach's alpha) were beyond the critical point (0.60).

The reliability of measures for hierarchy is low. There are two reasons; firstly, the measurement items developed in the Western context are applied to the Korean situation. Secondly, if we used more than three questions, the reliability would be enhanced. However, our study adopted only two measurement items. Such low reliability of the measurement items is considered to be a limitation of this study. To check the validity of measurement items for culture bias, we executed exploratory factor analysis based on those six CT (Cultural Theory) survey items. Table 2 shows that there is a discriminant structure consisting of three factors among six items.

Table 1. Concepts, measures, and reliability.

Concept	Measures	Reliability
Climate Change Skepticism	- The problem of climate change is much exaggerated - The data that global warming creates problems are unreliable - It is exaggerated that the damage is caused by climate change - The damage caused by climate change will happen in the far future - The damage caused by climate change occurs far from me - The climate change problem is related to other people, not me - It is not certain whether climate change is actually happening	0.921
Religiosity	- I am religious - I am convinced of the existence of God	0.877
Environmentalism	- Currently, the earth faces a serious environmental and ecological crisis - The earth already surpassed its limitations - Animals and plants have as much of a right to live as human beings - Since nature is very sensitive, it is easily destroyed	0.768
Egalitarianism	- Our society needs overall reform to distribute wealth equally - We need overall revolution to make the wealth equally distributed	0.790
Hierarchy	- Our society is confused because authority is disregarded - Strong laws create a good society	0.505
Individualism	- People are poor because they do not try hard enough - A competing society is a good society	0.582
S&T optimism	- Science and technology (S&T) solve more problems than they create - Science and technology perform more positive functions than negative ones	0.657
Perceived risk	- Climate change is a serious threat to the survival of humankind - Planetary changes due to global warming will cause me a lot of damage - I am worried that the problems caused by global warming will be harmful for humans	0.910
Perceived benefit	- If climate change problems are resolved, there will be tremendous benefits - Solving climate change will lead to economic development	0.839
Trust	- How much do you trust the following organizations in addressing climate change and energy issues? 1. University research institutes, 2. Environmental protection organizations, 3. Consumer organizations, 4. Press, 5. Government, 6. Private companies, 7. Energy companies, 8. Scientists	0.817
Negative affect	- I am sad to see climate change due to climate global warming - I am worried about climate change due to global warming - I am afraid of climate change due to global warming	0.912
Knowledge	- I know the problems of climate change well - I am more knowledgeable about climate change than others	0.839

Table 2. Factor matrix.

	Statement	Factor		
		1	2	3
Egalitarianism	We need overall revolution to make the wealth equally distributed	0.902	−0.080	0.038
	If our society is equalized, many problems will be solved	0.901	−0.026	0.102
Individualism	A competing society is a good society	−0.004	0.876	0.075
	People are poor because they do not try hard enough	−0.106	0.766	0.255
Hierarchy	Our society is confused because authority is disregarded	−0.024	0.146	0.834
	Strong laws create a good society	0.170	0.153	0.759

Note: extraction method → principal component analysis; rotation method → Varimax.

4. Analysis and Findings

4.1. Basic Structure

Figure 2 shows the participants' responses to statements measuring skepticism. Climate change skepticism was measured through seven items: uncertainty, relatedness, distrust in S&T facts, and the evaluation of denial of the climate change.

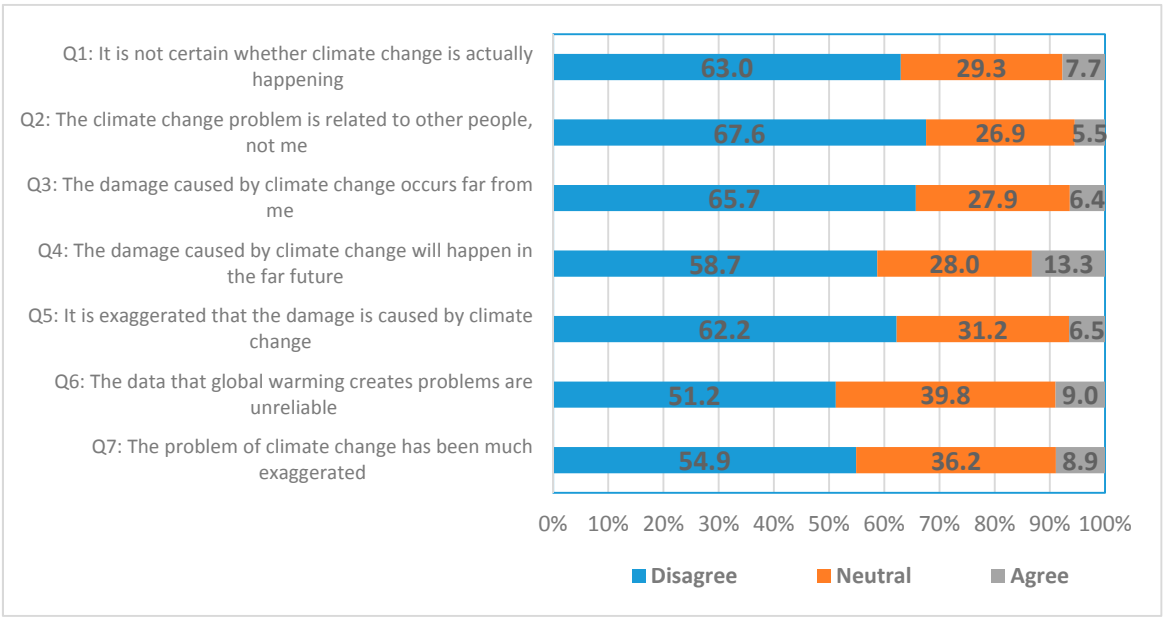

Figure 2. Attitudes toward climate change.

Firstly, the number of participants who revealed some degree of doubt about climate change was very low. More than half of respondents, ranging from 51.2% to 67.6%, showed a recognition or understanding of the problem of global warming. A total of 67.6% did not agree that the climate change problem was related to people other than me. This implies that the majority of people feel some degree of responsibility for global warming. Likewise, in the UK, Poortinga et al. [11] showed that 59% of people (a majority) disagree with the statement that they are uncertain about the existence of climate change. In seven questions, the proportion of those indicating a neutral response ranged from to 26.9% to 39.8%. This implies that three or four out of 10 respondents did not have a concrete opinion of the facts and evidence related to climate change.

On the other hand, 5.5% to 13.3% of participants were skeptics who denied climate change and did not believe in the evidence for it. A total of 13.3% of respondents believed that the damage caused by climate change would happen in the distant future. One out of twenty respondents agreed that the climate change problem was related to other people, not themselves. Such figures are similar to Poortinga et al.'s [11] findings, which showed that climate skepticism is not widespread in Britain, as well as those of Whitmarsh [10], whose study results showed that a rejection of the idea of human-induced climate change appears to be between 10% and 20%.

In short, the above results show that many respondents denied the exaggeration and uncertainty around the occurrence of and evidence for climate change. Moreover, people disagreed that the evidence is undeniable. Therefore, they believed that problems resulting from climate change are not remote nor will they happen in the distant future. However, there were still some respondents with neutral or opposite perspectives toward climate change that did not align with the views of the majority.

To discover the basic relationships between variables, we calculated the mean according to primary sociodemographic variables. Islam et al. [5] empirically showed that the extent of this skepticism is significantly affected by sociodemographic variables such as farmers' ages, economic status, and education. Figure 3 shows the results.

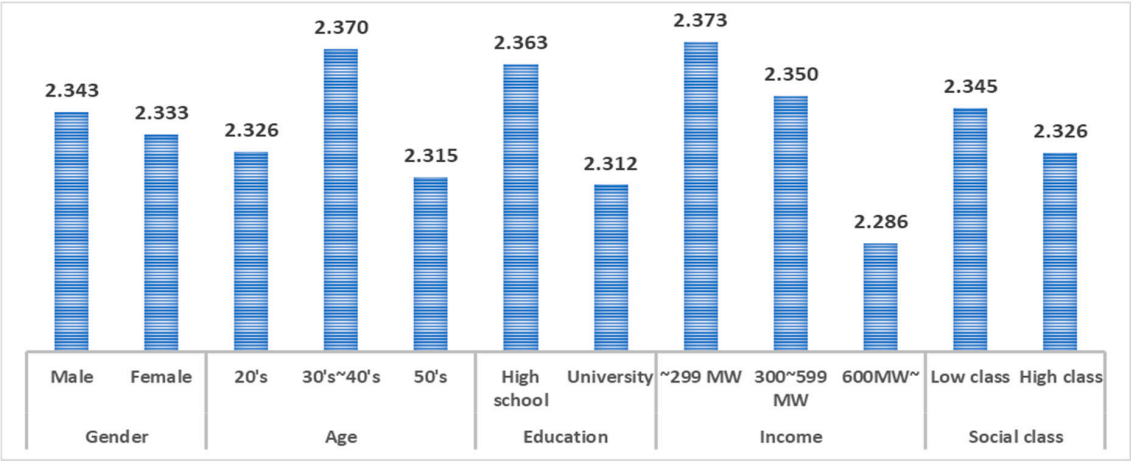

Figure 3. Mean by sociodemographic variables.

Previous research indicates that females more often thought that global warming posed a threat in their lifetime [16]. Likewise, Whitmarsh et al. [10], Zhou [40], and Tranter and Booth [28] confirmed that, compared with women, men display a higher level of skepticism. Zhou [40] explained that socialization is "gendered", and women are socialized to take on roles of nurturer and caretaker, which are averse to risks (p. 67).

With respect to age, Zhou [40] and Poortinga et al. [11] showed that older people reveal more skepticism toward environmental science. It is argued that younger generations are more likely to possess pro-environmental attitudes than those who are older since the former seek different values, i.e., non-materialistic values such as environmentalism and well-being. However, our data did not confirm a linear relationship between age and skepticism. Respondents in their 30's–40's revealed more skepticism than those in their 20's or those 50's and above. This implies that each generation has different experiences, causing attitudes to vary within age groups.

With respect to education, high-school graduates show more skepticism than those educated at a university. Formal education tends to provide knowledge about the scientific facts related to climate change. Such knowledge might eliminate doubt about climate change. Zhou [40] and Tranter and Booth [28] showed that education has a significantly negative effect on environmental skepticism.

Figure 3 shows that wealthier individuals are less skeptical. Moreover, one's inclusion in a higher social class decreases climate change skepticism. However, previous studies showed different results; Whitmarsh [10] showed that those with household incomes over £75,000 are far more likely to be skeptical than others ($F = 3.3$, $p < 0.001$, p. 694). Akter et al. [12] showed that high-income earners are more skeptical about the impact of climate change. Also, Poortinga et al. [11] reported that those in a higher social class express higher levels of climate skepticism. From these contrasting results, we infer that, if people are satisfied with their level of economic security, they seek higher needs, enabling a higher level of environmental concern. Higher income induces environmentalism and includes less skepticism.

Next, to discover the relationships between variables, we executed a simple correlation and partial correlation, in which age, income, education, and social class were controlled. The results are shown in Table 3. With the diagonal line as an axis, the lower part is a simple correlation whereas the upper part is a partial correlation value. Bald italic numbers are partial correlation coefficients. They have different values because of controlled variables. The second column shows the correlation coefficients between climate change denial and other variables.

Progressive political affiliation was positively associated with skepticism. Such findings confirm the findings of previous studies [10,40]. There was a negative relationship between environmentalism and skepticism and a positive links between religiosity and skepticism. However, the coefficient is not

larger than that of environmentalism. This shows that different effects exist, which vary depending on values levels related to climate change skepticism.

Next, three types of cultural biases showed different impacts on skepticism. Results show that hierarchy and individualism had a positive relationship with skepticism, whereas egalitarianism had a negative relationship. The first two had stronger relationships with skepticism than the latter. It is remarkable that, among the three correlation coefficients (between three cultural biases and skepticism), hierarchy had the largest values. S&T optimism had a weak positive correlation with skepticism. If people have a positive attitude toward S&T, they may believe that S&T will solve the climate change problem. Therefore, they will be less concerned with climate change, which is a more skeptical position.

Among perception variables, there was a strong negative correlation between perceived risk and skepticism. Fear of climate change increases the concern toward it, making people less remote from skepticism. Also, the perceived benefit of overcoming climate change had a negative relationship with skepticism. This implies that stressing the benefit of adaptation policies for climate change will contribute to a reduction in negative views toward climate change.

Skepticism had a negative relationship with trust. Siegrist et al. [65] found positive relationships between trust and environmental action. They showed that trust in the government makes environmental risks more acceptable, since people believe that the government will provide a solution to environmental problems. However, correlation coefficients between trust and the skepticism in Table 2 were the lowest among the perception variables. Moreover, emotional affect had a negative relationship with skepticism. Among four perception variables, affect had the highest correlation with skepticism. This implies that climate change could be a matter of emotional rather than rational thinking. If it is indeed concerned with feeling, policy-makers should adopt persuasive strategies toward the public by appealing to people with affective images or messages. Lastly, knowledge had a weak negative correlation with skepticism. The more knowledge people have, the less skepticism they exhibit. However, the value of the coefficient was relatively smaller than that which exists between negative affect and skepticism. This implies that emotional thinking (affective images) may play a more critical role than cognition (knowledge) with which people assess and evaluate the problem of climate change.

Table 3. Simple correlation.

		1	2	3	4	5	6	7	8	9	10	11	12	13
	1. Skepticism	1	0.081 **	−0.344 ***	0.106 ***	−0.102 ***	0.282 ***	0.261 ***	0.104 ***	−0.441 ***	−0.338 ***	−0.071 ***	−0.460 ***	−0.072 *
Value factor	2. Ideology (progressive)	**0.073** *	1	−0.131 ***	0.122 ***	−0.23 ***4	0.162 ***	0.230 ***	0.003	−0.120 ***	−0.103 ***	0.015	−0.155 ***	−0.142 ***
	3. Environmentalism	**−0.347** ***	**−0.122** ***	1	−0.038	0.252 ***	0.016	−0.016	0.070 *	0.499 ***	0.354 ***	0.022	0.455 ***	0.157 ***
	4. Religiosity	**0.093** **	**0.164** ***	**−0.029**	1	−0.017	0.166 ***	0.163 ***	0.048	0.057	0.074 **	−0.158 ***	0.010	0.052
	5. Egalitarianism	**−0.105** ***	**−0.224** ***	**0.249** ***	**−0.023**	1	0.148 ***	−0.105 ***	0.136 ***	0.181 ***	0.179 ***	−0.132 ***	0.194 ***	0.103 ***
	6. Hierarchy	**0.282** ***	**0.170** ***	**0.020**	**0.160** ***	**0.147** ***	1	0.373 ***	0.241 ***	−0.033	0.018	−0.134 ***	−0.036	0.041
	7. Individualism	**0.237** ***	**0.284** ***	**−0.020**	**0.204** ***	**−0.104** ***	**0.359** ***	1	0.241 ****	−0.047	−0.005	−0.228 ***	−0.042	0.026
	8. S&T optimism	**0.096** **	**0.020**	**0.062**	**0.062** *	**0.136** ***	**0.232** ***	**0.261** ***	1	0.071	0.138 ***	−0.255 ***	0.079 **	0.123 ***
Perception factor	9. Perceived risk	**−0.440** ***	**−0.085** **	**0.498** ***	**0.083** **	**0.174** ***	**−0.026**	**−0.002**	**0.078** **	1	0.539 ***	−0.015	0.735 ***	0.221 ***
	10. Perceived benefit	**−0.337** ***	**−0.078** **	**0.350** ***	**0.096** **	**0.172** ***	**0.019**	**0.029**	**0.146** ***	**0.544** ***	1	0.107 ***	0.585 ***	0.263 ***
	11. Trust	**−0.067** *	**−0.038**	**0.021**	**−0.209** ***	**−0.114** ***	**−0.136** ***	**−0.281** ***	**−0.262** ***	**−0.016**	**−0.128** ***	1	0.047	0.090 **
	12. Negative affect	**−0.457** ***	**−0.124** ***	**0.455** ***	**0.056**	**0.177** ***	**−0.035**	**−0.009**	**0.182** ***	**0.735** ***	**0.587** ***	**0.080** **	10.000	0.283 ***
	13. Knowledge	**−0.070** *	**−0.121** ***	**0.128** ***	**0.077** **	**0.074** **	**0.019**	**0.076** **	**0.147** ***	**0.218** ***	**0.269** ***	**0.120** ***	**0.286** ***	1

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

4.2. Determinant Structure

To discover the causal power of values and perception factors, we regressed the skepticism variable on those factors. The results appear in Table 4. In model 1, we controlled sociodemographic variables such as gender, age, education, and household income.

Table 4. Multiple linear regression analysis of climate change skepticism.

		B	SE	Beta	t	Sig.
	Constant	3.782	0.297		12.727	0.000
F1: Sociodemographic factor	Gender (female)	0.068	0.044	0.049	1.535	0.125
	Age	−0.003	0.002	−0.065	−1.841	0.066
	Education level	−0.060	0.049	−0.043	−1.231	0.219
	Income	−0.125	0.057	−0.080	−2.181	0.030
	Social class	0.028	0.017	0.062	1.603	0.109
F2: Value factor	Ideology (Progressive)	−0.030	0.013	−0.079	−2.375	0.018
	Environmentalism	−0.149	0.039	−0.139	−3.850	0.000
	Religiosity	0.040	0.019	0.068	2.061	0.040
	Egalitarianism	−0.014	0.026	−0.018	−0.550	0.582
	Hierarchy	0.159	0.027	0.202	5.892	0.000
	Individualism	0.141	0.032	0.164	4.448	0.000
	S&T optimism	0.066	0.033	0.067	2.020	0.044
F3: Psychometric factor	Perceived risk	−0.144	0.045	−0.152	−3.197	0.001
	Perceived benefit	−0.096	0.038	−0.099	−2.559	0.011
	Trust	0.006	0.039	0.005	0.155	0.877
	Negative affect	−0.227	0.046	−0.242	−4.948	0.000
	Knowledge	0.047	0.034	0.047	1.396	0.163
F-value				24.111 ***		
R^2/Adjusted R^2				0.371/0.355		
F1: R^2/Adjusted R^2				0.014/0.007		
F2: R^2/Adjusted R^2				0.229/0.221		
F3: R^2/Adjusted R^2				0.250/0.245		

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.; B = unstandardized coefficients; SE=standard errors; Beta = standardized coefficients; t = T-value; Sig.=significance.

Among the five sociodemographic variables, age and income showed a significant impact on skepticism. Firstly, older individuals were more likely to be skeptical about climate change than younger individuals. According to Zhou [40], environmental skepticism increases with age. Poortinga et al. [11] showed that climate skepticism appears to be especially common among older individuals from lower socio-economic backgrounds who are politically conservative and hold traditional values (p. 1015). Older people are more integrated into society; thus, they believe that solutions to environmental problems threaten the existing social order [66] (p. 183). Therefore, old people may deny climate change.

Income level decreased skepticism. This result contrasted with Whitmarsh et al.'s [10] finding that people with higher household incomes are far more likely to be skeptical. Why does such an effect occur for the income variable? According to Maslow's [67] theory of need hierarchy, if satisfied with basic needs such as economic security, people tend to seek higher-level needs such as aesthetic needs. Environmentalism is one of these higher-level aesthetic needs with which people worry about the problem of climate change.

However, gender, education, and social class did not show a significant impact on climate change skepticism. In particular, previous research showed the effect of gender on skepticism; females show less skepticism than males [10,28]. Our data did not confirm this gender effect.

Political affiliation was a determinant of skepticism; more progressive respondents showed less confidence in climate change. A conservative is more likely to be skeptical of climate change than a progressive. In the US, Dunlap and McCright [25] found that skepticism was rooted in a reaction against the progressive movement in the 1960s. Conservatives attacked environmental science, which disseminated information related to the risk of climate change to the public, and a coalition formed among conservatives. This coalition consisted of conservative foundations, media, politicians, think tanks, contrarian scientists, and industrial (especially fossil fuel) interests. We confirmed the existence of conflict between conservatives and progressives in Korea.

Individuals who were more concerned about environmental issues tended to be more skeptical about climate change. This confirmed Whitmarsh et al.'s [10] finding that environmental values are found to be the strongest determinant of certainty about climate change. Tranter and Booth [28] suggest that, if climate change skeptics are the mirror image of environmentalists, most people who are not concerned about environmental issues should also tend to be climate change skeptics (p. 157).

Individuals' religiosity influenced their level of climate change skepticism. More religious people tended to believe that climate change threats are exaggerated. Why are religious people likely to be more skeptical? As already reviewed, Dunlap and McCright [25] explain that the anthropocentric view of the natural world comes from the Judeo-Christian perception that nature is created for human use.

With respect to cultural bias, hierarchy and individualism were negative determinants of skepticism toward climate change. This confirms Captstick and Pidgeon's [22] and Kahan et al.'s [37] studies, in which people's cultural worldviews were the most relevant predictors of skepticism. Why do those with two cultural biases deny climate change? The foundation of a hierarchy is based on respect for traditional social authority and order. However, action and policy to combat climate change require new orders, as opposed to those that are traditional. According to Poortinga et al. [11], traditional values increase one's proclivity toward skepticism. Kahan [68] (p. 296) explained that individualists demonstrate a negative attitude toward climate change because the widespread acceptance of such evidence would lead to restrictions on commerce and industry, activities they support. In particular, Sjöberg [51] argued that cultural worldviews have low explanatory power, even positing that cultural theory is simply wrong (p. 150). Egalitarianism did not have a significant impact on climate change skepticism.

S&T optimism had a positive impact on skepticism. Why does S&T optimism reduce skepticism? Tranter and Booth [28] explained that those who believe that scientific solutions to climate change are possible are also expected to believe in the claims made by scientists per se, including the predictions of climate scientists. Ceteris paribus, they should also be less likely to be climate skeptics (p. 159). Strong belief in science as a solution ushers in fewer concerns with climate change and is more involved with skepticism.

Those with higher perceived risk were significantly more skeptical than those with lower perceived risk. This is consistent with findings in the literature [11]. Perceived benefit from fighting against climate change had a negative impact on skepticism. Trust was a negative but insignificant. The impact of trust depends on its object. According to Zhou [40], trust in general society is negatively related to environmental skepticism. Siegrist et al. [61] found a positive relationship between trust and environmental action. If people have a stronger emotional response, they are less skeptical of climate change. Fearful emotional images enhance belief in climate change, which signifies a decrease in skepticism.

Finally, there was no significant relationship between skepticism and knowledge. This undermines the knowledge deficit explanation for climate change. Such significant results may come from a lack of effective knowledge management and its measurement. Whitmarsh [10] demonstrated that the presence of more information will not engage the most skeptical groups, which suggests that knowledge ultimately has no effect. With respect to measurement, van der Linden [21] argued that self-reported measures tend to be (a) less reliable and (b) confound different types of knowledge; thus, he suggested more concrete and objective measures. Zhou [40] found that self-assessed

environmental knowledge has a significantly negative effect on environmental skepticism (p. 74). Interestingly, education and knowledge, both of which share the attributes of enlightenment, showed no significant effect on climate change skepticism. This result is similar to Whitmarsh [10], in that skepticism is found to be strongly determined by an individual's environmental and political values, rather than by education or knowledge. The result implies that, when working to persuade the public, communication strategies that only supply knowledge and information have the greatest extant limits.

Based on the comparison of standardized coefficients, we could evaluate which predictors had greater effects. Among the predictors, the effect from hierarchy as cultural bias was a particularly strong predictor, followed by negative affect. Next, among value variables, environmental values were found to be the strongest determinants of climate change skepticism. Among psychometric variables, negative affect had the largest impact on skepticism, followed by perceived risk and perceived benefit. Religiosity and S&T optimism had relatively weaker impacts.

To determine the relative importance of the three factors in predicting skepticism, a linear regression analysis of the skepticism score was conducted, in which the sociodemographic factors, values, and psychometric perception factors were entered separately. Model 1 included only sociodemographic factors and accounted for 1.4% of variance; Model 2 included the value factor and accounted for 22.9%; and Model 3 was based on psychometric factors and explained 25.0% of the variance. The proportion of variance explained by sociodemographic factors was less than that which was accounted for by the other two variables.

4.3. Interaction Structure

How do value factors intervene in the relationships between psychometric variables and skepticism? To examine the moderating effect of seven values, we included interaction terms (i.e., each of the five psychometric variables was multiplied by each of the seven values variables as moderators) in the existing model. To explore the moderating effect, we followed a method and procedure suggested by Baron and Kenny [69].

As shown in Appendix A, among 35 interaction terms, nine appeared to be statistically significant. We did a simple slope test to learn whether the seven values variables played a significant role as moderators when they had a low, medium, or high value (see Appendix A). To provide a simpler figure to illustrate the interaction, the moderating effect of each of the seven value variables is depicted in Figures 4–12, in which the *X*-axis is the independent variable in the psychometric paradigm and the *Y*-axis represents climate change skepticism.

Based on the nine significant interaction terms, it is noteworthy that trust and knowledge had significant power because they did not show a significant or direct impact on skepticism, as shown in Table 4. This implies that those two variables can influence skepticism only through values such as ideology, environmentalism, religiosity, and individualism.

Figure 4 demonstrates that the effect of perceived risk on skepticism depended on religiosity. Religiosity weakens the power of perceived risk by lowering the level of skepticism. Although those who had higher perceived risk demonstrated less skepticism, they expressed a more skeptical view if they had higher levels of religiosity. This demonstrates the attenuation effect of conservative religious beliefs in decreasing the negative impact of perceived risk on skepticism. Figure 5 shows that perceived risk generally decreased skepticism. However, this effect was attenuated by higher levels of individualism. Higher levels of individualism increased skepticism, which intervened in the relationship between perceived risk and a skeptical view.

Figure 6 shows that individualism moderated the relationship between perceived benefit and skepticism. In general, perceived benefit from adaptation and mitigation of climate change decreased skepticism. However, this effect appeared more in the case of lower individualism. Higher levels of individualism decreased the negative impact of the perceived benefit on skepticism.

Figure 7 reveals that the effect of trust on skepticism relied on ideology. If there was strong progressive ideology, trust increased skepticism, whereas, in the case of weak progressive ideologies,

it decreased skepticism. Since weak progressive ideology is a mirror image of strong conservative ideologies, the latter seems to increase skepticism. Similarly, Figure 8 shows that trust's impact on skepticism depended on environmentalism. When strong environmentalism existed, trust increased skepticism, whereas, when weak environmentalism existed, it decreased.

Figure 9 presents the moderating role of egalitarianism, which intervened in the relationships between negative affect and skepticism. Negative affect usually increased skepticism. Such an effect was facilitated when there was a low level of egalitarianism. On the other hand, the higher level of egalitarianism lagged the negative effect from negative affect. Egalitarianism had an indirect impact on skepticism, although it did not have a direct effect.

In Figures 10–12, the impact of knowledge on skepticism was moderated by each of the three values: religiosity, hierarchy, and individualism. When the three values were stronger, knowledge increased skepticism, whereas, when they were weak, it decreased that.

In short, these findings demonstrate that, both directly and indirectly, values play a critical role in creating the impact of the psychometric paradigm on skepticism. Perceived risk and benefit reduce skepticism when religiosity and individualism are strongly represented. On the other hand, knowledge increases skepticism when religiosity, hierarchy, and individualism become stronger. Moreover, the effect of trust and negative affect on skepticism varies with the degree of intervention by values. Trust decreases skepticism under low progressivism and higher individualism, whereas it increases skepticism when the opposite is true. Negative affect reduces skepticism, which is facilitated when there is a low level of egalitarianism.

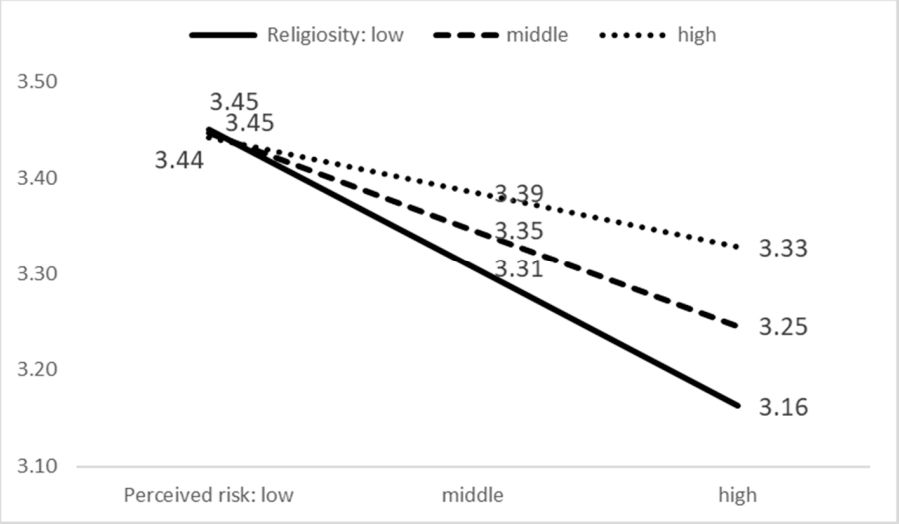

Figure 4. Perceived risk (IV) × religiosity (M) = skepticism (DV). Note: IV (independent variable), M (moderator), DV (dependent variable).

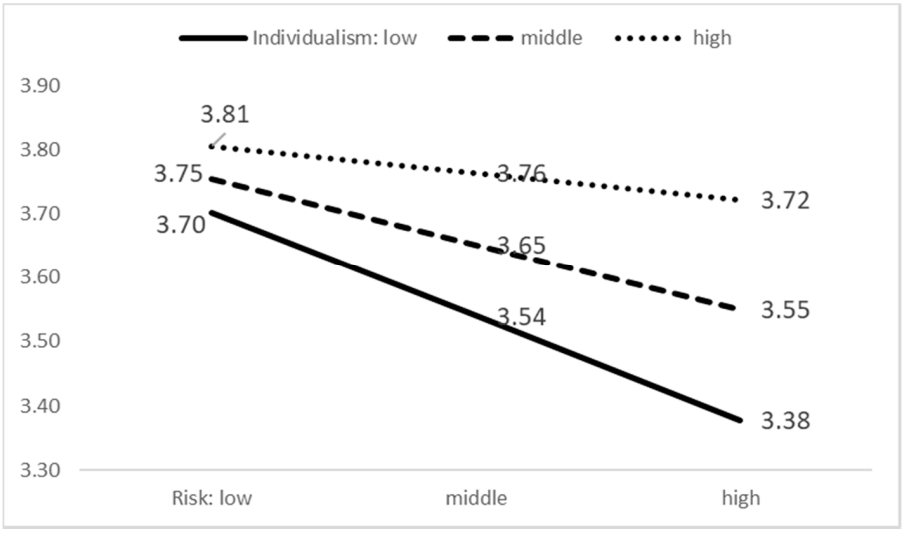

Figure 5. Perceived risk (IV) × individualism (M) = skepticism (DV).

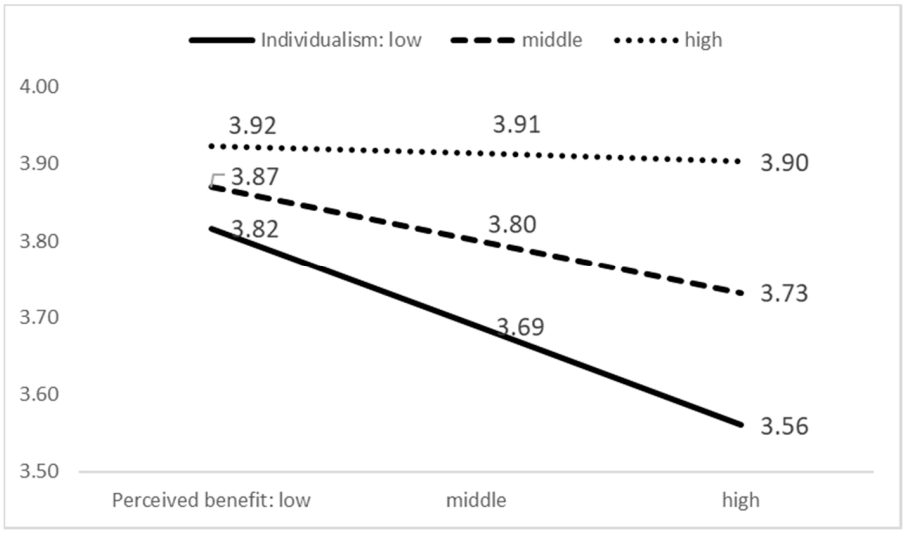

Figure 6. Perceived benefit (IV) × individualism (M) = skepticism (DV).

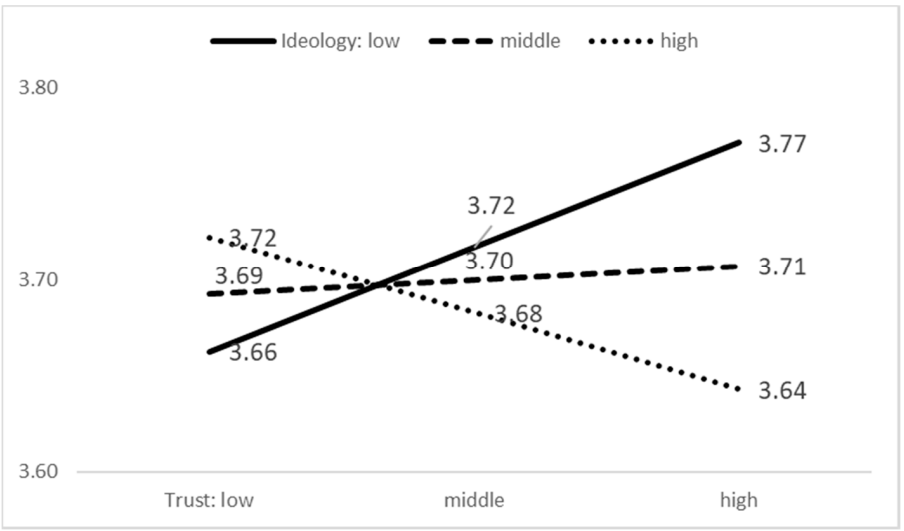

Figure 7. Trust (IV) × ideology (M) = skepticism (DV).

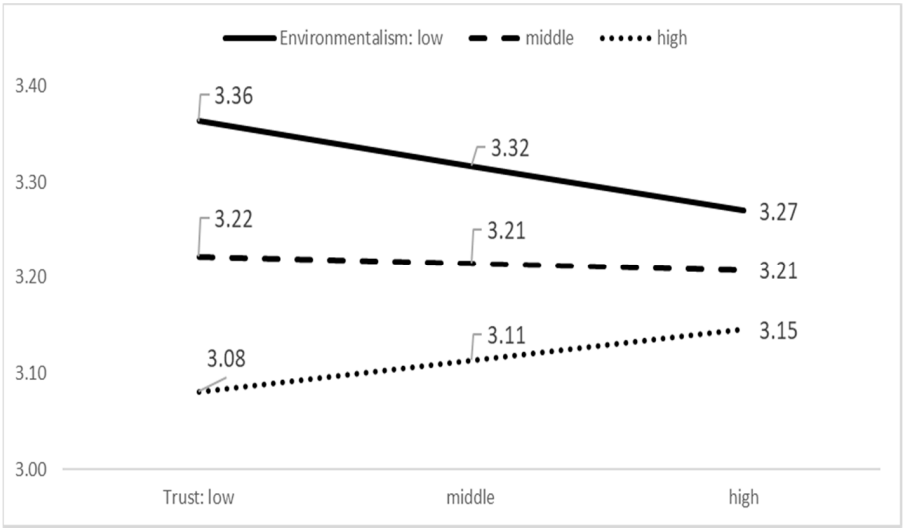

Figure 8. Trust (IV) × environmentalism (M) = skepticism (DV).

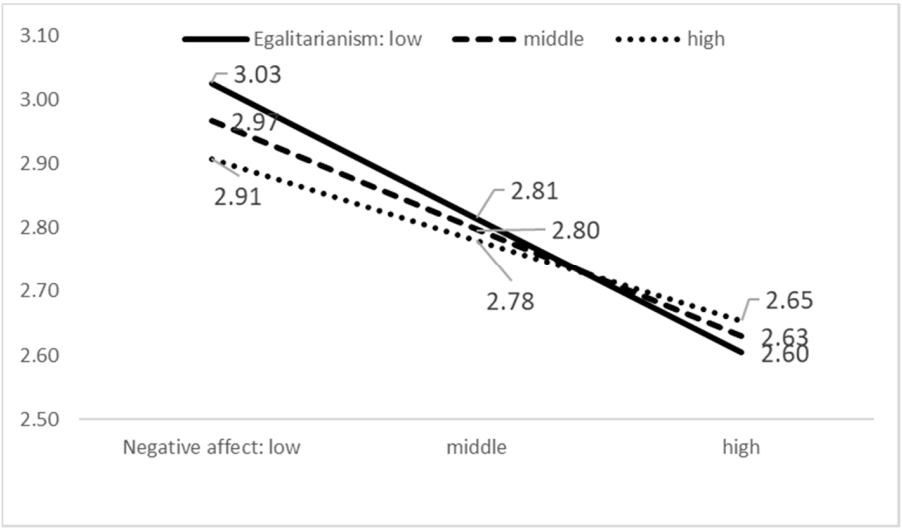

Figure 9. Negative affect (IV) × egalitarianism (M) = skepticism (DV).

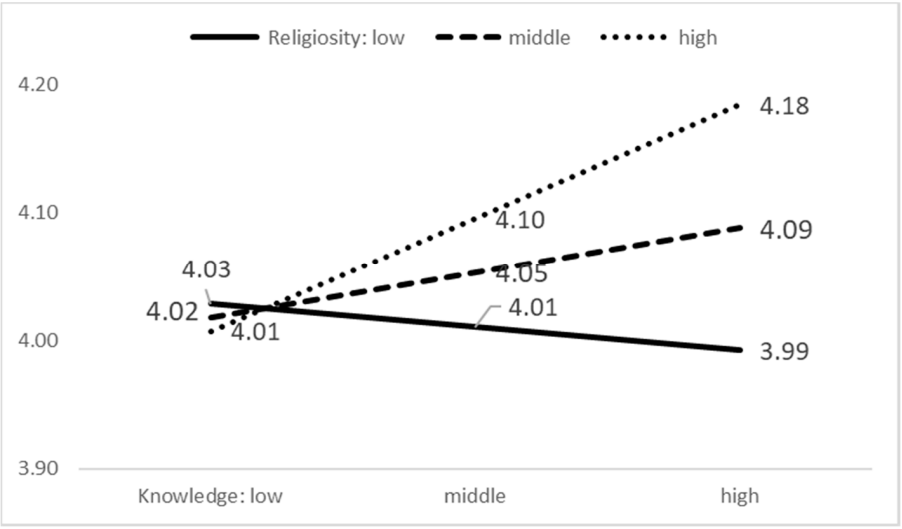

Figure 10. Knowledge (IV) × religiosity (M) = skepticism (DV).

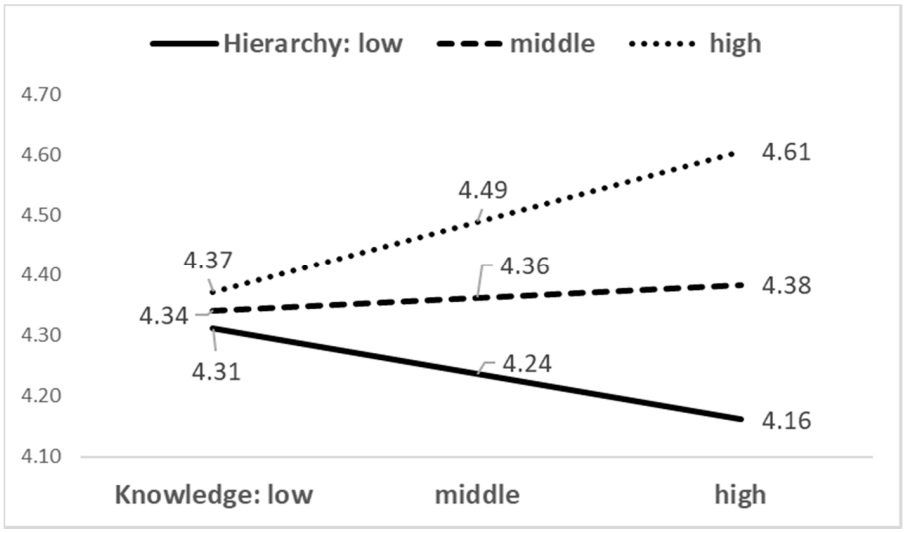

Figure 11. Knowledge (IV) × hierarchy (M) = skepticism (DV).

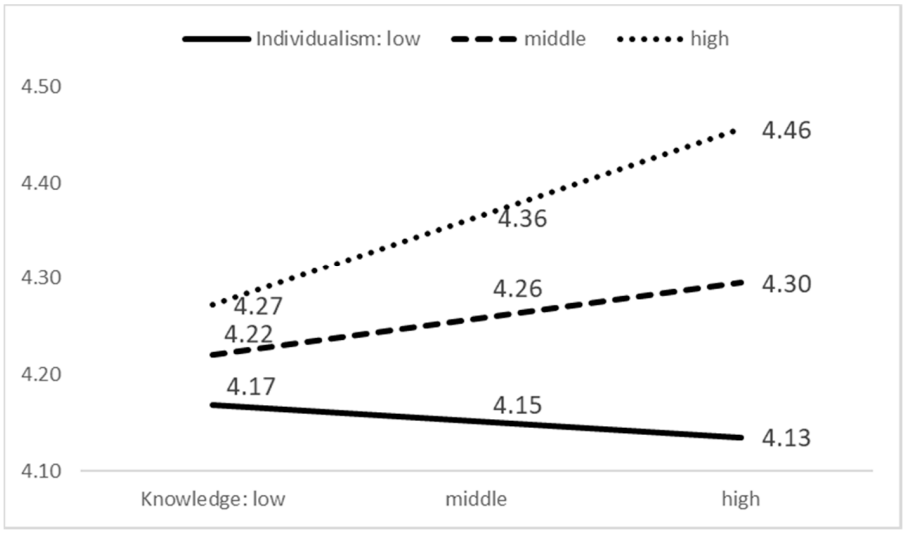

Figure 12. Knowledge (IV) × individualism (M) = skepticism (DV).

5. Summary and Implications

Our study examined which factors influence climate change skepticism. This study included both perception and values as independent variables and incorporated many insights from the climate change literature. This study proposed and tested the causal model of climate change skepticism, concerning both the direct and indirect causal processes. The findings clearly showed the determinants and moderators for climate change skepticism.

Firstly, simple percentage and mean analyses showed that a larger proportion of samples agreed with climate change from 51.2% to 67.6%. On the other hand, very few respondents (13.3% to 5.5%) were unsure about climate change. Although there were a relatively lower number of skeptics, quite a few people (39.8% to 26.9%) assumed a neutral position. It is true that skeptics exist in Korea, even if their number is smaller.

Secondly, the regression results showed which variables had a significant impact on skepticism. Religiosity, hierarchy, and individualism had positive impacts on skepticism, whereas age, income, ideology, environmentalism, perceived risk, perceived benefit, and negative image had negative impacts. However, gender, education level, and social class did not have significant impacts on skepticism. Also, egalitarianism in value factors and trust and knowledge in perception factors

appeared to have no significant effect. The lack of an effect of knowledge on skepticism implied that the attempts to increase literacy about climate change may be ineffective.

Thirdly, in terms of the variable explanation power, hierarchy had the largest impact on climate change skepticism, followed by negative affect, individualism, and perceived risk. This implies that skepticism is a mixed byproduct of values and perceptions. In a separate model, the perception factors explained more variance than sociodemographic or value factors.

Finally, in exploring the moderating effect of values factors, we observed the significant role of ideology, environmentalism, and religiosity, with three cultural biases as moderators. They facilitated, buffered, and changed the impact of psychometric variables on skepticism. The perceived risks and benefits decreased skepticism when religiosity and individualism were significant. Knowledge increased skepticism when religiosity, hierarchy, and individualism became stronger. Moreover, the effect of trust and negative affect on skepticism depended on values; negative affect reduced skepticism, in particular, under low levels of egalitarianism. Wolf et al. [31] showed that different values dictate how the intangible and subjective effects of climate variability and change are felt. Our studies demonstrated that the effect of perception factors on climate change depended on values such as ideology, religiosity, and cultural bias.

Our studies provide a new theoretical understanding of skepticism in three important ways. Firstly, we provided insights into the underlying determinant structure of skepticism by differentiating between values and perception factors and by exploring the former's moderating role between the latter and skepticism. Secondly, since relatively few studies focused on the impact of values, our research contributes to specifying the direct and indirect role of values. Sjöberg [32] argued that the role of values in risk perception is not explored and that more relevant value structures need to be identified. In particular, we highlighted the specified role of values that influence skepticism, in terms of both direct and indirect routes. Thirdly, this study provided new empirical evidence of three variables—cultural bias, S&T optimism, and negative affect—in the domain of risk perception of climate change. They were not frequently tested in empirical studies, although there were extensive theoretical discussions.

Such theoretical findings provide practical implications for public policy related with climate change. Löschel et al. [70] showed that 85% of survey respondents in Germany support the idea that climate change poses serious threats to future generations. However, half of the sample was not willing to pay any cost for climate change mitigation. It seems that an underlying skepticism may be fueling their unwillingness.

Our findings suggest the need for communication strategies to differentiate the content by reflecting diverse values and perceptions. Merely providing more information is not sufficient to persuade the public to adapt and support mitigation policies against climate change. Messages should be tailored to particular public values and perceptions. Poortinga et al. [11] (p. 1022) explained that simply providing climate change information is unlikely to be successful, as new information is often interpreted by people in alignment with their existing attitudes and worldviews. Therefore, those communicating the messages must differentiate them according to these diverse values [10]. Moreover, policy-makers should give priority to values over perceptions, since the first has greater influence than the second.

Furthermore, it is necessary to consider not only instrument of communication but also time for persuasion. There is a limit to changing values in a short period of time because values have fundamental characteristics such as deep belief. This suggests that an incremental strategy is needed for persuading value change.

Moreover, while various values affect skepticism, the degree of likelihood of change is different. It is not easy to change ideology and religion because they are fundamental. However, compared with these ideals, S&T optimism is likely to change through the diffusion of scientific and technological knowledge. Strategies that enhance scientific literacy can be a means of overcoming climate change skepticism.

Lastly, it is easy to change perception rather than values. To increase perceived risks and benefits, it is necessary to emphasize that active responding to climate change is a better means of reducing risk and increasing benefits. Negative emotions play an important role in the judgment process. Therefore, it is a strategy to provide positive "image information" to the public in order to turn negative images into positive ones by mobilizing vivid, realistic, impressive media contents.

Our study cannot answer all questions regarding climate change skepticism. We know the limitations of this study and propose several ideas for future research. Firstly, this study was based on cross-sectional data from one point in time. Such data cannot show the dynamics of attitude change. Therefore, it has limits in terms of generalizing the findings. This implies the necessity of implementing a study based on longitudinal data in the future. Secondly, although climate change skepticism has multiple dimensions, our study depended on one dimension. In future studies, more questions are needed to capture individuals' attitudinal positions within the multiple dimensions of skepticism. Akter et al. [12] demonstrated that the different dimensions of climate skepticism are interrelated, as significant overlaps were identified among skeptics' beliefs. Thirdly, according to Tranter and Booth [28], there are variations by country regarding climate change skepticism. Moreover, objective conditions such as CO_2 emissions and vulnerability to climate change have close connections with skepticism. Therefore, the focus must be on the connection between subjective perception and objective conditions under which people judge climate change. Clearly, more research is needed to address these limitations in the future. Fourthly, this study did not aim to test the hypotheses because there were very few studies that established relationships between values and skepticism. Our studies explored the relationships between them in moderation, which is a further limitation. Lastly, previous studies showed that attitudes to climate change vary depending on the type of religion. For example, according to Morrison et al. [71], there are differences in attitude and behavior between religious groups. In this study, we were forced to use the concept of religiosity because we could not measure religion type, which is another limitation of this study. However, in Korean society, interest in environmental issues is a common denominator beyond religious sects. For example, Buddhists and Christians participated in the opposition movement against the Saemangeum development project.

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Appendix A

Table A1. Analysis of interaction effect and simple slope test.

Perceived risk (IV) × Religiosity (M) = Skepticism (DV)							**Perceived risk (IV) × Individualism (M) = Skepticism (DV)**						
	B	SE	beta	B	SE	beta		B	SE	beta	B	SE	beta
Perceived risk	−0.144 ***	0.045	−0.152	−0.136 **	0.045	−0.144	Perceived risk	−0.144 ***	0.045	−0.152	−0.138 **	0.045	−0.146
Religiosity	0.040 *	0.019	0.068	0.033	0.02	0.056	Individualism	0.141 ***	0.032	0.164	0.137 ***	0.031	0.16
Interaction rerm				0.050*	0.023	0.066	Interaction Term				0.00 **	0.034	0.091
F-value	24.111 ***			23.141 ***			F-value	24.111 ***			23.521 ***		
R^2	0.371			0.375			R^2 square	0.371			0.379		
R^2 change	0.355			0.359			R^2 square Change	0.355			0.362		
Simple slope test	Law	B = −0.195 *** se = 0.057 t = −3.456					Simple Slope Test	Law	B = −0.220 *** se = 0.051 t = −4.278				
	Middle	B = −0.136 *** se = 0.448 t = −3.039						Middle	B = −0.138 *** se = 0.045 t = −3.068				
	High	B = −0.077 se = 0.060 t = −1.274						High	B = −0.056 *** se = 0.054 t = −1.055				
Effect size	0.004						Effect Size	0.008					
Perceived benefit (IV) × Individualism (M) = Skepticism (DV)							**Trust (IV) × Ideology (M) = Skepticism (DV)**						
	B	SE	beta	B	SE	beta		B	SE	beta	B	SE	beta
Perceived benefit	−0.094 *	0.038	−0.099	−0.096 *	0.037	−0.099	Trust	0.006	0.039	0.005	0.004	0.039	0.004
Individualism	0.141 ***	0.032	0.164	0.138 ***	0.032	0.16	Ideology	−0.03 *	0.013	−0.079	−0.029 *	0.013	−0.078
Interaction term	–			0.100 **	0.034	0.088	Interaction Term	-			−0.043 *	0.018	−0.074
F-value	24.111 ***			23.477 ***			F-value	24.111 ***			23.255 ***		
R^2	0.371			0.378			R^2 square	0.371			0.376		
R^2 change	0.355			0.362			R^2 square Change	0.355			0.36		
Simple slope test	Law	B = −0.178 *** se = 0.042 t = −4.203					Simple Slope Test	Law	B = 0.030 se = 0.041 t = 0.729				
	Middle	B = −0.096 *** se = 0.032 t = −2.982						Middle	B = 0.004 se = 0.040 t = 0.102				
	High	B = −0.014 se = 0.042 t = −0.342						High	B = −0.022 se = 0.041 t = −0.527				
Effect size	0.007						Effect Size	0.005					

Table A1. *Cont.*

Trust (IV) × Environmentalism (M) = Skepticism (DV)						
	B	SE	beta	B	SE	beta
Trust	0.006	0.039	0.005	−0.012	0.04	−0.01
Environmentalism	−0.149 ***	0.039	−0.139	−0.155 ***	0.039	−0.146
Interaction term				0.101 *	0.049	0.064
F-value	24.111 ***			23.111 ***		
R^2	0.371			0.374		
R^2 change	0.355			0.358		
Simple slope test	Law	B = −0.078 se = 0.055 t = −1.479				
	Middle	B = −0.012 se = 0.045 t = −0.267				
	High	B = 0.054 se = 0.055 t = −1.418				
Effect size	0.003					

Negative affect (IV) × Egalitarianism (M) = Skepticism (DV)						
	B	SE	beta	B	SE	beta
Negative affect	−0.227 ***	0.046	−0.242	−0.227 ***	0.046	−0.241
Egalitarianism	−0.014	0.026	−0.018	−0.019	0.026	−0.024
Interaction Term	–			0.063 *	0.028	0.07
F-value	24.111′***			23.188 ***		
R^2 square	0.371			0.375		
R^2 square Change	0.355			0.359		
Simple Slope Test	Law	B = −0.283 *** se = 0.053 t = −5.368				
	Middle	B = −0.227 *** se = 0.0456 t = −4.982				
	High	B = −0.171 *** se = 0.053 t = −3.222				
Effect Size	0.004					

Knowledge (IV) × Religiosity (M) = Skepticism (DV)						
	B	SE	beta	B	SE	beta
Knowledge	0.047	0.034	0.047	0.05	0.033	0.051
Religiosity	0.040 *	0.019	0.068	0.036	0.019	0.061
Interaction term				0.064 **	0.024	0.083
F-value	24.111 ***			23.390 ***		
R^2	0.371			0.377		
R^2 change	0.355			0.361		
Simple slope test	Law	B = −0.026 se = 0.041 t = −0.627				
	Middle	B = 0.05 se = 0.032 t = 1.582				
	High	B = 0.126 *** se = 0.043 t = 2.923				
Effect size	0.006					

Knowledge (IV) × Hierarchy (M) = Skepticism (DV)						
	B	SE	beta	B	SE	beta
Knowledge	0.047	0.034	0.047	0.03	0.033	0.03
Hierarchy	0.159 ***	0.027	0.202	0.143 ***	0.027	0.181
Interaction Term				0.155 ***	0.03	0.157
F-value	24.111 ***			25.063 ***		
R^2 square	0.371			0.394		
R^2 square Change	0.355			0.378		
Simple Slope Test	Law	B = −0.107 ** se = 0.032 t = −2.419				
	Middle	B = 0.03 se = 0.032 t = 0.933				
	High	B = 0.167 *** se = 0.040 t = 4.170				
Effect Size	0.020					

Knowledge (IV) × Individualism (M) = Skepticism (DV)						
	B	SE	beta	B	SE	beta
Knowledge	0.047	0.034	0.047	0.053	0.034	0.054
Individualism	0.141 ***	0.032	0.164	0.130 ***	0.032	0.152
Interaction term	-			0.095 **	0.033	0.09
F-value	24.111 ***			23.493 ***		
R^2	0.371			0.378		
R^2 change	0.355			0.362		
Simple slope test	Law	B = 0.024 se = 0.040 t = −0.613				
	Middle	B = 0.053 se = 0.032 t = 1.678				
	High	B = 0.130 *** se = 0.043 t = 3.053				
Effect size	0.007					

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$. IV—independent variable; M—moderator; DV—dependent variable.

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