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Air pollution in Northeast Asia: can framing of public messages influence beliefs and attributions?

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ABSTRACT

Public support for any policy is often influenced by communications highlighting aspects of it – such as a policy's perceived "costs" or "benefits" to people. This paper tests for these attitudinal differences as they relate to the transboundary air pollution problem in South Korea where cross-national coordination efforts among China, South Korea, and Japan have done little to alleviate the problem. We conduct an emphasis framing experiment launched in mid-2019, testing whether the importance of cooperation with China decreases or increases with exposure to different frames, such as Korea working alone to address the problem or Korea and China working together. While the message frames utilised in our study did not show a powerful direct impact on respondents, a secondary analysis reveals differences across pre-existing beliefs and attitudes. For Korean policy makers to effectively respond to both domestic and foreign demands related to the air pollution problem in Northeast Asia, there must be acknowledgement of this variance throughout the policy making process. This study thus highlights a tension for policy makers: trying to shift public beliefs through specific messages or allowing change in policy design by engaging the public in a more bottom-up deliberative approach.

Introduction

The prospect for a policy to be implemented increases with a requisite amount of support from the public and given politicians' responsiveness to the public's issue priorities and policy preferences (Jones & Baumgartner, 2004; Page et al., 1983; Soroka & Wlezien, 2011). However, public support for any policy can be influenced by the presence of new information regarding strategies and outcomes, and sub-populations of public are motivated by pre-existing beliefs (Bickerstaff, 2004; Druckman, 2015). This requires policy makers to be attuned to the dual effects of new information and to understand how this new information is moderated by an individual's characteristics, such as education level, partisanship, and existing knowledge about the issue area. To be explicit, we make a call here for a better understanding of how public administrators and other elites lead but also follow the public. Top-down approaches – i.e., elite-led approaches – do not

readily align with the deliberative and consensus-building processes that we see manifesting in Korea.

In the spirit of existing research targeting Asia-specific findings with regard to the effectiveness of select policy instruments (B. Cho & Moon, 2019; Smith, 2000), the present article attempts to show how this works in practice, focusing on the sources and solutions relating to air pollution in South Korea (henceforth, "Korea"), which the public views as extremely salient. According to a recent report, the foreign influence of particulate matter on Korea is estimated to usually be around 30–50% and, in the case of certain urban areas, around 60–80% (NCCA, 2020). Therefore, the estimation of particulate matter inflow from China remains unclear, making it all the more difficult to solve the particulate matter problem. Solutions need to be multifaceted, addressing domestic contributions to air pollution, transboundary air pollution from China, and attempts to coordinate internationally to resolve the issue. To assess the public's understanding of the problem in light of these possible solutions, we use framing analysis, assuming that the public's beliefs can be affected in different ways given their exposure to select information.

We find that, when exposed to select frames about air pollution, Koreans have unchanging, strong beliefs regarding the need to coordinate with China to address the air pollution problem. While there are no main effects from the framing experiment, we explore differences across beliefs and attitudes relevant for the air pollution policy making process. Such differences illustrate how segments of the public may need tailored and strong frames to shift their attitudes in light of these prior beliefs. Yet, we suggest that greater efforts also be made to understand the motivations behind these pre-existing beliefs. In other words, policy makers must design these policies in consultation with the general public about how Korea should coordinate with China where Korean agency is appropriate, and whether technological solutions should be used. Fortunately, this is the manner currently used by the Korean government to address the air pollution problem.

We proceed by first highlighting how the public's attribution of responsibility to China has overwhelmed efforts for Korea-China coordination and collaboration. We then describe the Korean government's efforts to understand these beliefs of the public, albeit with marginal success. Assuming that an information campaign may overcome the public's strong beliefs about transboundary air pollution, we then present a framing experiment, which allows us to recognise how specific information yields direct effects on people's attitudes and beliefs. This is coupled with a secondary analysis of our survey data to examine other motivations surrounding the need, or lack thereof, to coordinate with China. These findings are ultimately distilled into a recommendation for continued efforts by the Korean government to balance both the domestic and international policy making with regard to air pollution.

International coordination, pre-existing beliefs, and communication innovations

Our understanding of how communications affect the Korean public's response to the air pollution problem is rooted in two primary, seemingly incompatible domains. The first is embodied in coordination efforts between Korea and China to address the transboundary air pollution problem in Northeast Asia, a problem centring in China (Lane, 2009; Lane & Maeland, 2008). The second is reflected in Korea's domestic political environment, which

attributes much of the air pollution problem to China. In this context, it is all the more remarkable that the Korean government has taken steps to bridge these two domains by focusing on the specific concerns, pre-existing beliefs, and behaviours of the Korean public across the entire spectrum of the air pollution problem.

The option for international cooperation in Northeast Asia

Efforts to coordinate between Korea and China to address the air pollution problem span more than 30 years. This coincides with the need for better environmental institutions in China (Balme & Renwu, 2014) and the need to understand how these institutions might arise domestically (Turiel et al., 2017) or cross-regionally (Mukherjee & Howlett, 2015). Yet, political rivalries among the Northeast Asian countries are the primary reason for the lack of successful coordination thus far (I. Kim, 2007; Otsuka, 2018; Shim, 2017; Yoshimatsu, 2016). In response, in Korea, former UN Secretary-General Ban Ki-moon was elected chairman of an effort to increase coordination efforts across the Northeast Asian region with regard to air pollution (Han, 2019; N. Kim, 2019; J. Lee, 2019). Ban has insisted that the most rational way to solve the air pollution problem is through cooperation with China. He also argues that Korea should reduce its domestic air pollution levels while engaging in diplomatic efforts with China. This has started to bear fruit: the two countries established a policy council comprised of high-level officials to address the problem, which has facilitated multilateral consultations between Korea and China. It is expected that the council will expand to include North Korea, Japan, and Russia.

Perhaps these efforts will result in an international Northeast Asian environmental treaty that relies on better scientific methods to identify the source of pollution, which would then provide the impetus for China to more actively address the problem (Kwon, 2019). The effectiveness of such a treaty would be reflected in Europe's Convention on Long-Range Transboundary Air Pollution. In that case, the Scandinavian countries used the Convention to bind France, Germany, and England to agreements that required the reduction of polluting activities. Northeast Asian efforts to create an analogue to the Convention would build on existing regional institutions[1]; in particular, the Northeast Asia Subregional Programme for Environmental Cooperation has focused on the mitigation of transboundary air pollution and other concerns related to transboundary environmental conservation and protection (Shapiro, 2014). In spite of China's traditional reluctance to share significant portions of its air pollution-related data (Brettell, 2007), capacity-building efforts regarding the Northeast Asia Subregional Program for Environmental Cooperation have been accompanied by emissions monitoring and data sharing through the Northeast Asian Training Center for Pollution Reduction in Coal-fired Power Plants and the North East Asian Center of Environmental Data Training (Shapiro, 2014).

These efforts do not preclude Korea from cooperating with countries beyond the Northeast Asian region to find a solution to the air pollution problem, such as Sweden and the United States (Go, 2019; Y. Lee, 2019). Local governments, such as Seoul, have also taken the initiative to seek international cooperation on its own (J. Kim, 2019), and North Korea has become a major source of air pollution (Yonhap News, 2021), raising the possibility of North-South air pollution-related coordination. All of these efforts indicate that while China continues to be blamed for Korea's air pollution, international cooperation with China and other neighbouring countries and adherence to international law are

becoming increasingly viable policy and legal options. Simultaneously, efforts to engage in R&D collaboration among the Northeast Asian countries produce varying research emphases depending on whether Chinese researchers are collaborating with Korean or Japanese researchers, or whether the research is being funded by Chinese, Korean, or Japanese institutions (Shapiro & Yarime, 2021).

Korean politics and public opinion about air pollution

In terms of the specific views of Koreans towards air pollution, there are in fact three separate publics engaged with the air pollution problem. A cluster analysis with 1,010 Korean samples resulted in three distinctive public clusters: "china attributing," "risk optimistic," and "risk indulgent." The first cluster attributes air pollution to China and largely misunderstands how air pollution is caused. The second is generally risk-optimistic, having experienced few health consequences from air pollution. Finally, the third is concerned about the air pollution problem but does not have as much knowledge as people in the other two clusters (Kim, Lee, Jang et al., 2016).[2] We will dwell in particular on the first of these.

To be clear, beliefs regarding air pollution are driven primarily by the blame-China narrative, with many Koreans continuing to focus their attention on China as the source of Korea's air pollution problem. This correlates with the belief that the Korean government should refrain from domestic-only solutions and make stronger demands of China. For example, in March 2019, 56.7% of respondents (n = 1,016) to a survey commissioned by Korea's *The Dailian News* said that the government should ask China to take full responsibility for air pollution. In the aggregate, 50% of people support a more aggressive response by the Korean government. This number is higher for conservatives (61.5%) and moderate conservatives (61.0%) (Y. Cho, 2019).

While we acknowledge that there are a host of factors impacting how people attribute blame for policy failures and shortcomings, including one's political sophistication and science literacy,[3] we assume that Koreans' beliefs about air pollution are primarily a function of how the media reports on the issue of air pollution (Shapiro, 2016; Shapiro & Bolsen, 2018). An analysis of media content indicates that 62.5% of articles invoked the China-cause frame, while 32% mentioned other causes, such as the use of fossil fuels (Kim, Lee, Jang et al., 2015). In terms of how this type of reporting impacts Koreans' views towards China, we should also note that people identified solutions based on whether they attributed the pollution to Chinese sources (Kim, Lee, Lee et al., 2015). These differences were aligned with the political stances of specific media outlets: conservative media, such as *Chosun Ilbo, Joongang Ilbo*, and *Dong-a Ilbo*, focused more on Chinese sources, while progressive media, such as the *Hankyoreh* and *Kyunghyang* newspapers, emphasised alternative sources as well as the need for institutional and policy responses (Kim, Lee, Jang et al., 2015).

In terms of cross-national coordination prospects, conservatives tend both to criticise the absence of diplomatic efforts by the Korean government and attribute local air pollution to China (Bae, 2017). Progressives, on the other hand, focus on domestic problems. Further, research has identified possible connections among attribution of blame, information seeking behaviours, and policy prioritisation. Specifically, people who attribute Korea's pollution to China engaged in information seeking behaviours

but, most likely due to their inability to properly synthesise this information, remained ambivalent towards air pollution reduction policies (Kim, Lee, Jang et al., 2016; Kim, Lee, Lee et al., 2016). In other words, the more a person blames China for particulate matter pollution, the less one will actively try to reduce particulate matter pollution.

Unique air pollution-related communication in Korea

Motivating individuals to respond appropriately to air pollution-related announcements continues to be difficult (D'Antoni et al., 2017). People also remain uninformed about the sources of information about air pollution; vulnerable populations are entirely excluded from this information communication channel (Ramirez et al., 2019). In Korea, air pollution policies are similarly complex and easily conflated with the blame-China narrative, and agendas differ between conservatives and progressive regarding how to deal with the problem, which we discussed earlier.

Under these circumstances, it is noteworthy that, under the direct control of the President, the Korean government launched the National Council on Climate and Air Quality in April 2019. The National Council organises a process of proposing national policies through the national policy deliberation group as a means of increasing public participation in the process. The principles of open and unrestricted discussions provide the framework under which the entire process operates. Regarding Korean air pollution, a representative sample of the Korean public ($n = 501$) listened to experts discuss the various policy alternatives to address the air pollution. This national policy deliberation group also spent considerable time deliberating and debating with each other (National Council on Climate and Air Quality, 2019).

Through this process, a total of eight policy proposals were prepared by the national policy deliberation group to resolve the air pollution problem. The main contents of these proposals include the crackdown and support for the reduction of emissions in the industrial sector, a seasonal management system that can reduce air pollution in the power generation sector, restrictions on the operation of old vehicles in the transportation sector, and strengthened partnerships with China to jointly cope with the problem of Northeast Asian air pollution. Again, the national policy deliberation group developed these policy proposals strictly through consensus building. In other words, the policy proposal process to address the air pollution problem integrates multiple publics as well as coordinates across these publics through a bottom-up policy proposal process (National Council on Climate and Air Quality, 2019).

Materials and methods

This study proceeds in two stages. In Stage 1, we conduct a framing experiment to assess whether different emphasis frames significantly alter the extent to which Koreans prioritise coordination between Korea and China. In Stage 2, we examine the effects of beliefs, behaviours, and political affiliation on people's views towards Korea-China collaboration as well as views towards a technology-oriented solution for Korea's air pollution problem. With this two-stage approach, we are able to go beyond simply answering whether top-down communications from the media are able to shift beliefs about the air pollution problem. With both stages of analysis, we are also able to examine at an exploratory level

how other factors are predictive of the attitudes and behaviours that contribute to the deliberative and consensus-building processes in Korea on the topic of air pollution.

Emphasis framing and the role of prior beliefs

Ignoring the bottom-up policy proposal-related innovations described above, let us assume for the moment that air pollution-related communications flow in a top-down fashion – from policy makers and experts to the general public (Bickerstaff, 2004). For example, as air pollution increases in the springtime, there may be fine dust advisories posted by the Ministry of the Environment (Yonhap News, 2021), there may be statements from the medical community regarding the health-related consequences of air pollution (Koh, 2021), and there may be statements from the Ministry of Science and ICT regarding updated satellite data indicating that China is responsible in part for Korea's air pollution (Yonhap News, 2020). These sorts of communications are often transferred through media-based content, producing effects consistent with Framing Theory: emphasis framing effects occur when communicators use framing devices such as words and phrases causing an audience to privilege targeted considerations as they form their opinions (Chong & Druckman, 2007a; Druckman, 2001). There has been an enormous literature examining how these effects arise and impact individuals' attitudes, actions, and beliefs (Druckman, 2011; Entman, 1993; Goffman, 1974). In terms of Korea's air pollution, media-based frames improve individuals' understanding of the problem, followed by even greater acceptance of (1) the importance of a particular problem, (2) the attribution of responsibility assigned to China as the source of pollution, or (3) a particular policy response (Shapiro & Bolsen, 2019).

To better examine how unilateral assignment of blame may thwart efforts to establish a cooperative relationship with China, we conduct an emphasis framing experiment using a representative sample of the Seoul public. Seoul is the political, economic and cultural centre of Korea, and half of Korea's population lives in the metropolitan area. Most of the population of Seoul has emigrated there from each of Korea's provinces, so the distribution of the population is similar to that of the entire country. In addition, given that the observation data related to particulate matter are organised around Seoul, Seoul's population may serve as a barometer for the entire population of Korea. Specifically, we test for whether beliefs about the importance of cooperation with China decrease or increase when people are exposed to different messages, such as Korea working alone to address the problem or Korea and China working together to address the problem. To reiterate, the aggregate data suggests that there are framing effects from the media; we investigate this at the micro-level by testing the effect of different frames. These frames are based on a manufactured news article from the Korean Newswire, *Yonhap News*, and are presented in Table 1.

Given that framing theory claims that an individual's exposure to a single frame may shift opinion in the direction of the frame, competitive (or "combination") frames include directionally opposing frames of equal strength, cancelling each other out and leaving an individual's opinion unchanged (Chong & Druckman, 2007a). When frames of unequal strength are placed in opposition to each other in a competitive context, stronger frames dominate over weaker ones, and shifts in opinion are expected to reflect the stronger frame (Chong & Druckman, 2007b, 2010). Again, with regard to air pollution problems in

Table 1. Media-based frames focusing on transboundary air pollution.

Korea-alone frame	Korea-with-China frame	Combination frame
"Korea Must Work Alone to Fix Air Pollution" -Yonhap News- Korea has the ability to solve its own air pollution problem without relying on other countries. Korea has remarkable levels of technology, scientists, and funding. Alone, Korea will be able to do an excellent job fixing the air pollution problem.	"Korea Must Work with China to Fix Air Pollution" -Yonhap News- Korea must work with China to solve the air pollution problem facing both countries. Together, both countries have remarkable levels of technology, scientists, and funding. Together, Korea and China will be able to do an excellent job fixing the air pollution problem.	"Debating Whether Korea Must Work Alone or with China to Fix Air Pollution" [Combination of "Korea alone" and "Korea with China"]
"한국은 대기오염 문제를 단독적으로 해결해야 한다" -연합뉴스- 한국은 타국에 의존하지 않고 대기오염 문제를 해결할 능력을 소유하고 있다. 한국은 주목할 만한 수준의 기술과 과학자들 그리고 자금을 보유하고 있다. 이점은 한국이 단독적으로 대기오염 문제를 탁월하게 해결할 수 있다는 것을 의미한다.	"한국은 대기오염 문제 해결을 위해 중국과 협력해야 한다" -연합뉴스- 한국은 양국이 직면하고 있는 대기오염 문제 해결을 위해 중국과 협력해야 한다. 한국과 중국은 합동 적으로 주목할 만한 수준의 기술과 과학자들 그리고 자금을 보유하고 있다. 이점은 한국과 중국이 대기오염 문제를 탁월하게 협력적으로 해결할 수 있다는 것을 의미한다.	"대기오염 문제를 한국이 단독적으로 해결해야 하는지 혹은 중국과 협력적으로 해결해야 하는지에 대한 논쟁"

Korea, existing research shows that, in terms of Koreans' preferences for more coal use, frames competitively communicating the benefits of coal (lower expenses) are stronger than frames communicating the costs of coal (negative health consequences) (Shapiro & Bolsen, 2019).

Initially, in Stage 1 of our analysis, we use a single dependent variable measuring the importance Koreans place on cooperating with China. Specifically, respondents were asked the following: "How important is it for Korea to cooperate with China in order to fix the air pollution problem?" With this 7-point scaled outcome measure,[4] and in light of the extant Korea-specific framing-related research, the following three hypotheses are offered:

H1: The importance of cooperation with China decreases with exposure to a Korea-alone frame.

H2: The importance of cooperation with China increases with exposure to a Korea-and-China frame.

H3: The importance of cooperation with China remains unchanged with exposure to a competitive frame.

Given that Koreans attribute a significant amount of their air pollution to Chinese origins and given that there are a host of initiatives to foster greater levels of collaboration between Korea and China, an assessment of the effects of the frames from Table 1 will verify whether media-based top-down communications from the media shift respondents' beliefs.

Recognising the strength of pre-existing beliefs and behaviours, in Stage 2, we shift our interest to an examination of their influence on key matters relating to Korean air pollution. We consider the following research question:

RQ: How do pollution-related beliefs and behaviours affect specific attitudes about how to address the air pollution problem?

The following 7-point scaled measures, included in full detail in the Appendix A, are expected to influence views regarding the importance of Korea working with China to address the air pollution problem: two measures of pollution-related beliefs ("When you think about the air pollution problem in Korea, how concerned are you about its effects?" and "To reduce air pollution, to what extent is it necessary for electricity in Korea to be produced by clean energy sources?"), two measures of pollution-related behaviours ("To what extent is the success of air pollution policies important when you vote for politicians, including the President?" and "Which of the following contribute to air pollution? [check all that apply]? carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), PM2.5, sulphur dioxides), and a measure of political affiliation. Demographic controls (income, education level, age, and gender) were included given variance in the health-related aspects of air pollution across age and level of education, among others (M. Kim et al., 2012).

We also subscribe to the view that a comprehensive environmental policy incorporates science and technology innovations to reduce pollution (Fischer & Newell, 2008; Jaffe et al., 2003; Johnstone et al., 2010; OECD, 2009). We include in Stage 2 a second 7-point scaled dependent measure that assesses the public's views towards prioritising domestic R&D funding to address air pollution: "To what extent do you disagree or agree that the Korean government should increase research funding to reduce the impacts from air pollution?" This is based on claims that transnational interdependence, as articulated in Keohane and Nye (1989), and the need for cross-national epistemic communities of researchers and scientists, as explained in Haas (1990), are fundamental for a successful treatment of the air pollution problem in Northeast Asia. These are fundamental constructs for the diplomatic efforts Ban Ki-moon is currently attempting, and they have been described in Shapiro (2014) as physical transfers of scientists and researchers between countries as well as knowledge flows, technology transfers, and collaborative research efforts. In Northeast Asia, institutions currently exist to promote the production of technologies that can reduce greenhouse gases among other pollutants, such as the Asia Pacific Partnership on Clean Development and Climate (Shapiro, 2014).[5]

Data collection

This study is based on a survey experiment of a nationally representative sample of the Korean population administered by the Korean web survey agency, Macromilll-Embrain, Inc. ("Embrain"). Embrain recruits respondents via computer-telephony integration/random digit dialling, voluntary registration on Embrain's panel site, word of mouth, or banner advertisements on portal sites. An individual first requests to be a panel member for Embrain, followed by an email sent from Embrain's Panel Management Team to request additional information to confirm the potential panel member's email. To finally

confirm that the requesting individual is who they say they are, an Embrain Panel Management Team member contacts the individual via telephone to ensure heads of households are registering.[6] To limit bias and focus solely on a representative sample of the country's largest metropolis, we took a quota sample based on Seoul Metropolitan Area residency as well as gender and age distributions consistent with Seoul-based representative samples, determined by population data from the Ministry of Government Administration and Home Affairs statistical database.

In mid-2019, 605 individuals were randomly assigned to one of four conditions: control ($n = 152$), Korea-work-alone ($n = 151$), Korean-work-with-China ($n = 151$), and a combination frame ($n = 151$). To eliminate systematic bias from the sample, respondents were randomly assigned to one of two possible frames-in-combination treatments: half were assigned to a treatment that presented the Korea-alone before the Korea-with-China information, while the other half were assigned to a treatment that reversed the order of information (i.e., Korea-works-with-China and then Korea-works-alone). In terms of structure, as a feature of the sampling/filtering process, respondents first provided responses to questions about their gender and age as well as a question confirming their residency in Seoul. This was followed by questions that addressed the following topics: concern about pollution, the need for clean energy, and whether air pollution was prioritised when they voted. Respondents then read one of the vignettes outlined in Table 1, or none at all if they had been assigned to the control group. After reading the vignettes, respondents answered questions to gauge the importance they placed on Korea cooperating with China as well as the need for the Korean government to increase air pollution-related R&D. Respondents' knowledge of air pollution was assessed after this, and measures for income, political party affiliation, and education were collected at the very end of the survey.

Results

Stage 1 – main effects

The main effects of the Stage 1 framing experiment are presented in Figure 1 graphically with conditional means and 95% confidence intervals of the importance of cooperation with China for the control group ($\bar{x} = 6.020, \sigma = 1.058$), the Korea-work-alone group ($\bar{x} = 5.861, \sigma = 1.090$), the Korean-work-with-China group ($\bar{x} = 5.980, \sigma = 0.090$), and the combination group ($\bar{x} = 6.113, \sigma = 0.086$).[7] We observe that the messages, counter to our expectations, had little effect on respondents' beliefs: the effects of the Korea-work-alone frame and the Korea-work-with-China frame are neither significantly different from each other nor are they significantly different from the control group. That said, the movement in attitudes towards Korea working with China are in the expected directions. That is, relative to the control, those exposed to the Korea-work-alone frame experience a decrease in importance of working with China. And, while the Korea-work-with-China frame experiences no movement away from the control group, individuals exposed to that treatment assign greater importance of working with China compared to the Korea-work-alone group. Again, these differences are marginal but non-significant.

Regarding H3 and its claim that the competitive frame will produce no significant change from the control because individual effects (in the competitive frame) will cancel
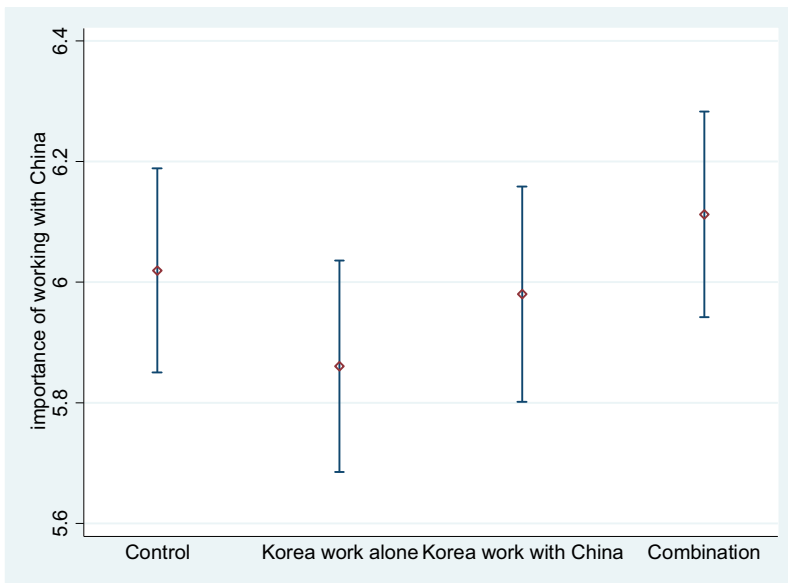
Figure 1. Treatment effects on importance of working with China. Dots represent group means, and error bars represent a 95% confidence interval.

each other out, we could argue that the hypothesis was accepted. There is potentially some effect of the rhetoric. Yet, our conclusions regarding this hypothesis are intended to reflect, relative to the control, a broader pattern of negative (H1) and positive (H2) changes in views towards collaboration with China. In sum, most likely because of the salience of the issue, we did not find that a single-shot exposure to a short news release communicating the need for cooperation with China had any impact on shifting respondents' beliefs on this issue. Frames – at least those we constructed – were not sufficiently strong to move these attitudes given the salience of the issue and/or as a result of the strength of people's existing beliefs. Additionally, we conducted exploratory moderation analysis to examine sub-population dynamics but did not find any significant interactions.

Stage 2 – beyond main effects – beliefs, behaviours, and political affiliation

In spite of the absence of main effects explaining the importance of Korea working with China, we turn now to other factors that could explain and shape people's attitudes towards coordination. Presented in Table 2 are descriptive statistics for these measures as well as the descriptive statistics for both Stage 2 dependent variables.[8] Based on these results, we observe strong pre-existing pollution-related beliefs, and we also see that the largest proportion of political affiliations are actually those who are non-affiliated. Only 10% of our sample represents individuals from Korea's conservative political parties, an imbalance of our dataset that unfortunately precludes deep cross-party comparisons.[9]

Presented in columns 1 and 2 of Table 3 are the respective linear regressions of the two dependent variables – views regarding the importance of China's cooperation and views regarding the need for more R&D funding – on pollution-related beliefs, pollution-related behaviours, political affiliation, and demographic variables. We find that pollution-related

Table 2. Descriptive statistics for Stage 2 variables.

	Mean	Standard deviation	Min.	Max.
Dependent variables				
Importance of China's coop.	5.993	1.081	1	7
Need for R&D funding	5.235	1.122	1	7
Pollution-related beliefs				
Concern about pollution	6.002	1.002	1	7
Need for clean energy	5.898	1.006	1	7
Pollution-related behaviours				
Air pollution when voting	5.250	1.074	1	7
Count of pollutants	3.023	1.478	1	5
Political affiliation				
Progressive parties	0.387	0.487	0	1
Conservative parties	0.101	0.301	0	1
Non-affiliated parties	0.512	0.500	0	1
Demographic variables				
Income	2.775	1.992	1	8
Education	2.007	0.527	1	3
Age	3.902	1.340	2	6
Male	0.494	0.500	0	1

beliefs and behaviours have the greatest influence on both dependent variables despite the fact that the means of the dependent variables are already quite high (see Table 2). Similar patterns are present for the effects of pollution-related behaviours: both of these measures positively and significantly increase both dependent variables. In sum, the following variables all increased beliefs that Korea should cooperate with China and that Korea should allocate more R&D funding to address the air pollution problem: beliefs that air pollution is a problem, beliefs in the need for clean energy, knowledge about air pollution, and air pollution-voting connections. Political affiliation was also impactful: conservatives thought that cooperation with China was important, while progressives thought that the government should invest more in R&D to solve the pollution problem.

In terms of differences between progressive and conservative sub-populations, we observe in model 1 of Table 3 that, relative to non-affiliated individuals (captured in the constant), conservatives are more likely to prioritise cooperation with China relative to progressives. This likely reflects conservatives attributing blame towards China as a means of attacking the policies of the incumbent progressive government in Korea. In other words, conservatives appear to be calling for greater cooperation with China, but it really reflects the blame attributed to China as well as calls for China to play a role in fixing the problem. In model 2 of Table 3, we observe that individuals affiliated with Korea's progressive parties are, relative to those who are non-affiliated, supportive of the need for more R&D funding to address the problem. This reflects the broader progressive agenda put forth by Korea's current political leaders.

Conclusion

This article examines a number of avenues for policy makers to address the air pollution problem in Korea. First, the Korean government could design a policy reflecting public opinion and continue with past efforts to primarily blame China for the problem. This approach would, however, threaten prospects for creating a true cross-national collaboration with China, which is clearly in the works under the leadership of former UN Secretary-

Table 3. Stage 2 linear regressions.

	(1)	(2)
	Importance of China's cooperation	Need for more R&D funding (domestic)
Pollution-related beliefs		
Concern about pollution	0.323***	0.086*
	(0.046)	(0.049)
Need for clean energy	0.145***	0.285***
	(0.048)	(0.051)
Pollution-related behaviours		
Air pollution when voting	0.098**	0.124***
	(0.044)	(0.046)
Count of pollutants	0.058**	0.050*
	(0.027)	(0.029)
Political affiliation		
Progressive parties	0.059	0.235**
	(0.086)	(0.091)
Conservative parties	0.271*	0.062
	(0.142)	(0.150)
Demographic variables		
Income	−0.007	0.015
	(0.022)	(0.023)
Education	−0.041	0.071
	(0.079)	(0.083)
Age	−0.004	0.038
	(0.032)	(0.033)
Male	0.125	0.107
	(0.086)	(0.090)
Treatments		
Korea alone	−0.174	0.097
	(0.112)	(0.119)
Korea with China	−0.147	0.083
	(0.113)	(0.119)
Combination	0.055	0.147
	(0.113)	(0.120)
Constant	2.586***	1.671***
	(0.351)	(0.371)
N	605	605
R^2	0.212	0.184
F-stat	12.23***	10.21***

*, **, and *** represent $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively; standard errors in parentheses.

General Ban Ki-moon. Alternatively, the government could attempt to influence Korean public opinion using a top-down approach, issuing strongly framed communications through the media. However, the results presented here indicate that, with regard to the air pollution problem, messaging is less crucial than individuals' original beliefs and behaviours regarding the following: the extent to which air pollution is a problem, the need for clean energy, one's knowledge about air pollution, and the importance one places on air pollution when voting for political candidates.

The survey-based evidence and analysis presented here, in conjunction with details presented on the Korean case, indicate that the Korean government is willing to engage the public in a dialogue via the National Council on Climate and Air Quality. This shows that the Korean government is taking crucial steps to juggle its relationship with China as well as legitimise its prospective policies with public support. Upon reflection, perhaps the use of competitive messages is ideal for the Korean case, as such communications are necessarily framed as deliberations. Single-statement messages are insufficient in shifting people's beliefs and attitudes, but the reality of competitive frames illustrates the complex

arguments and deliberations needed to work in a new reality: Korea needs China's cooperation, but it must also work on its own efforts to reduce domestic air pollution.

We acknowledge that it is difficult to move people's opinions about the air pollution issue. It was particularly surprising to observe that our exploratory moderation analysis of sub-population dynamics also revealed no statistically significant interactions. We must be explicit, thus, when we state that beliefs about air pollution extremely well-formed. Relatively short treatments like those used here provide less-than-ideal levels of context to the public, but this is the trade-off with longer and likely more convoluted treatments that contain so much information that it becomes nearly impossible to identify precisely what might be shifting beliefs. However, perhaps it would have been appropriate to include a source cue in our treatments, the absence of which might have left respondents untethered, wondering whether the information to which they were being exposed had originated with a trusted source (i.e., that *Yonhap News* interviewed an authority on the subject of air pollution). In addition, misinformation campaigns are possibly at work, which do not necessarily undermine the ability to conduct a randomised experiment, but nonetheless make it difficult to accurately assess public opinion if such campaigns are not fully accounted for (Del Vicario et al., 2016; Kuklinski et al., 2000; Lewandowsky et al., 2017, 2012). In short, if misinformation-rooted messages are present, the effects on beliefs and attitudes will be even more difficult to predict. It is also more likely that policy makers will have an even more difficult time avoiding politicising the air pollution issue, both domestically and at the cross-national level with China.

We also acknowledge that this article makes little effort to show how Korea or the Northeast Asian region are distinct from other countries/regions with regard to the selection of policy instruments. Existing efforts to make such cross-national/cross-regional comparisons, such as B. Cho and Moon (2019), account for how citizen preferences are impacted by factors that include social trust and government capacity. Recognising the limitations presented in both small and large-*n* studies, we believe that this line of inquiry is valuable, and we have plans for addressing the relationship between beliefs/attitudes and citizen preferences with regard to environmental management policies in Korea. This would, however, be only a starting point for understanding differences in the impact of Europe's Convention on Long-Range Transboundary Air Pollution and the Northeast Asia Subregional Program for Environmental Cooperation.

Notes

1. These include the Northeast Asia Conference on Environmental Cooperation, the Northeast Asia Subregional Program for Environmental Cooperation, the Northeast Asia Clean Air Partnership, the East Asian Acid Rain Monitoring Network, and the Tripartite Environmental Ministers Meeting.
2. Perceptions about the air pollution problem can diverge from real air pollution measures but, in some places, such as China, political institutions can mitigate these differences (Peng et al., 2019).
3. For more details on the connections between political sophistication and attribution of blame, see Gomez and Wilson (2007). For an example of how science literacy impacts perceptions of climate change, which is a topic paralleling Northeast Asian transboundary air pollution, see Kahan et al. (2012). It should be noted that, regarding science literacy, air

pollution-related knowledge among Koreans decreases satisfaction with the policy-related decisions of both Korea and China (Shapiro & Bolsen, 2018).
4. See the Appendix A for complete details regarding the wording of this question.
5. Some argue that the Asia Pacific Partnership on Clean Development and Climate arose from the Northeast Asian countries given the lack of the U.S.'s commitment to the Kyoto Protocol (Karlsson-Vinkhuyzen & Van Asselt, 2009). In addition to the Asia Pacific Partnership on Clean Development and Climate, the Northeast Asian Subregional Program for Environmental Cooperation also focuses on technological coordination across Northeast Asia.
6. Management of the panel is conducted by randomly sent invitations for participation in Internet surveys with monetary incentives for participation. The estimated monetary incentive for respondents participating in the experiment was approximately $5. Selection bias from targeting only Internet users is alleviated given the nearly 95.9% Internet penetration rate in Korea. This Internet penetration rate is based on 2018 data, according to the CIA World Factbook (https://www.cia.gov/library/publications/the-world-factbook/fields/204.html).
7. Two-sample *t*-tests confirmed that the differences among the four conditions were not statistically significant.
8. See the Appendix A for complete details regarding the wording of these questions used to collect these measures.
9. Pairwise correlation analysis confirms that multicollinearity among these explanatory variables is of no concern.

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Appendix A. Survey instrument

Dependent variable: importance of China's cooperation
How important is it for Korea to cooperate with China in order to fix the air pollution problem?
Extremely unimportant

(1) Very unimportant
(2) Somewhat unimportant
(3) Neutral
(4) Somewhat important
(5) Very important
(6) Extremely important

대기오염 문제를 해결하기 위해 한국이 중국과 협력하는 것이 얼마나 중요하다고 생각하십니까?
(1) 전혀 중요하지 않다
(2) 중요하지 않다
(3) 다소 중요하지 않다
(4) 보통이다
(5) 다소 중요하다
(6) 중요하다
(7) 매우 중요하다

Dependent variable: need for more R&D funding
To what extent do you disagree or agree that the Korean government should increase research funding to reduce the impacts from air pollution?

(1) Strongly disagree
(2) Moderately disagree
(3) Slightly disagree
(4) Neither agree nor disagree
(5) Slightly agree
(6) Moderately agree
(7) Strongly agree

귀하께서는 대기오염의 영향을 줄이기 위해 한국 정부가 연구비를 늘려야 한다는 데에 대해 얼마나 동의하십니까?
(1) 전혀 동의하지 않는다
(2) 동의하지 않는다
(3) 다소 동의하지 않는다
(4) 보통이다
(5) 다소 동의한다
(6) 동의한다
(7) 매우 동의한다

Pollution-related beliefs: concern about pollution
When you think about the air pollution problem in Korea, how concerned are you about its effects?

(1) Extremely unconcerned
(2) Very unconcerned
(3) Somewhat unconcerned
(4) Neutral
(5) Somewhat concerned
(6) Very concerned
(7) Extremely concerned

한국의 대기오염 문제를 생각할 때, 귀하는 그 영향에 대해 얼마나 걱정이 됩니까?
(1) 전혀 걱정하지 않는다
(2) 걱정하지 않는다
(3) 조금 걱정하지 않는다
(4) 보통이다
(5) 조금 걱정한다
(6) 걱정한다
(7) 매우 걱정한다

Pollution-related beliefs: need for clean energy
To reduce air pollution, to what extent is it necessary for electricity in Korea to be produced by clean energy sources?

(1) Extremely unnecessary
(2) Very unnecessary
(3) Somewhat unnecessary
(4) Neutral
(5) Somewhat necessary
(6) Very necessary
(7) Extremely necessary

대기오염 감소를 위해 귀하는 청정에너지로 생산되는 한국의 전력 이용이 얼마나 필요하다고 생각하십니까?
(1) 전혀 필요하지 않다
(2) 필요하지 않다
(3) 조금 필요하지 않다
(4) 보통이다
(5) 조금 필요하다
(6) 필요하다
(7) 매우 필요하다

Pollution-related behaviours: air pollution when voting
To what extent is the success of air pollution policies important when you vote for politicians, including the President?

(1) Extremely unimportant
(2) Very unimportant
(3) Somewhat unimportant
(4) Neutral
(5) Somewhat important
(6) Very important
(7) Extremely important

대선을 포함한 투표 시 귀하께선 성공적인 대기오염 방지 정책의 비중을 어느 정도로 두십니까?
(1) 전혀 중요하지 않다
(2) 중요하지 않다
(3) 다소 중요하지 않다
(4) 보통이다
(5) 다소 중요하다
(6) 중요하다
(7) 매우 중요하다

Pollution-related behaviours: count of pollutants
Which of the following contribute to air pollution? (check all that apply)

(1) Carbon dioxide (CO2)
(2) Carbon monoxide (CO)
(3) Nitrogen oxides (NOx)
(4) PM2.5
(5) Sulphur dioxides

다음 중 대기오염에 영향을 미치는 오염물질은 어느 것입니까? 모두 선택해주십시오. [모두선택]
(1) 이산화탄소(CO_2)
(2) 일산화탄소(CO)
(3) 질소산화물(NO_X)
(4) 초미세먼지
(5) 황산화물(SO_X)

Political affiliation
Which political party are you affiliated with?

(1) Democratic Party of Korea [Progressive]
(2) Liberty Korea Party [Conservative]
(3) Bareunmirae Party [Conservative]
(4) Party for Democracy and Peace [Progressive]
(5) Justice Party [Progressive]
(6) Another party – NA
(7) Not affiliated with any party – NA

　　귀하께서는 다음 중 어느 정당을 지지하십니까? [1개선택]
(1) 더불어민주당
(2) 자유한국당
(3) 바른미래당
(4) 민주평화당
(5) 정의당
(6) 기타 정당
(7) 아무 정당도 지지하지 않음

Demographic variables: income
What is your annual household income?

(1) Less than 30,000,000 won
(2) 30,000,000–39,999,999 won
(3) 40,000,000–49,999,999 won
(4) 50,000,000–59,999,999 won
(5) 60,000,000–69,999,999 won
(6) 70,000,000–79,999,999 won

(7) 80,000,000–99,999,999 won
(8) 100,000,000 won and above

귀하의 연간 총수입은 어떻게 됩니까?
(1) 3000만원 이하
(2) 3000~4000만원
(3) 4000~5000만원
(4) 5000~6000만원
(5) 6000~7000만원
(6) 7000~8000만원
(7) 8000~9000 만원
(8) 1억원 이상

Demographic variables: education
What was the last grade/level of school you completed?

(1) High School or less
(2) College/University
(3) Graduate School and above

귀하의 최종학력은 어떻게 됩니까?
(1) 고등학교 이하
(2) 대학교
(3) 대학원 이상

Demographic variables: age
How old are you?

(1) Under 20
(2) 20~29
(3) 30~30
(4) 40~49
(5) 50~59
(6) 60~69

귀하의 연령은 만으로 몇 세 이십니까? 출생연도 ()
(1) 20세 미만 → 조사중단
(2) 20~29세
(3) 30~39세
(4) 40~49세
(5) 50~59세
(6) 60~69세

Demographic variables: gender
What is your gender?

(1) Male
(2) Female

귀하의 성별은 어떻게 되십니까?
(1) 남자
(2) 여자