Public opinion change after the Fukushima nuclear accident : the role of national context revisited

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Abstract

This study explores how national context moderated change in support for nuclear energy after the Fukushima accident. The following national contextual variables are tested: geographical distance, nuclear energy production status, freedom of the press, and the building of new nuclear reactors. The results illustrate that previous research has misunderstood the moderating role of national context on opinion change after the Fukushima accident. A survey conducted shortly after the accident with more than 23,000 respondents from 41 countries has shown that geographical distance from the accident mattered: Contradicting a previous study, the decrease in support for nuclear energy was stronger in countries closer to Fukushima. In addition, support for nuclear energy decreased more in countries where new nuclear reactors were under construction. The country's nuclear energy production status and press freedom did not determine opinion change after the Fukushima accident. The non-effect of freedom of the press on opinion change contradicts the role of media after a focusing event as described in the literature. Overall results demonstrate a limited effect of national context on opinion change following a focusing event. Hence, national context provides only limited information to policy makers on how to respond to a nuclear accident.

Keywords: nuclear energy, opinion change, Fukushima, national context, distance, new build

Highlights:

- National context had limited effect on opinion change after Fukushima.
- Support for nuclear energy decreased more in counties closer to the accident.
- Support for nuclear energy decreased more where the nuclear energy debate was salient.
- Freedom of the press did not determine opinion change after Fukushima.

- Not all contextual factors are relevant when designing appropriate policy response.

1. Introduction

Public opinion is affected by focusing events (Page and Shapiro, 1992). These are events that are "*sudden, relatively rare, that can reasonably be defined as harmful […] and that are known to policy makers and the public virtually simultaneously*" (Birkland, 1997). Nuclear accidents are typical examples. Previous research has shown that focusing events play an important role in the political process because they have the capacity to direct public attention towards a specific issue (Baumgartner and Jones, 1991) and can cause a change in policy support on the issue (Page and Shapiro, 1992). In this paper, emphasis is on change in public opinion after the Fukushima nuclear accident, which started on March 11, 2011 when the Fukushima nuclear power plant was hit by a tsunami, caused by a major seaquake. Fukushima reminded the world again of the major risk inherent in nuclear energy production.

Public opinion studies conducted after Fukushima show that in most countries, support for nuclear energy decreased shortly after the accident. A decrease in support was observed not only in Japan (Poortinga et al., 2013), but also in countries such as Switzerland (Siegrist and Visschers, 2013), Belgium (Perko et al., 2012) and Italy (Prati and Zani, 2013). Yet in other countries, such as the UK, no drastic change occurred (Jones et al., 2016). To understand these cross-national differences in public opinion change, contextual factors should be taken into account.

Bishop (2014) has shown that opinion change after a focusing event is moderated by context. His research has shown that the Deepwater Horizon oil spill induced self-interested responses from people living in communities whose economies were affected by the event. A moderating effect of context can also be expected after a nuclear accident. However, only few studies looked at the effect of national context on public opinion change about nuclear energy. Focus on national context is most relevant, as nuclear energy policy decisions are mostly made at the

national level. In this case, national context seems to have affected public opinion both before (Pampel, 2011) and after the accident (Kubota, 2012). To our knowledge, only Kim et al. (2013) have conducted a comparative study on change after Fukushima, filling an important gap in the literature. Their results have shown that national context did indeed moderate change caused by the accident, meaning that the strength of the event's effect on public support for nuclear energy was determined by national contextual factors. Contrary to expectation, they found that support for nuclear energy decreased more if distance to the accident was greater. The impact of the accident was higher, when freedom of the press was more limited. A higher share of nuclear energy in the energy mix, on the other hand, reduced the negative impact of the accident on support for nuclear energy. This paper follows up on these findings to further refine current understanding of the effect of national context on public opinion after the Fukushima nuclear accident.

To study change in public support after Fukushima, the Win Gallup Snap Poll is used. This is the same data as used by Kim et al. (2013). Data were collected shortly after the Fukushima accident in over 40 countries. The aim of this study is twofold. The first aim is to test the robustness of the results of Kim et al. (2013) when more appropriate multilevel models are used to test the effect of distance, nuclear status (i.e., whether a country was nuclear active and what the share of nuclear energy was in the energy mix). This paper shows that Kim et al. (2013) overstated the importance of the national contextual factors as explanations for cross-national differences in public opinion change after the Fukushima accident. Of the contextual factors mentioned, only geographical distance from the accident significantly affected public opinion change: increasing distance reduced the effect of the focusing event on public opinion. The second aim of this study is to test the role of nuclear new build ─ whether a country was building new nuclear power plants ─ as moderator of public opinion change after the accident. This indicator is used as a proxy for the salience ─ i.e. relative importance ─ of the pre-Fukushima

debate on nuclear energy. Results showed that new build had a significant and negative effect, which means it amplified the decrease in public support. Hence, policy makers should not overstate the relevance of national context when assessing opinion change following a focusing event.

2. Theoretical background

Previous research has demonstrated that focusing events affect the policy process (Birkland and DeYoung, 2013; Wittneben, 2012). Most research on focusing events has investigated their capacity to alter the political agenda and to initiate policy change (Baumgartner and Jones, 1993; Sabatier and Jenkins-Smith, 1999). Scholarly perceptions differ on how a focusing event affects the political process; however, they agree that such events guide attention towards a particular problem. Focusing events affect both political attention and public opinion with regard to an issue.

There has been a debate in the literature about whether public opinion is capricious or rational. Page and Shapiro (1992) have argued that public opinion is collectively rational, as aggregate public opinion is meaningful, generally stable, and forms coherent patterns. Changes in collective policy preferences are often initiated by events, and they follow understandable and predictable patterns. These understandable shifts in public opinion after an event are larger for low-salience policy domains and issues (Birkland, 1997), which are issues that are mostly not at the top of the political and public agenda (e.g. nuclear energy). With public opinion mostly stable on such low-salience issues, a sudden increase in media attention after a focusing event can sway public opinion (Page et al., 1987). Such event induced public opinion changes were observed in the aftermath of Chernobyl (1986) and Fukushima (2011). Studies on opinion change after these nuclear accidents show that public support for nuclear energy generally decreased shortly after the accident (e.g. Siegrist and Visschers, 2013; Verplanken, 1989). However, cross-national differences in opinion change were observed after the Fukushima

accident. The accident reduced support for nuclear energy in some countries, for example Belgium (Perko et al., 2012), while in others, such as the UK, there was little or no change (Poortinga et al., 2013). To understand how a focusing event affects public opinion, the role of media should be considered (Page et al., 1987).

Media is the most important source of information on a distant focusing event (Shehata and Strömbäck, 2014). The Fukushima nuclear accident received global media coverage because the accident met multiple news values such as importance, negativity, and unexpectedness (O'Neill and Harcup, 2009), qualities that have been found to be universal (Shoemaker and Cohen, 2006). Media studies on Fukushima confirm that the accident received extensive coverage in the first weeks after the accident (Perko et al., 2015). Hence, increased media coverage made the issue of nuclear energy salient to the public, as is suggested by public agenda setting theory (McCombs, 2004). However, to understand cross-national differences in opinion change, it is necessary to consider how the event was covered in the countries.

In order to capture and hold the interest of the audience when reporting about distant events, “contextualization” and “domestication” are used. Contextualization means that the event is presented with sufficient information about the broader context, whereas domestication is the search for the domestic angle of the story (Mujica and Hanitz, 2013). Domestication has been found in reporting about Chernobyl (Joutsenniemi, 1987; Rager et al., 1987) and Fukushima (Kepplinger and Lemke, 2015; Lazic and Kaigo, 2013; Perko and Turcanu, 2011). A high share of newspaper articles in some countries focused on the domestic implications of the Fukushima accident, for instance, Germany and Belgium, as opposed to, for instance, the United Kingdom. Hence, it can be assumed that changes in public opinion are caused by the national media (Page et al., 1987). This raises the question which national contextual factors were reflected in the media, and how they affected public opinion after the accident.

A first important contextual factor to consider is the impact of the accident. After the Deepwater Horizon oil spill disaster in the Gulf of Mexico on April 20, 2010, regions that were economically more dependent on the oil industry turned more positive towards oil drilling after the accident than regions less economically dependent on the oil industry (Bishop, 2014). A similar response was noted after the 2008 financial crisis, when the crisis response depended on the level of affluence and wealth (Newman, 2015). Both studies show that opinion change after a focusing event is determined by self-interest (Bishop, 2014). A similar reflex can be expected after a nuclear accident, because opinion on nuclear energy is affected by perceptions of the risks and benefits of nuclear technology (Visschers and Siegrist, 2013). After a nuclear accident, people fear exposure to radiation, and this fear affects how public opinion on nuclear energy changes due to the event. Distance is a possible proxy to capture fear of exposure to radiation in cross-national studies.

Previous research has included distance to explain how people respond to risks. Kim et al. (2013) found that the greater the distance from the accident site, the stronger the negative impact on support for nuclear energy. However, this finding contradicts earlier studies on the effect of distance on risk perception. After the attack at the World Trade Center in New York, September 11, 2001, people living closer to the towers perceived greater terror risk than those living further away (Fischhoff et al., 2003). A similar effect of distance is described in the construal level theory (CLT) of Trope and Liberman (2010). According to CLT, a higher psychological distance—spatial distance being one dimension of psychological distance—causes people to think more abstractly about a problem (Fujita et al., 2006). The concept of psychological distance has also been applied to understand how people perceive distant risks, such as climate change. People who perceive climate change to be more distant are less concerned about its risks (Spence et al., 2012). A similar response to Fukushima is conceivable, with people at a greater distance from Fukushima thinking about the event in more abstract and

general terms. Distance affects not only a person's thinking about an event, but also his or her emotional reaction to it. People are more affected by others who are close than by those who are distant (Latane, 1981). Moreover, different studies, starting with Galtung and Ruge (1965), have stressed the role of proximity as a news value, proximate events having a higher chance to get covered. Nevertheless, in Europe Fukushima made it into the news because of the newsworthiness of the event, independent of its distance (Arlt and Wolling, 2015; Perko and Turcanu, 2011). However, distance can still affect the degree or focus of news attention or the length of its wave: Smaller social ties between countries, a greater homophily between source and receiver, and a shorter distance all increase attention to a disaster event in the news (Koopmans and Vliegenthart, 2010).

> *H1: The shorter the geographical distance between a country and the accident site, the stronger the negative effect of the Fukushima nuclear accident on support for nuclear energy.*

The presence of a national nuclear energy program is also expected to determine how public opinion changes after a nuclear accident. Studies have indicated that in non-crisis periods, acceptance of nuclear energy is higher in countries that produce nuclear energy (Pampel, 2011). Three possible explanations of this effect are noted in the literature. First, familiarity: Higher familiarity decreases concern with or highlights the benefits of the technology, which increases acceptance (Rohrmann and Renn, 2000). A second explanation describes the responsive relationship between policy and the public (Soroka and Wlezien, 2010). In a democratic state, the nuclear policy of a country should reflect the public's preferences. Therefore, public opinion should be reflected in the share of nuclear energy in a country's energy mix; however, public opinion might also be socialized within the energy policy. A third possible explanation pertains to economic dependence: The need for nuclear energy alleviates the negative effect of higher risk on support (Kubota, 2012). Kim et al. (2013) used both a dummy variable (nuclear active yes or

no) and the nuclear share in the energy mix to explain change in support for nuclear energy. The results were mixed: Whether a country is nuclear active did not moderate the impact of Fukushima on public opinion; on the other hand, the share of nuclear energy in the energy mix significantly moderated the change in support for nuclear energy following the accident, with slightly smaller decreases in support in countries with a higher share of nuclear energy. However, public opinion is more likely to turn negative in countries that produce nuclear energy because these countries have a stronger anti-nuclear advocacy coalition that can use the opportunity to reframe the debate (Baumgartner and Jones, 1991; Nohrstedt, 2008).

H2.1: The negative effect of Fukushima on public support for nuclear energy is stronger in countries that produce nuclear energy.

H2.2: The negative effect of Fukushima on public support for nuclear energy is stronger in countries that are more dependent on nuclear energy.

Above, reference was made to attempts by advocacy coalitions to control issue framing in the aftermath of a crisis (Baumgartner and Jones, 1993). This framing debate is dependent on structural characteristics of the media system, such as the relationship between the state and the press. Hallin and Mancini (2004) include the “role of the state” as an important dimension of the media system. The term refers to the extent and direction of state intervention (p.41). Bennett et al. (2007) found that when press and politics are too dependent on each other, the press fails to fulfill its role as watchdog. A first prerequisite for the media watchdog to be able to bark is freedom of press (Franklin et al., 2005), which determines to what extent government is able to control issue framing after a crisis. Low press freedom makes it easier for governments to control what is said and to suppress voices critical of nuclear energy. However, the need for governments to control the post-crisis debate is dependent on the vested interests in nuclear energy. In countries where the share of nuclear energy is high, governments might feel a greater

need to control issue framing. The share of nuclear energy in the energy mix can be used as a proxy for the strength of the pro-nuclear elite.

H3.1: The negative effect of Fukushima on public support for nuclear energy is stronger in countries with higher levels of press freedom.

H3.2: The decrease in support for nuclear energy after Fukushima is smaller in countries with low levels of press freedom, if these countries also have a strong pro-nuclear elite.

Further, the salience of the nuclear energy debate should be considered. Salience of the nuclear energy issue fluctuates over time, but its prominence increased in the years preceding the Fukushima nuclear accident (Bolsen and Cook, 2008; Brouard and Guinaudeau, 2015). Concerns about increasing energy needs, climate change, and energy security in the last decade moved some countries to build new nuclear reactors (Elliott, 2013), while others signaled their interest in starting a nuclear energy program (IAEA 2010). After Chernobyl, attitude change was dependent on opinions about issues specific to the national context (e.g., nuclear waste) (Eiser et al., 1990). The presence of new build before the accident likely caused public support to decrease more strongly after Fukushima, as the accident provided a window of opportunity for opponents to criticize national nuclear aspirations. Here too, however, the success of their framing attempts depends on the media. Lower levels of press freedom make it easier for governments to control policy criticism, which in turn enables them to control public opinion change.

H4.1: The decrease in support for nuclear energy due to Fukushima is stronger in countries that were building new nuclear reactors before the accident.

H4.2: The decrease in support for nuclear energy after Fukushima was more limited in countries with a lower level of press freedom, when these countries were also building new nuclear reactors.

3. Method

Data

Change in public opinion due to Fukushima is studied using the *Global Snap Poll on Tsunami in Japan and Impact on Views about Nuclear Energy*. Data were collected by WIN-Gallup International between March 21, 2011 and April 10, 2011 in 47 countries: Austria, Azerbaijan, Bangladesh, Belgium, Bosnia-Herzegovina, Brazil, Bulgaria, Cameroon, Canada, China (separate sample for Hong Kong), Colombia, Czech Republic, Egypt, Fiji Islands, Finland, France, Germany, Greece, Georgia, Iceland, India, Iraq, Ireland, Italy, Japan, Kenya, Latvia, Lithuania, Macedonia, Malaysia, Morocco, Netherlands, Nigeria, Pakistan, Poland, Palestine, Romania, Russia, Saudi Arabia, Serbia, South Korea, South Africa, Spain, Switzerland, Turkey, Tunisia, USA and Vietnam. Surveys were conducted by telephone, online or face-to-face (n= 36,121). Cases with missing information on the dependent variable or on the independent variables were removed from the analysis, which resulted in the exclusion of Ireland, Azerbaijan, Lithuania, Latvia, Palestine and Fiji (n= 3,407). Also Morocco was excluded for being a clear outlier—support for nuclear energy increased there by 20%. Japan was excluded because it is the only country that directly experienced the nuclear accident. The remaining sample consists of 23,331 respondents in 41 countries.

Dependent variable

The dependent variable is attitude about nuclear energy production measured with two opinion questions: (1) *"As of today, what is your view: Do you strongly favor, somewhat favor, somewhat oppose or strongly oppose the use of nuclear energy as one of the ways to provide electricity for the world?"* and (2) *"Before the earthquake in Japan, what was your view: Were you in favor, somewhat in favor, somewhat opposed, or strongly opposed to the use of nuclear energy as one of the ways to provide electricity to the world?".* Answers on both questions were dichotomized

so that scores represent the respondents' support for nuclear energy before and after Fukushima (0= somewhat/strong opposition, 1= somewhat in favor/strongly in favor). A dichotomous dependent variable was used in order to compare our results with previous studies.

Change due to Fukushima is operationalized using the two opinion questions as two repeated measures of the same latent attitude about nuclear energy. A fixed effect *Fukushima* was included to indicate the moment of measurement (0 = before Fukushima; 1 = after Fukushima). Aggregated at the national level, *Fukushima* indicates the proportion of opinion change due to the nuclear accident. Because of the short period between the accident and opinion measurement, and the use of a retrospective baseline, the coefficient of *Fukushima* reflects the change in support due to the nuclear accident. Since the dependent variable is dichotomous, the *Fukushima* effect in our models focusses on those respondents who swapped sides due to the nuclear accident. Small opinion changes ─ e.g. from somewhat opposed to strongly opposed ─ are not taken into account by the model. Consequently, this is a conservative yet realistic test for change in support, considering the polarized nature of the debate on nuclear energy production (Renn and Marshall, 2016). This conservative test best captures the potential behavioral consequences of people who change their opinion, as the attitude-behavior linkage becomes more likely when the attitude change is accessible (Krosnick, 1989).

The use of a retrospective measure of opinion change is necessary, because it is the only measure available to study the impact of the Fukushima nuclear accident comparatively. For most countries studied, a recent, objective and comparable pre-Fukushima baseline on support for nuclear energy is missing. There has been debate on the accuracy of recall measures (Grotpeter, 2007). Previous research has shown people have a tendency to underestimate change in opinion (Dassonneville and Hooghe, 2016; Jaspers et al., 2009; Markus, 1986). However, in this study an overestimation of change is more likely, as the retrospective change measure is applied after a highly mediated event. Most studies on recall accuracy used time-

spans of many years (e.g. Markus, 1986). The short period between the measurement of opinion and the moment to be recalled in this study most likely increased accuracy of the recalled opinion. However, people do not necessarily always have a clear attitude towards nuclear energy, because of the low saliency of the nuclear energy issue (Feldman, 1989). Hence, it seems reasonable to assume that the recall measure will be affected by the abundant media coverage after the accident (Zaller, 1992). Also the order of the questions made an overestimation of opinion change more likely, because respondents had already been primed to think about the nuclear accident before they were given the opportunity to indicate their previously held opinion. This priming resulted from how the questions were ordered in the survey (Strack, 1992; Todorov, 2000). In between these two opinion questions respondents answered two additional questions: i) whether they were aware of the earthquake and tsunami in Japan; ii) whether they were aware of the nuclear accident. Access to information about the occurrence of the nuclear accident, and applicability of that negatively valued information, made a decrease in support for nuclear energy most likely.

Before the accident 51% (N= 23,331) was in favor of nuclear energy, while after the accident it was only 46.5%. Opinion change in the 41 countries studied is shown in figure 1. In nearly all countries support for nuclear energy decreased due to the accident. A notable exception is Spain, where support increased by 0.01%. For all other countries, national support for nuclear energy decreased between 1% (Colombia) and 19% (Iraq). The general decrease in support for nuclear energy due to the Fukushima accident is statistically significant: t= 16.48; df= 48142; Ha diff>0 = 0.000.

Independent variables

National contextual variables

The following national contextual variables are tested: distance, nuclear production status (whether a country produces nuclear energy; share of nuclear energy in the mix), freedom of the press, and whether a country has new build projects (see table 1).

Distance is the log transformed distance in kilometers between the accident site and the capital of the country. Information on distance was collected via Free Map Tools. The following countries are statistical outliers based on their distance: Bangladesh, Vietnam, Hong Kong, China, South Korea, Brazil, Colombia and South Africa.

Nuclear energy production status is operationalized using two indicators: (1) whether a country is nuclear active or not (dichotomous variable) (Schneider et al., 2011), (2) the percentage of nuclear energy in the national energy mix in 2010 (World Bank, 2015). Two countries are statistical outliers due to their high nuclear shares: France (76%) and Belgium (51%). However, their outlying nature is reduced by performing a natural logistic transformation.

The Freedom House index is used as indicator for *freedom of the press* (Freedom House, 2012). Each country is scored between 0 (completely unfree) and 100 (complete freedom). Ratings of press freedom are determined based on three categories: legal constraints, political influences and economic pressures. Freedom of the press correlates strongly (r=0.8***) with GDP per capita of a country.

New build is a binary variable that indicates whether or not a country was building new nuclear reactors on April 1, 2011. Information about new build was found in Schneider et al. (2011) and cross-checked with country nuclear reports (IAEA 2016). The following countries were coded as having nuclear new build: Brazil, Bulgaria, China, Finland, France, India, Korea, Russia and USA.

Sociodemographic variables

The following sociodemographic variables are included as control variables: *age* (in years), *gender* (0= male/ 1= female), *income* and *education*. *Income* is a categorical variable with three categories: (1) low (bottom and second quintile), (2) medium (third and fourth quintile) and (3) high (fifth quintile). *Education* is a categorical variable with three categories: (1) low education (no/basic level), (2) medium education (secondary), and (3) higher education (higher studies).

All independent variables are constant across the two opinion measurements. All continuous variables—namely GDP, age and distance—were grand-mean centered to facilitate interpretation of the interactions.

Analysis

Binary logistic multilevel models are used because the dependent variable is binary and data are clustered. Data clustering violates the assumption of independence between sampling units underlying classic regression models. In addition, multilevel modeling takes into account the different sample sizes of the variables included in the model, which prevents false positives (Hox, 2010). All models presented have a three level structure: (1) opinions about nuclear energy production before or after Fukushima (n= 46,662) are clustered (2) in respondents (n= 23,331) who are clustered (3) in countries (n= 41). To account for the large sample size of respondents, the significance of individual characteristics is assessed using $p<0.01$. Time is included as a fixed effect (*Fukushima*).

The models presented test for *moderation* using interactions (multiplicative terms). Moderation is the situation where the effect of X (impact of Fukushima) on Y (acceptance of nuclear energy) is dependent on the value of a third variable Z (national contextual factors) (Jaccard, 2001). All models are hierarchically well defined, meaning that all lower order components of the higher

order term are included in the model (Kleinbaum and Klein, 2010). To control for bias due to multicollinearity, only variables with small correlations ($p<0.5$) were combined in the models.

[figure 1 about here]

[table 1 about here]

Results

Model 1 only contains the variable *Fukushima* (β= -0.96; SD= 0.04; odds ratio (OR)= 0.38). The negative coefficient indicates that the nuclear accident had an overall negative effect on support for nuclear energy. In addition, model 1 provides information as to what extent the variance in support for nuclear energy is due to individual differences or country differences (cf. random effects). Variance at the level of the respondents is 4.14 (SD= 0.06) and 2.32 (SD= 0.26) at the level of the countries. Both variances are statistically significant; respondents and countries significantly differ in support for nuclear energy while being controlled for the occurrence of the nuclear accident. Most of the variance is, however, due to differences between respondents. The intraclass correlation coefficient—a measure for data clustering—is 0.87 (0.006) at the respondent level and 0.21 (0.04) at the country level.

Models 2 to 4 (table 3) test how the contextual and individual level variables moderated the impact of Fukushima on support for nuclear energy. The main fixed effects in the models are the effects of independent variables on support for nuclear energy before Fukushima. Interaction

terms in the models can be interpreted in two ways, depending on which variable is seen as the focal independent variable and which as the moderator. For this study, *Fukushima* is seen as the focal independent variable, and the other variables as moderators. However, reversing the interpretation provides information about whether and how the effect of the independent variables on support for nuclear energy after the accident differs from before the accident.

[table 2 about here]

Model 2 tests the effect of the national contextual factors distance, nuclear status and press freedom as moderators of change in support for nuclear energy after Fukushima. Even when these potential moderators are included, the main effect of Fukushima is negative and significant (β= -0.85; SE= 0.11). However, the meaning of Fukushima in model 2 is different from that in model 1. As a result of the interactions, Fukushima now refers to the change in support for nuclear energy by a 41 year old male, who received no or only a basic level of education, who has a low income, lives 8297.36 km from Fukushima and in a country that does not produce nuclear energy and has a GDP per capita of 18601.68 dollars.

Of the three contextual variables in model 2, only *distance* significantly moderates opinion change due to the accident (*Fukushima*), with the negative effect of *Fukushima* smaller (β= 0.52; SE=0.08) at greater distance. In China, the effect of *Fukushima* is -1.5, in Finland -0.81 and in Brazil -0.36. Consequently, even in distant countries the effect on support was negative, but it was stronger in countries closer to Japan. Hence, H1 is accepted. The main effect of distance is also significant: β=-1.66 (SE=0.52). Before the accident, support for nuclear energy was lower in the Western part of the world. To fully understand the effect of distance, the sample of countries should be considered. Most of the countries included are Western countries, with only few countries located very near to or far from Japan. Nine countries are statistical outliers on *distance*: Bangladesh, Vietnam, Hong Kong, China and South Korea because they are close to Japan, and Brazil, Colombia and South Africa because they are far away. In most of the Asian

countries, support for nuclear energy decreased considerably in the aftermath of the accident (e.g., China -14%, Bangladesh -15% and South Korea -12%). Before the accident, support for nuclear energy was mostly high in these countries: China 84%, South Korea 87%, and Vietnam (70%). Hence, the effect of distance might be the result of public opinion and change in public opinion about nuclear energy in Asia. Therefore, model 2 was recalculated after excluding China (and Hong Kong), Korea and Vietnam as neighboring countries of Japan. Excluding these countries renders the effect of *distance* not-significant. This shows that the effect of *distance* is not linear, as the result is affected by a group of countries close to Japan. The effect of distance in model 2 is also found in models 3 and 4.

Model 2 also tests the effect of *nuclear energy status* -whether or not a country produces nuclear energy- on change in support for nuclear energy due to Fukushima. The interaction *FukushimaXnuclear energy status* is not-significant. The opinion change caused by the nuclear accident was not significantly different in countries that produce nuclear energy than in those who do not. Hence, hypothesis 2.1 is rejected. However, living in a country that produces nuclear energy had a significant effect on the absolute level of support before *Fukushima* (β= 2.87; SE= 0.55). As the interaction between *Fukushima* and *nuclear energy status* is not significant, the positive effect of living in a nuclear energy producing country on support for nuclear energy is also present after the Fukushima nuclear accident.

Freedom of press is also tested in model 2. The interaction *FukushimaXpress freedom* is not significant. The level of *press freedom* had no significant direct effect on how *Fukushima* affected support for nuclear energy. Decrease in support is not stronger in countries where there is a higher level of press freedom, hence, H3.1 is rejected. The effect of press freedom as moderator of change after *Fukushima* is further scrutinized in model 3 and 4. However, *press freedom* does affect the absolute level of support for nuclear energy (β= -0.05; SE=0.01). This coefficient together with the non-significant interaction shows that the absolute level of support

for nuclear energy is lower in countries that have a higher level of press freedom, both before and after the accident.

In model 3 (table 3) *nuclear energy status* is replaced by *nuclear share* in the energy mix. The effect of *nuclear share* is tested in a separate model as it correlates highly with *nuclear energy status* (r=0.979***). Hypothesis 2.2 states that a higher share of nuclear energy would amplify the negative effect of the accident on public support for nuclear energy. Nevertheless, the level of dependence on nuclear energy did not moderate the effect of *Fukushima* on support for nuclear energy (β=-0.001; SE=0.01). This non-significant effect of the level of dependence on nuclear energy on change in support is in line with the effect of *nuclear energy status* reported in model 2. Consequently, H2.2 is rejected. However, also *share of nuclear energy* is a significant predictor of the absolute level of support for nuclear energy, shown by the positive and significant main effect of the variable (β=0.39; SE=0.08).

Model 3 also tests H3.2 that the effect of *press freedom* is dependent on the strength of the pro-nuclear elite. To test this hypothesis the three-way interaction *FukushimaXpress freedomXnuclear share* is included. Non-significance of this three-way interaction indicates that the effect of *press freedom* on change in support after *Fukushima* is not-dependent on the presence and strength of the pro-nuclear elite. Consequently, H3.2 is rejected. The interaction *press freedomXnuclear share* is also not significant (β= 0.005; SE=0.003). Strength of the nuclear elite had no effect on the absolute level of support for nuclear energy before Fukushima.

Model 4 (table 3) includes the variable *new build*—whether a country is building new nuclear reactors. The interaction *FukushimaXnew build* (β=-0.29; SE=0.08) is negative and significant. Support for nuclear energy decreased more in countries with *new build* than in countries without. Hence, H4.1 is accepted. Before Fukushima, *new build* had a positive effect on the absolute level of support for nuclear energy (β=2.58; SE=0.71). Ideally, model 4 would control for national involvement with nuclear energy (*nuclear share*). However, *nuclear share* correlates highly with

new build when all 41 countries are used. Therefore, multicollinearity could potentially bias parameters when *nuclear share* is included. Nevertheless, it seems likely that the main effect of *new build* partly reflects the positive effect of the level of dependence on nuclear energy on support for this electricity source found in previous models. Consequently, the main effect of new build would decrease if nuclear involvement was controlled for. Model 4 also tests if the nuclear elite of countries with new build projects succeeded in protecting support for nuclear energy after the accident by keeping control of the media (H4.2). To test H4.2, a three-way interaction *FukushimaXpress freedomXnew build* is included. This three-way interaction is positive and significant (β=0.008; SD=0.003). In countries with new build, support for nuclear energy decreased less when press freedom was higher. The direction of the effect is surprising, as it runs opposite to the prediction. The unexpected direction of the press freedom in countries with *new build* is due to China and Russia. Both countries had low levels of press freedom but witnessed a substantial decrease in support. In China, for example, support decreased 14%, yet the country has a score of 15/100 for freedom of the press. When China and Russia are excluded, there is no effect of press freedom on change in support for nuclear energy in countries building a new nuclear reactor. Moreover, the interaction *FukushimaXnew build* is no longer significant when China and Russia are excluded. This indicates that the moderating role of *new build* is dependent on these two countries. However, the positive effect of *new build* on absolute support for nuclear energy before Fukushima prevails when China and Russia are excluded.

Additional statistical tests were conducted to assess the robustness of the results. The first was to test for the presence of floor- and ceiling-effects. Therefore, respondents who indicated being strongly in favor/opposed, both before and after the nuclear accident, were excluded from the analyses. The results passed this first robustness test. The second test checked if the results were robust for an alternative operationalization of the dependent variable. This was done by re-

estimating the models using an ordered polytomous dependent variable with four categories (multilevel ordered logistic models). These models confirm that distance significantly moderated opinion change, while nuclear production status and freedom of the press did not moderate changes in support for nuclear energy following the nuclear accident[i]. However, new build did not significantly moderate change in support for nuclear energy after the Fukushima accident, although the sign of the interaction effect *Fukushima*new build* was in the expected direction. However, as we mentioned before, such an ordered polytomous variable probably also takes opinion changes into account that are fairly inconsequential in a polarized issue context.

The moderating role of four individual characteristics was tested: *age*, *education*, *gender* and *income*. Two of the individual characteristics significantly moderated the impact of *Fukushima* on support for nuclear energy: *age* and *education*. For every year a respondent was older, the impact of *Fukushima* increased by -0.007 (SE=0.002). *Age* was not a significant predictor of support for nuclear energy before the accident. Support decreased more among the higher educated than among people with no/basic education (β= -0.30; SE= 0.10). Before Fukushima, support for nuclear energy was higher among people with secondary or higher education than among those with no/basic education. *Gender* did not affect change in support due to the nuclear accident, but it was a significant predictor of support before the accident. Women were less supportive of nuclear energy than men (β=-1.31; SE= 0.08). *Income* also had no significant moderating effect. Yet, before the accident, income had a positive effect on support for nuclear energy that was more evident in people with a higher income (β=0.78; SE=0.10) than for people with medium income (β=0.21; SD=0.10).

[table 3 about here]

Discussion

The Fukushima nuclear accident reduced public support for nuclear energy in all countries studied in this paper, with the exception of Spain. However, cross-national differences in the strength of the decrease were observed. This study identifies how the national context moderated the effect of the Fukushima accident on public support for nuclear energy production. Influence of the following contextual variables was tested: geographical distance, nuclear status (share of nuclear energy in the energy mix, and whether a country was nuclear active), whether a country was building new nuclear reactors and press freedom. Results show that the national contextual factors considered in this study help explain differences in the absolute level of support for nuclear energy. However, the same contextual factors have only limited value when explaining differences in opinion change caused by the Fukushima nuclear accident.

Distance affected change in support for nuclear energy following the accident, with stronger decreases in support in countries closer to Japan. Such an effect of geographical distance corresponds with insights on psychological distance (Trope and Liberman, 2010). Recently, Spence et al. (2012) showed that risk perception of climate change was lessened when the perceived psychological distance was greater. However, the effect of geographical distance found in this study runs contrary to the one reported by Kim et al. (2013). In addition, the results show that the effect of distance is dependent on the countries sampled: After excluding Japan's neighboring countries—China (and Hong Kong), South Korea and Vietnam—its effect became insignificant. Sensitivity to the effect of distance for the in- or exclusion of Asian countries indicates that (1) the effect of distance is not linear, and (2) there was a particular reaction to the Fukushima nuclear accident in these countries. There are two possible explanations for the stronger decrease in support in countries surrounding Japan. First, there was a greater risk of exposure to radiation in case the management of the damaged reactors had failed. Higher concern for the possible consequences of the accident resulted in a sharper decline in support

for nuclear energy. Second, the opinion changes observed reflect the national debates on nuclear energy before the accident. Most Asian countries had pro-nuclear energy policies before March 2011 (Sovacool, 2011). Some countries, such as China, India and South Korea, were expanding their reactor fleet. Others, such as Bangladesh and Vietnam, were considering starting a nuclear energy program (IAEA 2010). Therefore, the accident was an incentive for the public of these countries to reconsider its support for the national energy program. Because these countries often face similar tsunami and/or earthquake risks, such re-evaluation was warranted.

The second national contextual factor assessed is the nuclear energy production status. Results show that the change in support for nuclear energy was no different in countries that produce nuclear energy than in those that do not. Also the level of dependence on nuclear energy (share of nuclear energy) did not significantly moderate the impact of Fukushima on support for nuclear energy. The finding on the share of nuclear energy does not correspond with the finding of Kim et al. (2013). That both indicators of nuclear energy production did not determine change in support for nuclear energy after the Fukushima accident might be the result of cross-national differences in how the accident was framed. Kepplinger and Lemke (2015) show that countries differed in how strongly the media emphasized the tsunami as cause of the accident, also within the group of nuclear energy producing countries. Such differences might explain why no stereotypical “it could happen here” effect was found (Ramana, 2013). In addition, the share of nuclear energy might well represent the old political conflict, not capturing the current potential for politicization. Understanding the politicization of the nuclear energy issue after a focusing event requires a more detailed knowledge of the countries’ opportunity structure (Koopmans and Duyvendak, 1995).

A third national contextual factor included here is whether a country was building a new nuclear reactor when the Fukushima nuclear accident occurred. Such nuclear new build is included as

an indicator of issue salience. Results reveal that after the Fukushima accident, support for nuclear energy decreased more strongly in countries that were building a new nuclear reactor at the moment of the accident. To our knowledge, this is the first study to test the effect of new build on change in support for nuclear energy. Therefore, this finding cannot be compared with other studies. While previous research has shown that focusing events increase salience of the energy issue (Lowry and Joslyn, 2014), this study demonstrates that pre-event salience affects public opinion change after a focusing event. The results further indicate that effect of salience on opinion change is a direct, rather than a mediated, effect. The public is aware of this national contextual characteristic and uses the event as information to update its support for nuclear energy, independent of how the media framed the accident. Information about the event is processed and alters the accessibility of the information used to formulate an opinion (Iyengar, 1990), resulting in a more negative public opinion.

To examine how media framing of the accident affected opinion change after Fukushima, freedom of the press was tested. The literature suggests that events provide the opportunity to re-frame the debate (Baumgartner and Jones, 1993). Whether opponents can profit from the opportunity to reframe the debate is dependent on their access to the media. Our results show that freedom of the press had no direct significant effect on the change in support for nuclear energy following Fukushima, which again contradicts the findings of Kim et al. (2013). In addition, it was tested if the effect of freedom of the press was dependent on the strength of the nuclear elite. In countries with low freedom of the press, strong nuclear elite should have been able to control framing of the accident and subsequent opinion change. To test if the impact of freedom of the press on the opinion change after Fukushima was dependent on the share of nuclear energy, a three-way interaction was used. Non-significance of this interaction shows that the accident was not framed differently depending on the strength of the nuclear elite. Therefore,

no proof was found that the nuclear elite used the media to control issue framing in the aftermath of the accident.

An additional test was conducted to see if the effect of freedom of the press was dependent on the presence of nuclear new build. Nuclear new build creates an incentive for the pro-nuclear energy coalition to control issue framing in the aftermath of the accident, because a negative framing of the accident could stir opposition against the construction of new nuclear reactors. Results reveal that the effect of freedom of the press was indeed dependent on the presence of nuclear new build. In countries with new build projects, support for nuclear energy decreased more strongly where freedom of the press was lower. The direction of this effect is unexpected and is due to China and Russia. Low levels of press freedom in both countries should have allowed the political elite to control media framing and opinion change. However, in both countries there was a strong decrease in support for nuclear energy, which contradicts this hypothesis. Excluding China and Russia renders the effect of freedom of the press non-significant.

In addition to the national contextual factors, the influence of sociodemographic variables was tested. After the Fukushima nuclear accident, support for nuclear energy decreased more strongly among more highly educated respondents, compared with respondents with no or a basic level of education. This effect matches the theory of Zaller (1992), according to whom higher education increases reception of media information. In addition, support for nuclear energy decreased more strongly as age increased. This might be due to a stronger historical memory of the Chernobyl accident (1986); however, further research is required. Gender and income of the respondent did not affect change in support for nuclear energy after the accident.

While using the same data as Kim et al. (2013), our results differ substantially. Other moderating effects are found for geographical distance, share of nuclear energy in the energy mix, and freedom of the press. These differences are most likely due to modeling decisions. First, there is

the issue of data clustering. In this research, we made use of multilevel modeling to account for data clustering and to guarantee that significance is tested using the correct number of degrees of freedom. Testing the effect of contextual variables using an overestimated sample size increases the chance for a false positive, which results in the acceptance of spurious effects (Steenbergen and Jones, 2002). Whereas in this paper data clustering was accounted for by applying multilevel modeling, it remains unclear how Kim et al. (2013) resolved this issue. Second, more attention was given to sensitivity issues in the selection of countries. Van der Meer et al. (2010) showed that multilevel models are especially sensitive for case selection at the higher level. We decided to exclude Morocco and to include Germany in our analysis, while the decision of Kim et al. (2013) was the other way around. Our results also illustrate how the inclusion or exclusion of a few countries can alter conclusions. Third, we defined full hierarchical interaction models; not including all constitutive elements can bias the coefficients (Brambor et al., 2006). In their models, Kim et al. (2013) did not include the variable geographical distance, while they used this variable in an interaction term.

This research revealed the following points for improvement through future research. Firstly, upcoming studies should use an objective independent baseline to operationalize opinion change after Fukushima. We argued that there is reason to value the retrospective measure used in this study, because no other broad comparative baseline is available. Nevertheless, future research based on a smaller number of countries should use an objective baseline. The use of such an objective measure of change would reveal if the retrospective measure of opinion change is a valid measure of opinion change, and to what extent it is biased due to psychological processes such as cognitive dissonance and social desirability (Dassonneville and Hooghe, 2016). Secondly, future research should focus on the long-term impact of the nuclear accident on support for nuclear energy. Previous research shows that public opinion change caused by nuclear accidents is mostly temporary and that support stabilizes after some time

(Boer and Catsburg, 1988; Turcanu et al., 2016; Verplanken, 1989). Thirdly, because this paper focuses on change in 41 countries, the variables included are rough proxies for the dynamics studied. Future research should be more in-depth, allowing the inclusion of other national contextual factors, such as political elites. Elites play an important role in the policy process after a focusing event (Baumgartner and Jones, 1993; Sabatier, 1988), even more so when it comes to mobilizing attention for distant risks (Brulle et al., 2012). Such research would also allow using more refined indicators, for example for media coverage. In this study a rather crude operationalization of media framing is applied, indicating no effect of media framing on opinion change after Fukushima. However, research has found cross-national differences in the framing of the Fukushima accident (Kepplinger and Lemke, 2015). How the media covered the accident affected how public opinion changed, as was found to be the case in Germany (Arlt and Wolling, 2015). Future research should look into the effect of media on public opinion after Fukushima using a small or medium sample of cases to resolve this contradiction. Such in-depth studies would reveal other relevant and more refined contextual factors, which would improve the explanatory value and our understanding of the impact of the Fukushima accident. Fourthly, future studies might also reflect on the meaning of 'public opinion change'. In this paper support for nuclear energy is operationalized as a dichotomy (oppose vs. favor), which reflects well the polarized nature of the public debate on nuclear energy. Changes in these models indicate the extent to which people switched sides ─ from pro to contra and vice-versa ─ on nuclear energy due to the accident. A disadvantage of this operationalization, however, is that it does not take into account smaller changes in public opinion. People who ─ for example ─ changed from somewhat opposed to strongly opposed are considered to be unaffected by the accident. Additional robustness tests revealed that most of the findings are robust, except the finding related to new build. When using the polytomous operationalization, new build confirms the limited value of national context in explaining opinion change after an accident. The finding that

the chosen operationalization of ‘opinion change’ actually affects the results obtained requires future research to consider carefully the very meaning of opinion change and its implications.

4. Conclusion and policy implications

Framing nuclear energy as a climate-friendly technology resulted in reluctant acceptance of this electricity source by the public from the year 2000 onwards (Bickerstaff et al., 2008). It was expected that such acceptance would decrease in the event of a major nuclear accident (Pidgeon et al., 2008). On March 11, 2011, such an accident did occur when the Fukushima nuclear power plant was hit by a tsunami. After such a global focusing event policy makers need to determine appropriate policy responses, whilst lacking information about actual opinion changes. Hence, policy makers are forced to gauge opinion change using information proxies, such as national contextual factors. The findings of Kim et al. (2013) confirm the plausibility of this approach. However, our results do not confirm the utility of national contextual factors in assessing opinion change: Change in support for nuclear energy is only partly determined by national context. National contextual factors are far more useful for explaining cross-national differences in the absolute level of support for nuclear energy. Our findings therefore support the conclusions of Bishop (2014) and Eiser et al. (1990) that the national context helps to explain opinion change after a focusing event, but its informative function is limited.

The variables ‘nuclear energy status’ and ‘freedom of the press’ were not statistically significant. Distance and issue salience on the other hand significantly moderated crisis-induced opinion change after the Fukushima accident. Where distance reduced the negative impact of the nuclear accident on public opinion, the negative impact was stronger if the issue was more salient prior to the accident. Furthermore, it can be concluded that the role of media framing in the aftermath of a focusing event is not always the most important predictor of opinion change. Public opinion seems to be aware of and to respond to the national context independent of how the media framed the issue.

What practical implications do these findings have for policy makers? The findings signal the need to pay additional attention to crisis-induced changes in public support for nuclear energy in countries close to the accident. This shows that in the aftermath people's primary concern is safety: To make an assessment of the potential health impact, people use distance as a proxy. Support also decreased more in those countries where new nuclear reactors were being built. The populations of those countries became more negative after the accident than those living further away and than in countries without nuclear new build. Therefore policy makers, in these countries with new build, who seek to guarantee continued public support for their energy policy have an incentive to pay attention to public concern following the accident. Notable examples are the policy responses in China and in the UK: In these countries new nuclear reactors were respectively under construction or planned (Elliott, 2013). Policy makers and industry in the UK developed a shared public relations strategy preventing the accident from undermining public support for nuclear power (Edwards, 2011). There was also a quick policy response in China. Where the overall policy orientation towards nuclear energy remained positive in China, the country decided to suspend new build until new safety rules were in place. In addition, China increased safety inspections of existing nuclear reactors (Elliott, 2013). However, the fast policy responses raise questions about the causal relationship between public opinion and policy on the issue of nuclear energy after Fukushima.

Future research should look more closely at the relationship between public opinion change and policy on nuclear energy. Following the nuclear accident many countries witnessed changes in their energy policy. For instance, in 2014, the Japanese government adopted a new National Energy Strategy intended to reduce dependence on nuclear energy whilst still considering it as one of the important base-load electricity sources (Tatsujiro, 2015). Nuclear energy policies have also been reconsidered in countries worldwide; both near and distant countries, as well as in countries with nuclear new build. Some countries, in which the Fukushima accident caused an

extremely negative effect on public opinion, have decided as a result to reduce or even phase out their nuclear energy programs, for instance Germany (Renn and Marshall, 2016), whilst other countries with a strong negative opinion change after the accident did not change their energy policy; for instance Russia (Elliott, 2013) and China (Mu et al., 2015). Since the Fukushima accident, decision makers in all nuclear energy producing countries have increased the emphasis on meeting safety demands, e.g. the stress tests in EU (Álvarez-Verdugo, 2015). These aspects have been strongly emphasized in countries with new build and countries close to Japan; e.g. China (King and Ramana, 2015) or Korea (Hermanns, 2015). However, these countries have continued "their loyalty" as they have reiterated a commitment to their nuclear energy policies with no change other than safety policy aspects (Ramana, 2013). In the future more systematic research into the relationship between public opinion and nuclear energy policy is desirable to better grasp the dynamic of responsiveness after the nuclear accident.

Although using the same data, our conclusions do not match those of Kim et al. (2013) who found national context played a stronger role in the aftermath of Fukushima. Therefore, our findings suggest that the moderating role of the national context in public opinion change after a focusing event should not be overstated. Such vastly different conclusions require a reconsideration of the role of national context after Fukushima. To understand the substantial differences between the findings of Kim et al. (2013) and this paper, it is important to specify the meaning of the word 'revisiting'. Clemens (2015) recently advocated the distinction between revisiting as 'replication' and as 'robustness test'. Where replication studies closely resemble the original study (both in data and method), robustness tests however often make substantial alterations to the research design and/or model specification. The fact that we significantly altered the model specified by Kim et al. (2013) implies that we conducted a robustness test. Such tests should not yield results identical to the original study (Clemens, 2015). However,

more in-depth studies are needed, focusing on factors that better capture the political debate and the media framing of nuclear energy following the accident.

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References

Álvarez-Verdugo, M., 2015. The EU 'Stress Tests': The Basis for a New Regulatory Framework for Nuclear Safety. European Law Journal 21, 161-179.
Arlt, D., Wolling, J., 2015. Fukushima effects in Germany? Changes in media coverage and public opinion on nuclear power. Public Understanding of Science 25, 842-857.
Baumgartner, F.R., Jones, B.D., 1991. Agenda dynamics and policy subsystems. The Journal of Politics 53, 1044-1074.
Baumgartner, F.R., Jones, B.D., 1993. Agendas and instability in American politics. The University of Chicago Press, Chicago.
Beasley, R.K., Joslyn, M.R., 2001. Cognitive Dissonance and Post-Decision Attitude Change in Six Presidential Elections. Political Psychology 22, 521-540.
Bennett, L.W., Lawrence, R.G., Livingstone, S., 2007. When the Press Fails. Political Power and the News Media From Iraq to Katrina. University of Chicago Press, Chicago.
Bickerstaff, K., Lorenzoni, I., Pidgeon, N.F., Poortinga, W., Simmons, P., 2008. Reframing nuclear power in the UK energy debate: nuclear power, climate change mitigation and radioactive waste. Public understanding of science 17, 145-169.
Birkland, T.A., 1997. After disaster: agenda setting, policy change and focussing events. Georgetown University Press, Washington DC.
Birkland, T.A., DeYoung, S.E., 2013. Focusing Events and Policy Windows, in: Araral Jr, E., Fritzen, S., Howlett, M., Ramesh, M., Wu, X. (Eds.), The Routledge Handbook of Public Policy. Routledge, London, pp. 175-188.
Bishop, B.H., 2014. Focusing Events and Public Opinion: Evidence from the Deepwater Horizon Disaster. Political Behavior 36, 1-22.
Boer, C.d., Catsburg, I., 1988. A Report: The Impact of Nuclear Accidents on Attitudes Toward Nuclear Energy. The Public Opinion Quarterly 52, 254-261.
Bolsen, T., Cook, L.F., 2008. The polls-trend: public opinion on energy policy 1974-2006. Public Opinion Quaterly 72, 364-388.
Brambor, T., Clark, W.R., Golder, M., 2006. Understanding Interaction Models: Improving Empirical Analyses. Political Analysis 14, 63-82.
Brouard, S., Guinaudeau, I., 2015. Policy beyond politics? Public opinion, party politics and the French pro-nuclear energy policy. Journal of Public Policy 35, 137-170.
Brulle, R.J., Carmichael, J., Jenkins, J.C., 2012. Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010. Climatic change 114, 169-188.
Clemens, M.A., 2015. The meaning of failed replications: a review and proposal. Journal of Economic Surveys Advance online version.

Dassonneville, R., Hooghe, M., 2016. The Noise of the Vote Recall Question: The Validity of the Vote Recall Question in Panel Studies in Belgium, Germany, and the Netherlands. International Journal of Public Opinion Research.
Edwards, R., 2011. Revealed: British government's plan to play down Fukushima, The Guardian, Online.
Eiser, R.J., Hannover, B., Mann, L., Morin, M., Van der Plicht, J., Webley, P., 1990. Nuclear attitudes after Chernobyl: a cross national study. Journal of Environmental Psychology 10, 101-110.
Elliott, D., 2013. Fukushima: impacts and implications. Palgrave McMillan, New York.
Feldman, S., 1989. Measuring issue preferences: the problem of response instability, in: Stimson, J.A. (Ed.), Political analysis: an annual publication of the methodology section of the American Political Science Association. The University of Michigan Press, Ann Arbor, pp. 25-61.
Fischhoff, B., Gonzalez, R.M., Small, D.A., Lerner, J.S., 2003. Judged Terror Risk and Proximity to the World Trade Center. Journal of Risk and Uncertainty 26, 137.
Franklin, B., Hamer, M., Hanna, M., Kinsey, M., Richardson, J.E., 2005. Key Concepts in Journalism Studies. Sage Publications Ltd., London.
Freedom House, 2012. Freedom of the Press 2011. Signs of Change Amid Repression. Freedom House, Washington, p. 38.
Fujita, K., Henderson, M.D., Eng, J., Trope, Y., Liberman, N., 2006. Spatial distance and mental construal of social events. Psychological Science 17, 278-282.
Galtung, J., Ruge, M.H., 1965. The structure of foreign news the presentation of the Congo, Cuba and Cyprus Crises in four Norwegian newspapers. Journal of peace research 2, 64-90.
Grotpeter, J.K., 2007. Respondent recall, in: Menard, S. (Ed.), Handbook of longitudinal research. Design, measurment and analysis. Academic Press- Elsevier, Burlington|California|London, pp. 109-123.
Hallin, D.C., Mancini, P., 2004. Comparing Media Systems. Three Models of Media and Politics. Cambridge University Press, Cambridge.
Hermanns, H., 2015. South Korean Nuclear Energy Policies and the Public Agenda in the 21st Century. Asian Politics & Policy 7, 265-282.
Hox, J., 2010. Multilevel analysis. Techniques and applications. Routledge, New York.
IAEA 2010. International status and prospects of nuclear power. IAEA, Vienna.
IAEA 2016. Country nuclear power profiles.
Iyengar, S., 1990. The accessibility bias in politics: television news and public opinion. International Journal of Public Opinion Research 2, 1-15.
Jaccard, J., 2001. Interaction effects in logistic regression. Sage Publisher, Thousand Oaks-London-New Delhi.
Jaspers, E., Lubbers, M., De Graaf, N.D., 2009. Measuring Once Twice: An Evaluation of Recalling Attitudes in Survey Research. European Sociological Review 25, 287-301.
Jones, C.R., Elgueta, H., Eiser, J.R., 2016. Reconciling nuclear risk: the impact of the Fukushima accident on comparative preferences for nuclear power in U.K. electricity generation. Journal of Applied Social Psychology 46, 242-256.
Joutsenniemi, A., 1987. Chernobyl: Information and media coverage in Finland. Department of Communication at the University of Helsinki & the Research Institute for Social Sciences-University of Tampere, Helsinki.
Kepplinger, H.M., Lemke, R., 2015. Instrumentalizing Fukushima: Comparing Media Coverage of Fukushima in Germany, France, the United Kingdom, and Switzerland. Political Communication online, 1-23.
Kim, Y., Kim, M., Kim, W., 2013. Effect of the Fukushima nuclear disaster on global public acceptance of nuclear energy. Energy Policy 61, 822-828.
King, A., Ramana, M.V., 2015. The China Syndrome? Nuclear Power Growth and Safety After Fukushima. Asian Perspective 39, 607-636.

Kleinbaum, D., Klein, M., 2010. Logistic regression: a self learning text. Springer, New York.
Koopmans, R., Duyvendak, J.W., 1995. The political construction of the nuclear energy issue and it's impact on the mobilization of anti-nuclear movements in Western Europe. Social Problems 42, 235-251.
Koopmans, R., Vliegenthart, R., 2010. Media Attention as the Outcome of a Diffusion Process—A Theoretical Framework and Cross-National Evidence on Earthquake Coverage. European Sociological Review.
Krosnick, J.A., 1989. Attitude Importance and Attitude Accessibility. Personality and Social Psychology Bulletin 15, 297-308.
Kubota, Y., 2012. Facing a crisis with calmness? The global response to the Fukushima nuclear disaster. Japanese Journal of Political Science 13, 441-466.
Latane, B., 1981. The psychology of social impact. American psychologist 36, 343.
Lazic, D., Kaigo, M., 2013. US press coverage of the Fukushima nuclear power plant accident: Frames, sources and news domestication. Media Asia 40, 260-273.
Lowry, W.R., Joslyn, M., 2014. The Determinants of Salience of Energy Issues. Review of Policy Research 31, 153-172.
Markus, G.B., 1986. Stability and change in political attitudes: Observed, recalled, and "explained". Political behavior 8, 21-44.
McCombs, M.E., 2004. Setting the agenda: the mass media and public opinion. Polity, Cambridge.
Mu, R., Zuo, J., Yuan, X., 2015. China's approach to nuclear safety — From the perspective of policy and institutional system. Energy Policy 76, 161-172.
Mujica, C., Hanitz, T., 2013. Gatekeepers on Decision Making in Foreign News, in: Cohen, A.A. (Ed.), Foreign News on Television. Where in the World is the Global Village? Peter Lang, New York, pp. 209-225.
Newman, B.J., 2015. A Crisis in Context: Local Conditions, National Events, and Economic Policy Mood. American Politics Research 43, 1041-1073.
Nohrstedt, D., 2008. The Politics of Crisis Policymaking: Chernobyl and Swedish Nuclear Energy Policy. Policy Studies Journal 36, 257-278.
O'Neill, D., Harcup, T., 2009. News values and selectivity, in: Wahlberg, A.A.F., Hanitz, T. (Eds.), Handbook of journalism studies. Routledge, New York, pp. 161-174.
Page, B.I., Shapiro, R.Y., 1992. The rational public. Fifty years of trends in American's policy preferences. University of Chicago Press, Chicago.
Page, B.I., Shapiro, R.Y., Dempsey, G.R., 1987. What moves public opinion? The American Political Science Review 81, 23-44.
Pampel, F.C., 2011. Support for nuclear energy in the context of climate change: evidence from the European Union. Organization and environment 24, 249-268.
Perko, T., Mays, C., Valuch, J., Nagy, A., 2015. Mass and new media: review of framing, treatment and sources in reporting Fukushima. Mass Communication and Journalism 5, 5.
Perko, T., Turcanu, C., 2011. Media content analysis of the Fukushima accident in two Belgian newspapers. SCK●CEN, Mol, pp. 1-128.
Perko, T., Turcanu, C., Geenen, D., 2012. Media reporting and changes in public opinion after Fukushima nuclear accident: Belgium as a case study. International Journal of Nuclear Governance, Economy and Ecology 3, 291-307.
Pidgeon, N.F., Lorenzoni, I., Poortinga, W., 2008. Climate change or nuclear power—No thanks! A quantitative study of public perceptions and risk framing in Britain. Global Environmental Change 18, 69-85.
Poortinga, W., Aoyagi, M., Pidgeon, N.F., 2013. Public perceptions of climate change and energy futures before and after the Fukushima accident: A comparison between Britain and Japan. Energy Policy 62, 1204-1211.

Prati, G., Zani, B., 2013. The Effect of the Fukushima Nuclear Accident on Risk Perception, Antinuclear Behavioral Intentions, Attitude, Trust, Environmental Beliefs, and Values. Environment and Behavior 45, 782-798.
Rager, G., Klaus, E., Thyen, E., 1987. Der Reaktorunfall in Tschernobyl und seine Folgen in den Medien. Eine inhaltsanalytische Untersuchung., Lecture at the University of Karlsruhe ed.
Ramana, M., 2013. Nuclear policy responses to Fukushima: Exit, voice and loyalty. Bulletin of the atomic scientists 69, 66-76.
Renn, O., Marshall, J.P., 2016. Coal, nuclear and renewable energy policies in Germany: From the 1950s to the “Energiewende”. Energy Policy 99, 224-232.
Rohrmann, B., Renn, O., 2000. Risk perception research: an introduction, in: Renn, O., Rohrmann, B. (Eds.), Cross cultural risk perception. Springer Science+Business Media, Dordrecht pp. 11-55.
Sabatier, P.A., 1988. An Advocacy Coalition Framework of Policy Change and the Role of Policy-Oriented Learning Therein. Policy Sci 21, 129-168.
Sabatier, P.A., Jenkins-Smith, H., 1999. The advocacy coalition framework, in: Sabatier, P. (Ed.), Theories of the policy process. Westview Press Colorado, pp. 117-169.
Schneider, M., Froggatt, A., Thomas, S., 2011. The world nuclear industry status report 2010-2011. Nuclear energy in a post Fukushima world. , World Nuclear Status Report. Worldwatch Institute, Paris/Berlin/Washington, p. 84.
Shehata, A., Strömbäck, J., 2014. Mediation of political realities: media as crucial sources of information, in: Esser, F., Strömbäck, J. (Eds.), Mediatization of politics. Understanding the transformation of Western democracies. Palgrave MacMillan, New York, pp. 93-113.
Shoemaker, P.J., Cohen, A.A., 2006. News Around the World. Content, Practitioners and the Public. Routledge, New York.
Siegrist, M., Visschers, V.H., 2013. Acceptance of nuclear power: the Fukushima effect. Energy Policy 59, 112-119.
Soroka, S., Wlezien, C., 2010. Degrees of Democracy: Politics, Public Opinion, and Policy. Cambridge University Press, New York.
Sovacool, B.K., 2011. Contesting the future of nuclear power: a critical global assessment of atomic energy. World Scientific, New Jersey.
Spence, A., Poortinga, W., Pidgeon, N., 2012. The psychological distance of climate change. Risk Analysis 32, 957-972.
Steenbergen, M.R., Jones, B.S., 2002. Modeling Multilevel Data Structures. American Journal of Political Science 46, 218-237.
Strack, F., 1992. Order effects in survey research: activation and information functions of preceding questions, in: Schwarz, N., Sudman, S. (Eds.), Context effects in social and psychological research. Springer Verlag, New York, pp. 23-35.
Tatsujiro, S., 2015. Nuclear Energy Policy Issues in Japan After the Fukushima Nuclear Accident. Asian Perspective 39, 591-606.
Todorov, A., 2000. Context Effects in National Health Surveys: Effects of Preceding Questions on Reporting Serious Difficulty Seeing and Legal Blindness. The Public Opinion Quarterly 64, 65-76.
Trope, Y., Liberman, N., 2010. Construal-Level Theory of Psychological Distance. Psychological review 117, 440-463.
Turcanu, C., Perko, T., Latré, E., 2016. The SCK-CEN Barometer 2015. Perceptions and attitudes towards nuclear technologies in the Belgian population. SCK-CEN, Mol.
Van der Meer, T., Te Grotenhuis, M., Pelzer, B., 2010. Comment on Ruiter and De Graaf, ASR, April 2006: Influential Cases in Multilevel Modeling: A Methodological Comment. American Sociological Review 75, 173-178.
Verplanken, B., 1989. Beliefs, attitudes, and intentions toward nuclear energy before and after Chernobyl in a longitudinal within-subjects design. Environment and Behavior 21, 371-392.

Visschers, V.H., Siegrist, M., 2013. How a nuclear power plant accident influences acceptance of nuclear power: results of a longitudinal study before and after the Fukushima disaster. Risk Analysis 33, 333-347.
Wittneben, B.B.F., 2012. The impact of the Fukushima nuclear accident on European energy policy. Environmental Science & Policy 15, 1-3.
World Bank, 2015. Data- Electricity production from nuclear sources (% of total)
Zaller, J.R., 1992. The nature and origin of mass opinion. Cambridge University Press New York.

[i] Robustness of the effect of the three-way interactions—in the models 3 and 4—could not be checked due to convergence issues.