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Getting ready for mega disasters: the role of past experience in changing disaster consciousness

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Abstract

Purpose – Attempting to explore the role of direct experience in influencing disaster consciousness and public opinion, the purpose of this paper is to carry out comparative analyses of Japanese people's knowledge, risk perception, and policy preference about large-scale earthquake disaster before and after the Great East Japan Earthquake. More importantly, aiming to provide implications regarding the application of past experience, the predictive power of direct experience on disaster consciousness is also examined.

Design/methodology/approach – This study analyzed parts of the data collected from two nationwide public opinion surveys among Japanese conducted by the Japanese Government. Analyses of variance were performed to examine changes in disaster consciousness. A path model was developed to examine the predicted effects of direct experience. χ^2 tests were performed to examine changes in strategy preference.

Findings – This study found significant changes in Japanese people's knowledge of natural hazards and perception of mega disaster risk. Tests of the path model suggested significant positive effect of societal level impact on disaster consciousness and strong predictive power of knowledge on risk perception. Significant changes in strategy preference were also found.

Practical implications – Results supported the predictive power of direct experience, highlighting the significance of recalling past experience as well as creating indirect experience to raise public consciousness and motivate appropriate actions.

Originality/value – This is one of the few studies that investigate changes in public opinion among Japanese before and after the Great East Japan Earthquake.

Keywords Japan, Great East Japan earthquake, Direct experience, Disaster consciousness, Mega disaster

Paper type Research paper

Background

Japan is a country that frequently experiences earthquakes. According to a report of Cabinet Office (2015) of the Japanese government, from 2004 to 2013, 302 earthquakes with magnitude of 6.0 or greater had hit Japan, which represented 18.5 percent of the world's number during that period. Japan is also a country famous for its culture of preparedness. As of January 2015, there is a total of 4,377 seismic intensity observation points in Japan (Cabinet Office, 2015). Japan could become a leader in disaster management. Its early warning systems, information and communications systems, measures for support to disaster-affected people, disaster reduction drills, and disaster management bases and facilities are evaluated to be well prepared for disasters below a certain magnitude (Nagamatsu *et al.*, 2012).

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However, disasters that are above a certain magnitude will happen and could lead to severe consequences. Japan has experienced several severe large-scale earthquakes since 1990, for instance, the 1993 Hokkaido Earthquake (M7.8), the 1995 Great Hanshin Earthquake (M7.3), the 2008 Iwate-Miyagi Nairiku Earthquake (M7.2), and the 2011 Great East Japan Earthquake (M9.0). Including the most recent Kumamoto Earthquake (M7.3) occurred in April 2016, these major disasters have brought great impact to the Japanese society and left deep impressions on Japanese people. It is anticipated that near the capital area, Tokyo, a massive trench-type earthquake with a magnitude of 8.0 or greater will occur, which is presumed to cause extensive damage to Japan (Cabinet Office, 2015). Comparing to small and medium-sized earthquakes, mega disasters happen less frequently; however, they are more likely to cause catastrophic damages to various aspects of a society and evoke life safety concern. Dealing with mega disaster risk involves not only estimation of the probability and potential loss but also judgment of the likelihood of survival (Oi, 2013).

Although Japan is a disaster-prone country, it has a relatively short history of establishing the consciousness of mega disasters. From the second half of 1950s to the first half of 1970s, the Japanese society was immersed in its economic development and growth of national power. The improvement of social infrastructure had been highly valued, while many risks, either natural or man-made, had been ignored (Hirose, 2006). Even in public education the priority of human development had been deeply embedded with children's consciousness. The Japanese post-war economic miracle and rapid advancement of technology had supported a secure society for many years until the occurrence of the Great Hanshin Earthquake in 1995, which broke Japan's security myth and terrified the Japanese public (Hirose, 2006).

However, people are likely to have normalcy bias when facing a disaster, which refers to individuals' tendencies to underestimate both the possibility of encountering a disaster and its severity (Omer and Alon, 1994). Such cognitive bias had also been observed among Japanese people, which might be influenced by Japan's socioeconomic stability that made Japanese people reluctant to consider risks and hazards – the darker sides of current life, especially concerning mega disasters that do not happen often (Hirose, 2006). On the other hand, the Japanese government tried to take more responsibilities in disaster prevention and response, including conducting surveys to understand public demand and improve policies. As powerful disasters continue to challenge our cognitive limits, besides grasping public opinion, it is of greater importance to raise consciousness in the wider society and motivate the public to prepare for disasters.

Direct experience provides the most authentic knowledge of a disaster and could be the most available clues for judgments in future hazardous situations. Therefore, attempting to explore the role of direct experience in changing consciousness about mega disaster, this study carried out comparative analyses of Japanese people's knowledge, risk perception, and strategy preference about large-scale earthquake before and after the Great East Japan Earthquake. More importantly, aiming to provide implications regarding the use of disaster experience and memory, the predictive power of direct experience on disaster consciousness is also examined. Specifically, a psychological model is proposed to suggest a cognitive pathway to knowledge and risk perception. Rather than waiting for the next disaster then learn new lessons, it could be more effective to take past experience as a functional factor that has potential power in changing disaster consciousness. For instance, strategies to strengthen disaster memories, as well as to create indirect experience that could reach a larger audience may increase public knowledge and help them to make better judgments and decisions about risks and hazards.

In general, research on Japanese people's cognitive reactions to large-scale earthquake, like the Great East Japan Earthquake, may promote the discovery of new directions in Japan's policy for mega disaster management. Furthermore, the case study of Japan's largest earthquake could also contribute insights to mega disaster management in other countries. Economic development of many countries could be undergoing or about to undergo similar stages to that of Japan. Thus, Japan's case could be a reference, assisting these countries in their evaluation and improvement of the development strategies, as well as soft strategies for raising public consciousness about the threats to development.

Theoretical perspectives

From the psychological perspective, consciousness is explained to encompass diverse phenomena that people are aware of or experience (Velmans, 2009a). The term is often synonymous with awareness, referring to not only experiences that people commonly associate with themselves, for instance feelings, emotions, and thoughts, but also the experienced phenomenal world that is structured by human understanding (Velmans and Schneider, 2007).

Consciousness is sometimes connected to knowledge, in the sense that if one is conscious of something one also has knowledge of it (Velmans, 2009b). Knowledge is seen as an important feature of consciousness (Velmans, 2009a), which can be used as a convenient measure for detecting consciousness. Knowledge is also regarded as an important constructing factor of the risk society (Beck, 1992). It asserts that how people know a risk or hazard largely decides how it is conceptualized and how its characteristics are identified (Böhme, 1997; Böhme and Stehr, 1986; Stehr, 1994). Therefore, the risk society is also considered a knowledge society (Beck, 1992), in which the production of knowledge gives birth to the concept of risk and the debate between different types of knowledge characterizes risk (Strydom, 2002). As a result, delivering knowledge becomes the fundamental goal of risk communication (Covello and Sandman, 2001). It is common to see great efforts being made to educate the public for raising disaster consciousness and promoting precautionary behavior (Plough and Krimsky, 1987; Stern and Fineberg, 1996).

The cognitive perspective emphasizes more the competence of human being in dealing with risk and hazard. It is claimed that humans are able to actively learn from direct or indirect experience and apply appropriate reasoning to make judgments and guide behavior (Bandura, 1986). This particular feature of human functioning influences individual behavior in a purposeful and goal-directed way, in which knowledge is learned through observation and behavior pattern is developed based on one's own capabilities (Denler *et al.*, 2014). Therefore, policy makers are suggested to value people's competence and to design strategies to promote individual preparedness and self-protective behavior (Prati *et al.*, 2011; Schwarzer and Fuchs, 1995; Verroen *et al.*, 2013). Past experience of a disaster lets people know the possible consequences of a disaster and envision a future hazardous situation. As such, experience could be the most available learning material, which would facilitate better judgment and individual action plan.

Another important measure to detect disaster consciousness is perception of risk, which is conceptualized as non-experts' intuitive judgment of risk (Fischhoff, 1995; Slovic, 1987; Slovic *et al.*, 1982). The term often refers to how people see and make meaning of a risk. High level of risk perception regarding a hazard is probably linked to strong consciousness of the hazard. The expert and lay judgments of risk are based upon different evaluation schemes (Anderson, 1997). Different from the experts who own professional knowledge and skills to perform scientific assessment, non-experts

tend to rely on subjective factors, such as feelings, to estimate the likelihood and potential consequences of a hazard. Therefore, the concept of risk perception implies a cognitive gap between experts and the general public, which draws interest of scholars and practitioners to explore its structure.

It is worth noting that risk perception does not necessarily lead to irrational response. Previous research found that a high level of risk perception was likely to play the role of psychological stimulus, motivating cognitive, and behavioral efforts to alleviate the feeling of threat (Maddux and Rogers, 1983; Ruiter *et al.*, 2001). Therefore, risk perception is supposed to have the potential to boost precautionary behavior. For instance, a number of empirical studies (Griffin *et al.*, 1999; Huurne and Gutteling, 2008; Kahlor, 2010) supported the predicted effect of risk perception on individual's risk information seeking – a significant forerunner of self-protective behavior (Kellens *et al.*, 2012; Kievik and Gutteling, 2011; Mileti and Darlington, 1997). These findings also justify the significance of studying risk perception.

Some scholars try to explain risk perception from the sociological perspective. For instance, the cultural theory of risk claims that risk perception is closely related to how people adhere to their cultural background and act upon the world around them (Douglas and Wildavsky, 1983). It suggested that the sociological explanation of risk perception was capable to "predict and explain what kind of people will perceive which potential hazards to be how dangerous" (Wildavsky and Dake, 1990, p. 42). Although there have been very few empirical studies to support the theory (Sjöberg, 2000), such sociological perspective provides valuable insight into culture-based studies on people's reactions to risk and hazard.

Concerning the predictors of risk perception, previous research found a variety of personal and socio-cultural factors responsible for determining risk perception. To name a few, experience (Barnett and Breakwell, 2001; Kung and Chen, 2012), knowledge (Pagneux *et al.*, 2011), and feelings (Slovic *et al.*, 2010) are suggested to be significant personal factors, while media information (Berry, 2004; Wahlberg and Sjöberg, 2000) is suggested to be an important socio-cultural predictor. Among these factors, many studies on natural hazards suggest that direct disaster experience exerts a strong effect on risk perception, and in most cases it results in a higher risk perception (Wachinger *et al.*, 2013). It is explained that direct experience offers vivid illustration of the threat, enhanced imagination of the consequences, and strengthened negative feelings, which is likely to cause an overestimation of risk (Kung and Chen, 2012; Miceli *et al.*, 2008; Siegrist and Gutscher, 2006).

Given the above, this study examines the role of direct disaster experience from the perspective of cognitive psychology, attempting to provide new insight into strategies for raising disaster consciousness. Considering the impact of the Great East Japan Earthquake, this study assumes significant changes in Japanese people's disaster consciousness after such a mega disaster. Their knowledge and perception of earthquake could be considerably increased by what they saw, what they heard, and how they felt during the disaster. Hence, this study is interested in the predicting role of experience and assumes significant positive effect of direct experience on disaster consciousness. Therefore, the following research questions and hypotheses are proposed:

RQ1. Are there changes in Japanese people's disaster consciousness before and after the Great East Japan Earthquake?

H1. Japanese people's knowledge of natural hazards has been enhanced after the Great East Japan Earthquake.

H2. Japanese people's perception of mega disaster risk has been increased after the Great East Japan Earthquake.

RQ2. Whether and how does the direct experience of the Great East Japan Earthquake influence Japanese people's disaster consciousness?

H3. Direct experience of the Great East Japan Earthquake enhances Japanese people's knowledge of natural hazards.

H4. Direct experience of the Great East Japan Earthquake increases Japanese people's perception of mega disaster risk.

Moreover, it is believed that the real-time disaster response could be the most persuasive evidence to demonstrate the value and limitations of strategies and measures. Public opinion on disaster management is supposed to change after a major disaster. Therefore, this study also pays attention to Japanese people's strategy preference. The pre- and post-earthquake data regarding these two aspects of the Japanese public opinion are compared. Thus, the third research question, *H5*, and *H6* are proposed as follows:

RQ3. Are there changes in Japanese people's opinions on government strategies and responsibility allocation in disaster response before and after the Great East Japan Earthquake?

H5. Japanese people's strategy preference regarding disaster response has changed after the Great East Japan Earthquake.

H6. Japanese people's view on responsibility allocation in disaster response has changed after the Great East Japan Earthquake.

Methodology

The nationwide public opinion surveys before and after the Great East Japan Earthquake

This study analyzed parts of the data collected from the nationwide Public Opinion Survey on Strategies for Mega Disasters, 2011.1 and the Public Opinion Survey on Strategies for Mega Disasters, 2011.11, which were planned before and after the Great East Japan Earthquake by the Economic and Social Research Institute, Cabinet Office, Government of Japan.

Having benefited from the implementation of the systematic disaster management measures for years, Japan is confident in its prevention and response to small and medium-sized disasters. However, because of the geographical, topographical, and meteorological conditions, Japan is facing great risk of large-scale disasters. After the catastrophic Great Hanshin Earthquake in 1995, to deal with disasters with low probability and high consequence has became one major task in Japan's disaster management. The aim of the two surveys was mainly to outline the public's disaster consciousness and policy preferences regarding large-scale earthquakes and hydro meteorological hazards, which were identified as mega disaster with low probability and high consequence. Items on earthquake and hydro meteorological hazard were separated in the original questionnaires. Additional items about the Great East Japan Earthquake were included in the second survey. Data regarding earthquake in the two surveys were used in this study.

Data collection

Two Japanese survey research institutes were entrusted to implement the surveys. In the pre earthquake survey, participants were recruited based on four age groups

(i.e. 20 s, $n = 660$; 30 s, $n = 660$; 40 s, $n = 660$; 50 s, $n = 660$) from panel members of Institute N. A sample of 2,640 Japanese people (male = 1,320, female = 1,320) with an average age of 39.7 years was collected. Similarly, in the post-earthquake survey, participants were recruited based on four age groups (i.e. 20 s, $n = 889$; 30 s, $n = 889$; 40 s, $n = 880$; 50 s, $n = 894$) from panel members of Institute C. A sample of 3,552 Japanese people (male = 1,768, female = 1,784) with an average age of 39.6 years was collected. It is necessary to note that, comparing to the age distribution of the Japanese population in 2011 (Ministry of Internal Affairs and Communications, 2011, 2012), the younger and older age groups (i.e. 20s and 50s) were slightly overrepresented in both of the two surveys.

Measures

First of all, ten items were used in the post-earthquake survey to measure the participants' direct experience. All the ten items were invited for analyses in this study, which were rated on three-point scales (1 = not at all, 3 = very). As shown in Table I, factor analysis was performed to obtain two components of direct disaster experience. They were labeled societal impact and personal impact, which explained 57.2 percent of the total variance. The KMO and Bartlett's test were also performed to examine the suitability of the data for detecting factor structure. The resulting coefficients confirmed that the data were suitable for factor analysis (KMO measure of sampling adequacy = 0.86 > 0.60; Bartlett's test of sphericity, $p < 0.001$). To facilitate the later analyses, scores of items representing each of the two factors were averaged to form the indices of societal impact (four items, $\alpha = 0.779$) and personal impact (six items, $\alpha = 0.826$) experienced by the participants.

We found two aspects of Japanese people's disaster consciousness were investigated by the same questions in the pre- and post-earthquake surveys. One is their view on the relationship between human activities, global warming, and natural hazards. Three relevant items in the questionnaires were invited for analyses in this study and used to represent the knowledge of natural hazards (see Table II). The other aspect of disaster consciousness is their concerns about future mega disasters. Three relevant items were picked up from the questionnaires to represent risk perception (see Table II). All the items were rated on five-point scales (1 = strongly disagree, 5 = strongly agree).

Item	Factor 1	Factor 2	*M*	SD
Societal impact ($\alpha = 0.779$)				
Right after the earthquake, it became difficult to confirm the safety of my families, friends, and acquaintances	0.840		1.73	0.82
When the earth was shaking, I felt my life was in danger	0.797		1.83	0.76
The damage to the logistics lifeline has brought about hindrance to my daily life	0.747		1.60	0.73
Right after the earthquake, it became difficult to go back home	0.630		1.36	0.71
Personal impact ($\alpha = 0.826$)				
I have relatives and friends died from the disaster		0.785	1.08	0.37
I have relatives and friends forced to live a long-term refuge life		0.767	1.13	0.43
My heart hurts when the disaster hit my hometown		0.715	1.21	0.54
My house, car, and possessions have been damaged		0.703	1.14	0.44
The disaster made me apart from my house to live a refuge life		0.691	1.09	0.38
My work has decreased sharply because of the impact from the disaster		0.663	1.24	0.55

Table I. Factor analysis regarding Japanese people's direct experience of the Great East Japan Earthquake

Table II.
Analyses of variance regarding Japanese people's knowledge of natural hazards and perception of mega disaster risk before and after the Great East Japan Earthquake

Item	Group	*M*	SD	*F*
Knowledge of natural hazards				
Human activities are the major cause of global warming	Pre	3.82	0.99	11.70**
	Post	3.91	0.99	
Global warming increases natural hazards	Pre	3.96	0.88	9.67**
	Post	4.04	0.89	
Global warming cannot be stopped for the time being	Pre	3.88	0.85	13.99***
	Post	3.96	0.87	
Perception of mega disaster risk				
Mega disasters are very likely to lead to Japan's decline	Pre	3.71	0.87	174.85***
	Post	4.00	0.85	
I am worried about the aging lifeline facilities	Pre	3.79	0.83	63.00***
(e.g. road, railway, gas and water supplies)	Post	3.96	0.82	
Compared with our generation, the probability of the future	Pre	3.72	0.84	6.03*
generations to encounter mega disasters is higher	Post	3.77	0.87	

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Regarding Japanese people's opinions on government strategies for disaster response, the same question was asked in the pre- and post-earthquake surveys to investigate the public's strategy preference. Specifically, participants were asked to choose one of four strategies that they considered the most important strategy needed to be strengthened (see Table III, labeled Opinion 1). Japanese people's view on responsibility allocation in earthquake disaster response was also investigated by one question in the pre- and post-earthquake surveys. Participants were asked to indicate to whom the responsibility should belong in four situations (see Table IV, labeled Opinion 2_1-Opinion 2_4).

Results

Regarding the first research question, analyses of variance were performed to examine whether Japanese people's knowledge level of natural hazards and risk perception of

Table III.
χ^2 Test regarding Japanese People's Opinions on Government Strategies for Disaster Response before and after the Great East Japan Earthquake

Opinion 1	Group: Pre *n* (%)	Group: Post *n* (%)
Restrictions to land use and economic activities in the areas where earthquakes happen frequently and more likely to have significant shaking; no residents in the areas with high probability of being affected by earthquake	291 (11.0)	396 (11.1)
Improvement of buildings and urban infrastructures, so that even earthquake happens there will not be so much impact	1,001 (37.9)	1,065 (30.0)
Improvement of the post-earthquake relief system and crisis management to minimize the damage	920 (34.8)	1,395 (39.3)
Enhancement of the support for the reconstruction of damaged areas, to accomplish as soon as possible the recovery of victims' lives and local economy	428 (16.2)	696 (19.6)
Total	2,640	3,552
Pearson χ^2	46.07***	
df	3	
ϕ and Cramer's *V*	0.086***	

Note: ***$p < 0.001$

Group	a *n* (%)	b *n* (%)	c *n* (%)	d *n* (%)	e *n* (%)	Total	Pearson χ^2	df	ϕ and Cramer's *V*
Opinion 2_1 development of strong urban infrastructures									
Pre	705 (26.7)	1213 (45.9)	666 (25.2)	41 (1.6)	15 (0.6)	2,640	20.20***	4	0.057***
Post	1107 (31.2)	1597 (45.0)	776 (21.8)	44 (1.2)	28 (0.8)	3,552			
Opinion 2_2 improvement of earthquake resistance of private buildings									
Pre	233 (8.8)	595 (22.5)	1369 (51.9)	379 (14.4)	64 (2.4)	2,640	11.40*	4	0.043*
Post	316 (8.9)	716 (20.2)	1819 (51.2)	596 (16.8)	105 (3.0)	3,552			
Opinion 2_3 preparation of emergency essentials									
Pre	651 (24.7)	1058 (40.1)	857 (32.5)	60 (2.3)	14 (0.5)	2,640	17.41**	4	0.053**
Post	822 (23.1)	1335 (37.6)	1314 (37.0)	56 (1.6)	25 (0.7)	3,552			
Opinion 2_4 evacuation support for vulnerable populations									
Pre	627 (23.8)	1183 (44.8)	765 (29.0)	49 (1.9)	16 (0.6)	2,640	3.03	4	0.022
Post	874 (24.6)	1559 (43.9)	1033 (29.1)	55 (1.5)	31 (0.9)	3,552			

Notes: a, all responsibilities should be taken by the government; b, the government should take some of the responsibilities; c, the public should share the responsibilities with the government; d, the government should not be involved too much; e, the government should not be involved at all. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table IV. χ^2 Test regarding Japanese People's Opinions on Responsibility Allocation in Disaster Response before and after the Great East Japan Earthquake

future mega disasters became higher. The resulting *F*-values in Table II suggested that, the means of every item measuring knowledge and every item measuring risk perception significantly increased from the pre- to the post-earthquake group. In addition, the Brown-Forsythe test and the Welch test were performed for each item to assess the homogeneity of variance. All resulting coefficients were significant at the 0.001 level, which validated that the two samples (i.e. the pre- and the post-earthquake samples) came from the same population. Therefore, *H1* and *H2* were fully supported by the results.

The second research question concentrates on the relationship between direct experience and disaster consciousness. A path model under the structural equation modeling (SEM) framework was developed to examine the proposed predicted effects of societal and personal impact experienced by the Japanese people on their knowledge of natural hazards and perception of mega disaster risk. Sex and age were controlled to exclude their potential influence. AMOS 21.0 was used to evaluate model fit. Figure 1 presents the results of the SEM analysis. The resulting model ($\chi^2 = 43.43$, df = 5) was significant at the 0.000 level, which is expected given the large sample size ($N_{post} = 3552$). Other statistics present good fits: the goodness of fit index (GFI) is 0.996, the comparative fit index (CFI) is 0.974, the Tucker-Lewis index (TLI) is 0.921, the root mean square error of approximation (RMSEA) is 0.047, and the standardized root mean square residual (SRMR) is 0.023. The indices met the criteria of GFI > 0.90, CFI > 0.90, TLI > 0.90, RMSEA < 0.08, and SRMR < 0.05. Overall, the indices indicate good fit between the data set and the proposed path model.

Estimates in Figure 1 showed that societal impact significantly increased knowledge ($\beta = 0.13$, $p < 0.001$), while personal impact significantly reduced its level ($\beta = -0.05$, $p < 0.01$). On the other hand, societal impact significantly increased risk perception ($\beta = 0.04$, $p < 0.05$), however, personal impact showed no significant effect. In the meantime, knowledge demonstrated great power in increasing risk perception ($\beta = 0.41$, $p < 0.001$). Cumulatively 18 percent of the variance in risk perception could be explained by societal impact and knowledge. As a result, both *H3* and *H4* were partially supported.

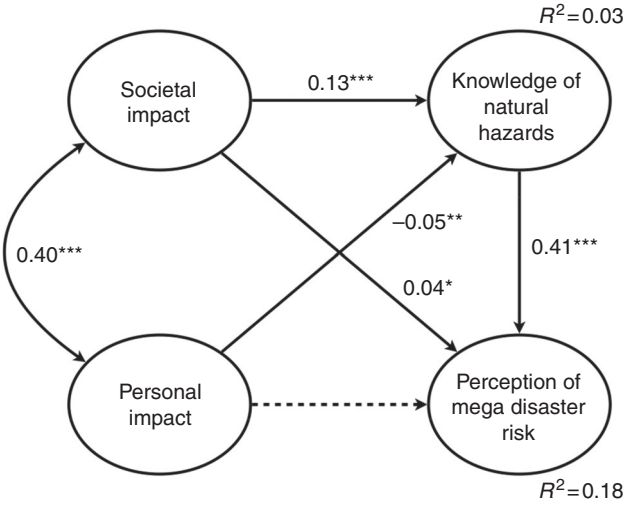

Figure 1.
The resulting model predicting knowledge of natural hazards and perception of mega disaster risk

Notes: Estimates are standardized coefficients of regression. *$p<0.05$; **$p<0.01$; ***$p<0.001$, and dash line represents the nonsignificant relationship

Source: Created by authors

The third research question is to investigate changes in Japanese people's strategy preference (Opinion 1) and their view on responsibility allocation in disaster response (Opinion 2). Table III showed the results of χ^2 test regarding Opinion 1. To be specific, both the χ^2 statistics and the ϕ and Cramer's V were significant at the 0.001 level, suggesting that between the pre- and the post-earthquake groups significant differences were found in their preference about the four strategies. Changes in percentage implied that, after the Great East Japan Earthquake, more Japanese people expected more efforts from the government to be invested in the post-disaster relief system and reconstruction. Overall, *H5* was supported by the results.

Regarding public opinion on responsibility allocation in disaster response, χ^2 tests were performed to examine the difference between the pre- and the post-earthquake groups in four situations (Opinion 2_1-Opinion 2_4). Results in Table IV showed that, the χ^2 statistics and the ϕ and Cramer's V were significant at the 0.001 level, the 0.05 level, and the 0.01 level in the tests for Opinion 2_1, Opinion 2_2, and Opinion 2_3, respectively; however, the statistics were not significant in the test for Opinion 2_4. The significant differences between the pre- and the post-earthquake groups implied that, after the Great East Japan Earthquake, more Japanese people thought the government should take all the responsibilities in developing urban infrastructures, more people thought the government should not involve too much in improving private buildings' earthquake resistance, and more people thought the public should share responsibility in preparing emergency essentials. These results suggested changes in Japanese public opinion on responsibility for preparedness. *H6* was partially supported.

Discussion

Based on the data of two Japanese public opinion surveys, this study endeavors to discover the trends relating to Japanese people's disaster consciousness and opinions

on government strategies for dealing with future disasters, particularly concerning the mega disasters with the characteristics of low probability and high consequence. As the most powerful earthquake in Japanese history, the Great East Japan Earthquake is supposed to influence Japanese people's knowledge, risk perception, and policy preference about mega disaster.

By comparing the pre- and post-earthquake data, this study first found significant changes in Japanese people's knowledge of natural hazards and perception of mega disaster risk. After the big earthquake, Japanese people's consciousness about the causes of natural hazards was increased. They became more aware of the negative impact of global warming on the environment, the role of human activities in contributing to global warming, and the powerlessness of humanity in controlling it. Meanwhile, Japanese people's risk perception of mega disaster became higher. They showed an increased concern about the consequences of mega disasters and became more worried about the catastrophic effects of mega disasters on the Japanese society and the next generation.

These changes in disaster consciousness were found to have strong association with the extent to which people experienced the societal and personal level impacts from the big earthquake. Specifically, the more people experienced the societal level impact, such as life-threatening situations involving many people and large-scale damages to critical infrastructures, the more likely they would have strong awareness of the causes of disasters and perceive great risk of mega disaster. In contrast, the more people felt personally affected, such as influence on daily life and loss of relatives or friends, the less likely they would be aware of the causes, and there would be no significant change in their risk perception. The difference of social and personal impacts in affecting disaster consciousness may be because Japan has frequently experienced small and medium-sized earthquakes. Japanese people tend to pay more attention to personally relevant consequences when earthquake occurs (Hirose, 2006). Therefore, severe impact on personal life may cause people to overlook damages to the wider society as well as many other important facts about the disaster.

As the societal level impact has significantly contribute to the accumulation of knowledge about natural hazards, the increase in knowledge leads to higher level of perceived mega disaster risk. A large volume of knowledge is supposed to decrease risk perception because knowledge could ensure a comprehensive judgment of risk to relieve the fear about a hazardous situation. However, most of the existing evidence has rejected this assumption, suggesting that knowledge usually increases risk perception (Wachinger *et al.*, 2013). The positive effect of knowledge on perceived risk could be explained that knowledge is able to induce more people's cognitive effort to imagine the consequences of a disaster. Accordingly, as people know more about it, they may perceive it to be more dangerous because they know it to be dangerous.

Findings of this study demonstrate a salient role of direct disaster experience in promoting disaster consciousness. In many cases, awareness reach higher levels after a disaster, but drop back to average levels in a very short period of time (Walker *et al.*, 2003). This fading effect of unpleasant past experience might negatively influence disaster prevention and preparedness, particularly for mega disasters that do not frequently occur. The post-earthquake data used in this study were collected within one year after the Great East Japan Earthquake and the analyzing results supported the predictive power of direct experience, which highlighted the significance of recalling past experience to raise public consciousness and motivate appropriate actions.

From the cognitive psychological perspective, the potential effects of past experience is explicated by connecting it with availability heuristic, which is

conceptualized as a useful clue for making judgment (Tversky and Kahneman, 1974). Past experience of a disaster stored in memory contains many instances, which are usually easy and fast to recall. Therefore, the availability heuristic is supposed to function efficiently when evaluating a similar situation. Past experience is able to facilitate constructing a mental image of the effects of a disaster and various difficulties one might encounter during the disaster. Furthermore, previous occurrence can be reproduced and disseminated via various levels of communication. Such indirect experience generated from communication networks would reach a larger audience, providing knowledge and sharing the feeling to the wider society. Therefore, government strategies are suggested to include a communication strategy, by which past disasters can be vividly portrayed to get the public connected with the disaster.

Additionally, this study also observed changes in Japanese people's opinions on government strategies and responsibility allocation in disaster response. After the Great East Japan Earthquake, more Japanese people emphasized the importance of improving post-disaster relief. There was also a tendency among Japanese people to think the public should share responsibilities in disaster preparedness. The real-time response is the most powerful evidence to identify the limits and shortcomings of policies and strategies. The disaster caused 15,894 deaths, 6,152 injured, and 2,561 missing, as well as 121,805 buildings being completely destroyed (National Police Agency of Japan, 2016). Therefore, it is not surprising that such a serious disaster changed the public's evaluation. In addition, previous study found that Japanese public's trust in organizations dealing with earthquake disasters had decreased after the Great East Japan Earthquake (Nakayachi, 2015), which could also be related to the changes in the public's strategy preference.

Overall, findings of this study highlight the role of direct experience in promoting disaster consciousness. The predicted effects of experience are expected to provide implications for disaster prevention education and the communication of mega disaster risk. Regardless of how technologically advanced we are, we cannot tell when the next big disaster will occur. For many Japanese people, it might be difficult to answer the question "Are you ready for mega disaster?" The consequences of a major disaster like the Great East Japan Earthquake are too terrifying to be conscious of. However, at least we treasure human life, what disaster management is trying to do is to minimize the negative impact when mega disaster strikes. This study on public opinion is helpful for improving policies and strategies. More importantly, it provides new insight regarding the functional role of past experience in changing people's cognitive reactions to disaster. Future research is encouraged to put continuous effort into investigations on the public consciousness, including in-depth interviews and longitudinal surveys, for discovering more effective methods of getting the public prepared and strengthening the resilience of the society.

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