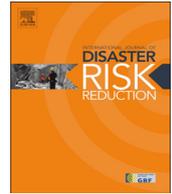




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Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: www.elsevier.com/locate/ijdr

A method to improve trust in disaster risk managers: Voluntary action to share a common fate

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ARTICLE INFO

Article history:

Received 14 March 2014

Received in revised form

9 July 2014

Accepted 10 July 2014

Available online 17 July 2014

Keywords:

Trust

Risk manager

Salient value similarity

Common fate

ABSTRACT

In this study, the effect of voluntary action to share a common fate on trust was empirically examined. Voluntary actions to share a common fate involve decisions by risk managers that place them at an equal risk as the public during times of disaster. Participants included 118 housewives who were randomly assigned to one of the three conditions: voluntary sharing of a common fate, passive sharing of a common fate, and non-sharing of a common fate. The results of the analysis indicated that trust ratings of risk managers in the voluntary condition were greater than were the ratings in the other two conditions; moreover, the trust ratings in the passive and non-sharing conditions were at equally low levels. Furthermore, the results indicated that perceived value similarity for trust had a high explanatory power in both the passive and non-sharing conditions. These results suggested that risk managers can improve their trust by voluntarily sharing the fate of the general public. The results also indicated that when trust level is low, individual differences in trust are explained by the perception that the values are shared between risk managers and the public. Finally, the relationship between trust in risk managers and the forecast of risk reduction was discussed.

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1. Introduction¹

1.1. Action to share a common fate

The public's trust in people who manage risk plays a significant role in controlling damage caused by disasters [1–3]. If risk managers are not trusted, residents may be hesitant about evacuating an area, even if they are informed that a major disaster is imminent; this would likely result in greater damages. Furthermore, if a lack of trust exists between risk managers and the public, the

public may demand unnecessary disaster countermeasures even when risk managers assert that a risk of a disaster is small. In turn, this may result in government agencies expending an excessive amount of resources (i.e., budget and personnel) unnecessarily; moreover, this may make societies more vulnerable to future disasters since governments have limited resources they can invest in disasters.

Therefore, the trust of the public is important for appropriate risk reduction. Indeed, trust in risk managers has been examined in studies of risk perception [4–6]. These studies indicated that there is an asymmetry inherent in trust [7–9]; in other words, trust is difficult to establish and can be easily destroyed. Once it is destroyed, it is difficult to rebuild. Difficulty in gaining and re-gaining trust is the very reason why researchers have paid much

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E-mail addresses: nakayachi@mail.doshisha.ac.jp (K. Nakayachi), dkn0206@mail2.doshisha.ac.jp (T. Ozaki).¹ INES=International Nuclear Event Scale; SVS=Salient Value Similarity.

attention to trust as a research topic. However, most studies have focused on the composition and prerequisites of trust; few studies, in fact, have provided an achievable prescription to improve trust [10].

In the present study, we propose that the voluntary action to share a common fate is a prescription for trust, and we empirically examine its effect herein. We define an action to share a common fate as an act where the risk manager (trustee) places him/herself in a position where he/she will experience similar damage as the public (truster) during a disaster. Moreover, we define this action as voluntary when it is decided upon by the risk manager's own volition. For example, if a chemical plant accident affected a certain region, a voluntary action to share a common fate would entail a risk manager moving into that region according to his/her own volition; thus, the risk manager would inhale the same air, drink the same water, and live the same life as the residents of the affected area.

In the sections below, we will provide a rationale for why a voluntary action to share a common fate would predict heightened trust.

1.2. Rationale of the present study

When sharing a common fate, the risk managers themselves would be damaged if they could not minimize the risk. Consequently, risk managers are expected to do their best to avoid the damage. In this way, sharing a common fate produces an incentive for risk managers to work hard to reduce risk. Correspondingly, we predict that members of the public who observe risk managers' action to share a common fate will show greater trust toward these managers.

Our research shows that there is another reason why an act to share a common fate increases trust, other than a change in the incentive structures. Acting to share a common fate means the actors (risk managers) themselves are creating a situation where they have little incentive to go slow. Therefore, acting to share a common fate not only changes incentive structures but also implies that the actors are willing to risk themselves in order to become in-group members and that they seriously wish for risk reduction. This function of the action can be interpreted as a signaling effect, suggesting it works only when the risk managers voluntarily share a common fate. In other words, perceived trustworthiness of the trustees would not be affected by the passive acceptance of sharing a common fate.

Another psychological model, the Salient Value Similarity (SVS) approach, also explains how trust is derived from an action to share a common fate [4]. In this approach, trust toward risk managers is conceived when the truster (i.e., the general public, residents, or consumers) feels that a value in the problem is salient to them and the trustee (risk manager). Specifically, if the truster perceives that the trustee shares the same salient values, the truster will trust the trustee. The SVS approach has been used as a framework in studies of risk perception. Many of the studies in this field have shown that risk managers tend to be trusted when they are perceived as having shared values with the truster [11–17].

Indeed, the most significant values during times of disaster for citizens are those related to protecting their own lives and their own health, as well as that of their families. A risk manager's decision to share a common fate regarding exposure to disaster risk means that they risk the same values as the citizens do. When the citizens see such actions, they will realize that the risk manager shares the same values in the same situation with them, leading them to evaluate him/her as trustworthy. Furthermore, voluntariness in risk managers' actions will function as a signal of high trustworthiness. According to the discussion above, the first hypothesis regarding the effects of voluntarily sharing a common fate is as follows.

Hypothesis 1. The public's trust toward the risk managers, who voluntarily share their fate with the trusters will be higher than will the general public's trust toward risk managers who do not share their fate or those who share their fate passively.

1.3. Comparison of the three determinants of trust

Risk perception studies have examined various determinant factors of trust. As aforementioned, the perceived value similarity appears to be an important factor to consider. This is a context dependent variable where the extent of similarity is determined by combining the values of the truster and the trustee. In addition, other determinant factors have been documented in the literature. These include the truster's evaluation of the characteristics of the trustee. For example, the perceived competency, integrity, fairness, transparency, objectivity, and honesty of the trustee have been examined as potential determinants of trust [18–25]. In these studies, perceived competency is frequently treated as an independent factor; however, there is a conceptual overlap in the other traits, and it is argued that they can be integrated into a single factor of motivation [26,27], affect [28], or care [25]. In sum, there are typically three factors that determine trust of risk managers: perceived salient value similarity, competency, and motivation.

Thus, it seems prudent to examine how these determinants of trust change their explanatory power depending on the context. A better understanding of which trait best predicts trust depending on the situation will provide valuable information for how risk managers can improve their own trustworthiness. In fact, previous studies have shown that the explanatory power of perceived value similarity toward trustworthiness increases when individuals are concerned about the issues facing them [29] or when social opinions about the issue are divided [30]. In addition, one recent study has revealed that the explanatory power of perceived value similarity becomes higher when the overall trust level of the trustee is low [31]. In the study, researchers examined the trust level of the public toward the eight organizations involved in risk management after the 2011 Tohoku Earthquake. The results of the study revealed that perceived value similarity best explained the trustworthiness rating of risk management organizations among those organizations that the general public trusted less. On the other hand,

the explanatory power of perceived value similarity for trust was low for organizations with an overall higher level of trust.

Therefore, we predicted that when people's trust in risk managers was heightened through voluntarily sharing a common fate, the perceived value similarity was not expected to explain a significant amount of the variance in trust scores. In other words, perceived value similarity will have a weaker relationship with individual differences in trust levels, after the trust level has been elevated via a risk manager's voluntary action to share a common fate. On the other hand, if trust levels in risk managers who do not take action to share a common fate (or do so only passively) are low, the perceived value similarity was predicted to explain a large amount of the variance in individual differences in trust scores. This is outlined in the following hypothesis.

Hypothesis 2. Value similarity will explain trust less for the trusters whose trust level was heightened due to the voluntary action to share a common fate taken by the trustee (risk manager). Conversely, if trust toward the trustee was low due to no voluntary action, value similarity will explain trust more among trusters whose trust level was low.

1.4. Relationship between trust and the forecast of risk reduction

Researchers in the field of risk perception have paid attention to trust in risk managers because it strongly relates to perceived risk. A number of studies have presented evidence on how trust influences perception of risk [4–6,9,14–17]. Therefore, if action to share a common fate by a risk manager increases the public trust toward the manager, it is also expected that the public will perceive less risk in areas managed by that manager. Particularly, when the action is taken voluntarily, it will signal that the risk manager is highly motivated to minimize risk. As a result, those who are informed of risk managers' initiatives in sharing a common fate will expect that the risk is sufficiently reduced. Namely, if **Hypothesis 1** is supported, the forecast of risk reduction will be greater in cases where voluntary action is taken by a risk manager to share a common fate than in cases where action is taken passively or no action is taken.

Hypothesis 3. The forecast of risk reduction is expected to be high for trusters whose trust level is heightened due to the voluntary action taken by the risk manager to share a common fate. On the other hand, if trust toward the risk manager is low due to passive action or no action to share a common fate, the forecast of risk reduction will be low.

2. Materials

The Tohoku Earthquake occurred off the coast of north-eastern Japan on March 11, 2011. The seismic magnitude was Mw 9.0, the largest ever observed in the history of the country [32]. The earthquake brought astounding damage [33], including the accident at the Fukushima-Daiichi nuclear power plant, which was designated as a Level 7 event, the

highest level on the International Nuclear Event Scale (INES) [34]. In this study, we used the issue of low-dose ionizing radiation that affected Fukushima residents as an example.

After the disaster, residency was restricted in areas within a 20 km radius of the Fukushima-Daiichi nuclear power plant, as well as regions in which the annual cumulative radiation exposure dose exceeded 20 mSv/year. Although it appears that in areas outside of this region the radiation dose remained at low levels and posed little risk to health, the levels of radiation in the air was one order of magnitude higher than the level prior to the nuclear plant accident [35]; this has prolonged the concerns of the Fukushima residents. As a result, there were many cases of mothers prohibiting their children from playing outdoors or refraining from giving them vegetables in order to minimize their children's exposure to radiation. These practices were so extreme that risks from lack of exercise and unbalanced diet became a concern for these children. To reduce such risks, Fukushima prefecture (the local government) and Fukushima Medical University held several briefing sessions for residents on the health impact of radiation. Furthermore, the measurement of internal radiation exposure was conducted using whole body counters; in addition, thyroid medical examinations were conducted on residents who were 18 years or younger [36]. Thus, the risk managers (those who were responsible for risk assessment and communication with residents after the Fukushima-Daiichi nuclear power plant accident) were the radiation medicine experts. Therefore, this study examined how trust toward radiation medicine doctors who worked with Fukushima prefecture was influenced by their actions to share a common fate.

3. Method

3.1. Participants

One hundred and eighteen housewives who were living in the Kansai region with their children participated in the experiment. The ages of the participants was distributed as follows: 21.2% were in their 30s, 39.0% were in their 40s, 35.6% were in their 50s, and 4.2% were in their 60s. Participants were average housewives who had registered with a survey company. They applied to participate in the experiment in July 2013. Housewives with children were selected as subjects because mothers' trust and perception of risk has an impact on the health risk management of children.

Kansai is located over 500 km away from the Fukushima-Daiichi nuclear power plant. The participants from this region were selected because they have not faced trust issues concerning low dosage radiation, even after the nuclear power accident. In addition, it is likely that the residents of eastern Japan have been affected by the nuclear plant accident; thus, they probably already have an opinion about the risk management system of low-dose ionizing radiation. Hence, it was suspected that those from regions closer to the Fukushima-Daiichi nuclear power plant were not appropriate participants because the manipulation used herein would likely be affected by preexisting attitudes.

3.2. Design

A one-factor, between subjects design was used. The information given to participants was the independent variable, while participants' evaluation scores of an expert on radiation medical care were the dependent variables. Participants were randomly assigned to one of the following conditions: voluntary sharing condition, where the participants evaluated a trustee who voluntarily takes action to share a common fate; passive sharing condition, where a trustee's action to share a common fate is passively taken due to the pressure from his/her surroundings; and non-sharing condition, where no actions to share a common fate are taken by the trustee.

3.3. Procedure

A researcher of disaster risk perception conducted the experiment in groups consisting of thirteen to seventeen participants. They were provided with a questionnaire including the profile of an expert on radiation medical care (Professor A) and fifteen items related to trustworthiness of Professor A based on the profile. No time limit was set and participants were asked to read the profile and to respond to the items at their own pace.

3.4. Script and questions

In all conditions, the profile started with the following introduction: "Due to the Fukushima-Daiichi nuclear power plant accident associated with the Great Tohoku Earthquake, many residents have been exposed to radiation and are concerned about its adverse effects. Under such a state, Professor A, who has been working in the medical department of a university in eastern Japan and who specializes in radiation medical care, has..." The remainder of the sentence differs depending on the condition, as detailed below.

In the voluntary sharing condition, the rest of the sentence was "...migrated to Fukushima by his own volition and started implementing medical treatments. Professor A left his former medical department and chose to work for a medical research organization within Fukushima. Professor A has completely relocated to Fukushima, and has changed his residence certificate. Professor A voluntarily relocated."

The passage in the passive sharing condition was as follows: "...migrated to Fukushima due to the pressures from his surroundings and he started to engage in medical practice in that region. Although Professor A himself wanted to avoid migrating, he unwillingly conceded to do so after strong demands from the involved parties. As a result, Professor A quit his former medical department and started working for a medical research organization in Fukushima. Professor A has completely relocated to Fukushima and has changed his residence certificate. The relocation of Professor A was a result of the demands from his surroundings and was not a voluntary choice."

In the non-sharing condition, the passage continued as follows: "...started practicing medicine in Fukushima. He did not move to Fukushima; he engaged in his duties by

traveling to a medical research organization within Fukushima as needed. After he fulfilled his obligations, Professor A immediately returned to western Japan, where he now resides."

We used the same items in all conditions to evaluate Professor A. Based on previous studies comparing the explanatory power of perceived value similarity, competency, and motivation on trust scores, the following items were selected: three items that measured trust ("Can be trusted," "Can be relied upon," and "Can be entrusted"), three items that measured value similarity ("Shares the same point of the view as the residents," "Understands the feelings of the residents," and "Priorities match with those of the residents"), three items that measured competency ("Has high expertise," "Is efficient," and "Has abundant expert knowledge"), and three items that measured motivation ("Tries one's best," "Works very hard," and "Is passionate") [36]. Furthermore, three items about the forecast of risk reduction ("The activities of Professor A will be beneficial to the residents' health," "Professor A will aid in assessing the health states of the residents," and "Professor A will contribute to the reduction of the damage to the residents' health") were selected. A five-point Likert scale was used for all items; the scale ranged from "1=do not agree at all" to "5=strongly agree."

Although Professor A's profile was presented to the participants as a fictional account, many doctors had actually migrated to Fukushima prefecture after the disaster in 2011. Therefore, the action to share a common fate depicted in this experiment is not unrealistic.

4. Results

4.1. Effects of voluntary action to share a common fate on trustworthiness rating

Participants' ratings of trustworthiness were quantified from 1 to 5, with larger values indicating higher trust. Cronbach's alpha coefficients were computed to determine the internal consistency of the three trust items. The results indicated high internal consistency for the evaluations of trustworthiness ($\alpha=0.93$). The average value of the three items for each participant was calculated as a trust composite for Professor A.

The results of an analysis of variance (ANOVA) indicated that the effects of the conditions were significant ($F(2, 115)=35.55, p < 0.001, \eta_p^2=0.38$). A multiple comparison test using the Bonferroni correction indicated that the ratings of trustworthiness were significantly higher in the voluntary sharing condition ($p < 0.001$) than in the other two conditions. Moreover, there were no significant differences between the passive sharing and non-sharing conditions. The mean scores of the trust composite variables for each condition are presented in Fig. 1. Given that the scale ranged from 1 to 5, the mean score of 4.26 for the voluntary sharing condition is high and close to the upper bound of the range. Thus, it appears that voluntarily sharing the same fate had a strong effect on trustworthiness ratings. On the other hand, if sharing a common fate

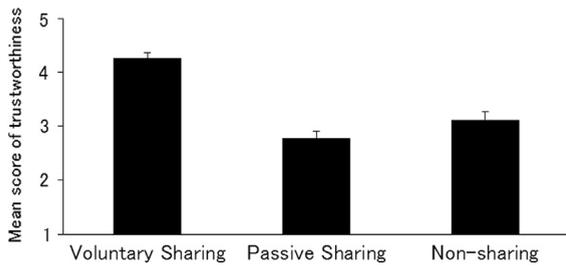


Fig. 1. Mean ratings of trustworthiness by condition.

was done passively, the trust level remained at the same level as when not sharing a common fate. These results support Hypothesis 1, which stated that voluntary action to share a common fate will increase trust.

4.2. The explanatory power of value similarity, competency, and motivation on trust

The Cronbach's α coefficients for the three items that measured each of the three variables of value similarity, competency, and motivation were calculated and high internal consistencies were found for all three factors (value similarity: $\alpha=0.93$, competency: $\alpha=0.90$, motivation: $\alpha=0.97$). Therefore, the mean scores of the three items in each factor were calculated for each individual and then used as composite variables. Hypothesis 2 predicts that the explanatory power of the perceived value similarity on trust changes depending on how the common fate is shared between trustees and trusters. In order to test this hypothesis, a hierarchical multiple regression analysis predicting trust by fate-sharing condition was conducted. The competency composite and the motivation composite were entered as the predictors at the first step, followed by the additional entry of the value similarity composite in the second step. The results of the analysis are shown in Table 1. In the voluntary sharing condition, the addition of value similarity as a predictor improved the explanatory power of the model ($\Delta R^2=0.040$), with a significant t -value of the value similarity at $p < 0.05$. The increase in variance explained by the entry of value similarity in this condition, however, was less than half than those in the other two conditions ($\Delta R^2=0.097$ in the passive sharing condition; $\Delta R^2=0.087$ in the non-sharing condition). The t -values of value similarity in these two conditions were significant at $p < 0.001$. Moreover, as suggested by the β coefficients in the second step, the value similarity composite was the strongest predictor in the passive sharing and non-sharing conditions; it was not so in the voluntary sharing condition, being far behind the competency composite.

The results of the hierarchical regression analyses when considered with the values of trustworthiness presented in Fig. 1 can be summarized as follows: voluntary action to share a common fate heightens trust and comparatively decreases the explanatory power of value similarity on trust level within this condition. On the other hand, passive sharing and non-sharing confines trust to low levels and comparatively heightens the explanatory power

Table 1 Results of the hierarchical multiple regression analysis predicting trust.

Condition	Step 1					Step 2						
	Unstandardized coefficients-B	Standardized coefficients- β	t	R^2	Adj. R^2	Unstandardized coefficients-B	Standardized coefficients- β	t	R^2	Adj. R^2	ΔR^2	N
Voluntary sharing condition	(Constant)	-0.364				-0.023						
	Competency	0.584	0.636	6.48***	0.702	0.526	0.573	5.94***	0.742	0.720	0.040*	40
	Motivation	0.466	0.357	3.63***		0.252	0.193	1.67				
Passive sharing condition	(Constant)	0.720			0.588	0.439	0.281	2.34*	0.685	0.659	0.097**	40
	Competency	0.125	0.125	0.96		0.150	0.150	1.29				
	Motivation	0.611	0.687	5.28***		0.352	0.396	2.73***				
Non-sharing condition	(Constant)	0.749			0.611	0.529	0.417	3.33***	0.699	0.671	0.087**	37
	Competency	0.338	0.327	2.07*		0.299	0.290	2.04*				
	Motivation	0.381	0.509	3.22**		0.169	0.225	1.34				
Value similarity						0.432	0.430	3.09**				

* $p < 0.05$.
 ** $p < 0.01$.
 *** $p < 0.001$.

Table 2
The means of composites by sharing condition.

	Voluntary sharing	Passive sharing	No sharing
Value similarity	4.03 (0.14) ^a	2.13 (0.13)	2.33 (0.15)
Competency	4.15 (0.12) ^{b,c}	3.60 (0.13)	3.45 (0.15)
Motivation	4.70 (0.09) ^a	2.64 (0.15)	3.11 (0.20)

Values in brackets indicate standard errors.

^a Values in the voluntary condition exceeded those in the other two conditions; $p < 0.001$.

^b Values in the voluntary condition exceeded that in the non-sharing conditions; $p < 0.01$.

^c Value in the voluntary condition exceeded that in the passive sharing condition; $p < 0.05$.

of value similarity on trust. In sum, these results support [Hypothesis 2](#).

In addition, the mean scores of the composite variables for each condition are displayed in [Table 2](#). The mean scores of value similarity, competency, and motivation show a similar pattern to that of the mean score of trust. These results indicate that the general evaluation of Professor A is the highest in the voluntary sharing condition, with the evaluation remaining at similarly low values in the passive sharing and non-sharing conditions. When an ANOVA was conducted, the main effect of all composite variables was significant (value similarity: $F(2, 115) = 56.43$, $p < 0.001$, $\eta_p^2 = 0.50$; competency: $F(2, 113) = 7.49$, $p < 0.001$, $\eta_p^2 = 0.12$; motivation: $F(2, 113) = 52.29$, $p < 0.001$, $\eta_p^2 = 0.48$). Results from a multiple comparison test using the Bonferroni correction indicated that the mean scores of value similarity and motivation in the voluntary sharing condition were significantly higher than in the other two conditions ($p < 0.001$). Competency was significantly higher in the voluntary sharing condition than in the non-sharing ($p < 0.01$) and passive conditions ($p < 0.05$). There were no significant differences in the composite variables between the passive sharing and non-sharing conditions. These results confirmed that voluntarily sharing a fate heightens the evaluation of value similarity, competency, and motivation. On the other hand, if the sharing of fate is done passively, it appears to be equivalent to not taking any action.

The internal consistency of the three items regarding risk reduction forecast was high ($\alpha = 0.92$). The mean score of the three items was calculated as a composite variable. The means of the three conditions were similar to those found for trustworthiness as depicted in [Fig. 1](#). The results of the ANOVA indicated that there was a significant main effect ($F(2, 115) = 10.55$, $p < 0.001$, $\eta_p^2 = 0.115$) in the prediction of risk reduction forecast. The mean score in the voluntary sharing condition was 4.26 ($SD = 0.63$), which was significantly higher than those in the passive sharing ($M = 3.61$, $SD = 0.96$, $p < 0.01$) and non-sharing conditions ($M = 3.32$, $SD = 1.12$, $p < 0.001$); there were no significant differences between the passive sharing and non-sharing conditions. In addition, the Pearson correlation coefficient between the trustworthiness rating and risk reduction forecast was high ($r = 0.64$; $p < 0.001$). These results provide support for [Hypothesis 3](#), suggesting that trust in risk managers is strongly connected with forecast of risk reduction.

5. Discussion

In sum, the results of the data analysis supported [Hypothesis 1](#). Participants' ratings of risk managers' trustworthiness increased when risk managers voluntarily shared their fate with that of the residents. On the other hand, when a common fate was shared passively, the perceived trustworthiness remained as low as not sharing a common fate. These results suggest that, if risk managers do their job remotely, away from the affected region, they will not be highly trusted by the citizens living in the region, even if their management is scientifically and technically sound. Although action while sharing the same fate is not necessarily relevant to the risk management profession, our findings indicate that peripheral behaviors outside of one's primary duties strongly affect trust.

Our results supported [Hypothesis 3](#)—the forecast of risk reduction when the risk manager voluntarily shared his/her fate with local residents was greater than that when passive sharing was done or than when it was not done at all. Furthermore, the correlation between ratings of trustworthiness and the perception of risk reduction was high. These results suggest that the effect of voluntarily sharing a common fate extends beyond trust to forecast of risk reduction.

There were no differences in the ratings of trust between the condition where doctors passively shared their fate with residents and the condition where doctors did not share the fate of residents. This begs the question: why was it that the trust toward the risk manager who passively shared a common fate was not greater than the trust toward the risk managers who did not share the same fate at all? It may be that the passive sharing of a fate is viewed by participants as signifying one's lack of intention to share a common fate. In other words, a trustor may view this risk manager as a trustee that wanted to escape sharing the same fate, which seems similar to a trustee that did not share the same fate. Moreover, the emphasis on intention is consistent with the results that indicated that the motivation composite score was the same in the passive sharing and non-sharing conditions. The practical implications of these results underscore the importance for risk managers to demonstrate initiative in sharing a common fate; in truth, taking this type of action after being asked by involved parties is the equivalent of doing nothing.

Sharing a common fate has the same feature as what is termed hostage posting [[37–41](#)]. The concept of hostage posting refers to a self-sanctioning system whereby an individual posts something valuable (usually a sum of money) that will be forfeited if the poster deceives the receiver. Sharing a common fate and hostage posting are similar in that they both aim at increasing trust by interlocking the loss of trustees (risk managers) with that of trusters (the general public). The two approaches heighten trust, however, there is a crucial difference with regard to whether the loss is controlled by the trusters. While trusters control the loss of trustees in hostage posting, trusters do not control it in sharing a common fate. To the best of our knowledge, no research has examined whether delegation of control is necessary to

increase trust by means of interlocking the loss of trustees with that of trusters. This research has revealed that voluntary interlocking of loss increases trust even though no control is delegated to trustees. As a realistic policy for engendering trust, sharing a common fate seems to be superior to hostage posting because the latter presumes an impracticable power of trusters (the general public), allowing them to damage trustees' (risk managers') health, property, or life at will.

The results of the multiple regression analysis indicated that the explanatory power of competency on trust level becomes greater, while that of value similarity and motivation become smaller, in conditions where the trust has been heightened because risk managers are voluntarily sharing a common fate. Less trusted risk managers usually wish to improve the perceived trustworthiness from the public they serve, hence, they may observe and try to imitate the relationships between highly trusted risk managers and the public. However, less trusted risk managers would come to an erroneous conclusion if they see the correlations between trust and perceived competency of highly trusted risk managers who have voluntarily shared a common fate (see Table 1), and then interpret this as meaning they should emphasize their capability to the public. This conclusion would be erroneous because the strong relationship in scores between trust and competency appeared after the risk managers applied the means of voluntary sharing of a common fate, which heightened their trustworthiness. Thus, it is expected that the effects of engaging in an attempt to heighten evaluations based on competency will be limited to the conditions where voluntary action to share a common fate has already been conducted and trust has already reached a certain level. In the opposite condition, where no voluntary action is conducted and trust level is low, risk managers should aim first at heightening trust by working to share a common fate and salient values with the public. After succeeding in this stage, if they would like to further increase trust, they must do more than simply convey to the public that there are shared values between them. An example of this next stage of building trust includes engaging in initiatives to increase evaluations of competency (as shown by the results of our regression analysis).

The limitations of this study should be mentioned. We used the risk of low dosage radiation exposure on residential health as an example of risk, but damage caused by such exposure will appear long after initial exposure, if ever. Therefore, residents can only evaluate the performance of a risk manager after a long period. In other words, residents could not judge the efficacy of risk management by the results of risk managers' primary duties for several years after the disaster. This particularity of the topic we used might make the peripheral action (i.e., voluntary action to share a common fate), which is observable immediately onsite, more influential on trust evaluation.

The discussion above leads to the question of whether sharing a common fate is always beneficial for risk managers. The performance of risk managers in some fields can be clearly observed by looking at objective events (e.g., increases in the crime rate in a city). Will

the enhanced trust in a risk manager who voluntarily moves into the affected area be maintained even when facing the upsurge of sufferers of the hazard? Is sharing a common fate even necessary for a risk manager who has achieved a high level of performance despite not sharing his/her fate with the public? When the performance regarding the prime duty of the manager is clearly observable, peripheral behavior like sharing a fate may be no more influential on trust. Empirical research based on the trust, confidence, and cooperation model [42,43], however, found that the high trust caused positive perception of past performance of the trustees. Therefore, voluntary sharing a common fate may still be beneficial even facing a record of heavy loss because it may positively change the public's interpretation of a record. Indeed, a double asymmetry effect of trust [11,44] claims that new information is processed to preserve the previous trust level. Whether the voluntary actions of risk managers influence trust when the performance of the managers is presented should be addressed in future research.

Finally, it is important to discuss the findings regarding the relationships that emerged between trust and disaster risk reduction. The methods for improving trust included herein were investigated under the assumption that trust in risk managers is desirable and would lead to improvements in residents' safety. It is possible, however, that high levels of trust could make residents vulnerable in disaster situations. For example, it has been reported that strong trust in public protective systems against floods is associated with decreases in subjective assessment of the probability of a flood; this simultaneously leads to a decline in negative feelings about floods [2], which may decrease one's preparations for a flood. Building trust is not the final goal in risk management. Strategies regarding public trust should be designed to promote disaster risk reduction.

Acknowledgments

This work was supported by a Grant-in-Aid for Scientific Research of the Japan Society for the Promotion of Science (Grant no. 24330189). The authors are grateful to the anonymous reviewers for their valuable comments and suggestions on earlier drafts of this article.

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