The Social Impact of Natural Hazards:
A Multilevel Analysis of Disasters and Forms of Trust in Mainland China

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Abstract

This study aimed to assess the multilevel effects of natural hazards on trust in Chinese society. Using the Chinese General Social Survey conducted in 2012 as well as provincial disaster damage records, the study examined how individuals' past experiences of disasters and province-level damage (measured by the number of affected people, deaths, and economic loss) are associated with various forms of trust: in-group, out-group, generalized, and political trust. The results indicate that Chinese individuals with experience of disaster demonstrate higher levels of out-group trust but lower levels of political trust. Similarly, at the province level, damage from the previous 3 years of disaster events (2009–2011) was positively associated with residents' out-group trust while negatively affecting their political trust. However, when provincial damage was aggregated for the past 5 years of disasters (2007–2011), which included the historic Sichuan earthquake of 2008, only total deaths showed a positive effect on generalized trust.

Keywords: Disaster, natural hazards, social trust, political trust, China.

Introduction

Studies of social capital and community resilience have highlighted the positive role of trust, networks, and norms in building a community that is adaptive and resilient in the face of natural hazards (e.g., Adger et al., 2005; Aldrich, 2012, 2019; Cox & Perry, 2011; Dynes, 2006; Hawkins & Maurer, 2010; Nakagawa & Shaw, 2004; Norris et al., 2008; Wickes et al., 2015). Those studies have focused on the pre-disaster social structures and conditions that determine a community's ability to adapt and recover during and after disaster events. However, questions remain concerning post-disaster social capital, especially as some studies have shown the depletion of social connections and trust after a disaster (e.g., Miller, 2006; Papanikolaou et al., 2012), while other studies portray an increase in altruism and volunteer activities after a disaster (e.g., Albrecht, 2018; Chang, 2010). This study was motivated by the need for more studies on post-disaster social capital that explain how social behaviors and attitudes are

affected by extreme, hard-to-predict natural events, which can help us define and develop theories on the social impact of natural hazards. More broadly, understanding the social impact of natural events can also provide insights into how community members respond to various emergency situations.

In considering the social impacts of natural hazards, this study focused especially on trust, which has been considered an integral part of societies and the core of social capital (Coleman, 1990; Fukuyama, 1995; Inglehart, 1999; Putnam, 2001; Uslaner, 2002). However, many sociologists have pointed out that trust is not monolithic; some people are more trusting of people close to them, such as family, friends, and neighbors, while others trust a broader range of people, including fellow citizens and other individuals whom they have not met before (Crepaz et al., 2016; Delhey et al., 2011; Freitag & Traunmüller, 2009; Realo, 2008; Uslaner & Conley, 2003; Van Hoorn, 2015; Welch et al., 2007). Furthermore, one's trust spreads not only horizontally but also vertically to politicians and government officials (see Newton & Zmerli, 2011; Putnam, 2001). Considering these diverse forms of trust, this study questions how individuals' exposure to disasters affects their various forms of trust, a topic that has not been fully explored in previous studies. Moreover, trust is shaped not only by individual experience but also by social circumstance (see Delhey & Newton, 2003); therefore, a better means of testing trust and disaster is to examine both the individual- and group-level effects of disaster. Therefore, this study, focusing on China, examines the impact of individual-level experiences and province-level damage resulting from natural hazards, such as loss of life, impacted lives, and economic loss, on individuals' in-group, out-group, generalized, and political trust.

This study contributes to the literature of disaster and natural hazards by using empirical evidence covering all provinces of mainland China, which has been exposed to varoius natural hazards that threatened a great number of people. Table 1 shows China's nationwide damage from natural hazards that occurred between 1993–2012, provided by the Emergency Events Database (EM-DAT). According to the data, flood is the most frequent disaster and affects the highest number of people. Although less frequent, storm and drought have also affected large numbers of people. Earthquake is a deadlier disaster than any other, and floods and earthquakes cause the greatest economic loss. Although this study does not distinguish disaster types, its key province-level variables—deaths, economic loss, and the number of people affected—will provide some insights into the type of disaster. Moreover, this study uses other measurements that are commonly used in national and international social surveys; therefore, the methods of this study are easily replicable and applicable in areas outside China, enabling comparison or generalization of the results in future studies. Furthermore, previous studies on post-disaster trust have not paid attention to the diverse forms of trust, which can highlight

broader sociological and political implications. By studying various forms of trust in the context of disaster, this study bridges the gap between two bodies of literature. Finally, this study explores the impacts of disaster at two distinct levels. Unlike individual-level disaster experiences, province-level disaster experiences do not necessarily require the residents to be directly exposed to the events. The findings of this study will describe the impact of both the direct and the indirect effects of disaster, deepening the understanding of the social implications of natural hazards.

Table 1. Damage caused by natural hazards in China (1993-2012)

	Occurrence	Total affected	Total deaths	Economic Loss ('000 US$)
Flood	92	756,393,382	7,496	66,055,585
Storm	76	285,409,299	2,857	27,838,449
Earthquake	48	50,903,678	90,939	87,635,024
Landslide	28	2,147,600	2,883	898,000
Drought	12	240,194,000	134	10,324,000
Extreme temperature	6	80,800,000	193	21,381,000
Epidemic	5	6,829	423	
Mass movement (dry)	2		55	
Wildfire	2		22	
Total	**271**	**1,415,854,788**	**105,002**	**214,132,058**

Source: The Emergency Events Database (EM-DAT)

The Aftermath of Disaster and the Forms of Trust

An increasing number of studies have reported the relationship between social capital and community resilience to disasters (see Aldrich, 2012, 2019; Cox & Perry, 2011; Dynes, 2006; Hawkins & Maurer, 2010; Lee, 2019; Nakagawa & Shaw, 2004; Norris et al., 2008). In those studies, scholars have emphasized community members' "routine" networks and trust that are useful in "non-routine" situations, in other words, pre-disaster social structures that are useful during and after disasters (Hurlbert et al., 2000, p. 599; Wickes et al., 2015). Questions about post-disaster social capital remain relatively underexplored. Those questions, as Albrecht (2018) points out, include whether the level of

social capital changes due to natural hazard events; how the scale, frequency, or type of disaster affects the level of social capital; and the differences in the social impacts of direct and indirect experiences of disasters associated with natural hazards.

These questions are worth exploring, as it seems that there are two opposing views of the aftermath of disaster. One group of studies has shown that the individuals affected by a disaster tend to become more individualistic and try to protect their own property, giving rise to so-called *corrosive communities* (see Picou et al., 2004; Ritchie & Gill, 2007). For example, Miller (2006) provides evidence of a decrease in trust near New Orleans after Hurricane Katrina, which pitted survivors against outsiders and neighbor against neighbor. Similarly, Papanikolaou et al. (2012) found that Greeks affected by the 2007 wildfires were less likely to trust and support one another than people who were not affected by the fires. Picou et al. (2004) argue that members of disaster-stricken communities in the United States suffer from stress, loss of trust, and the disruption of social connections.

Other studies—greater in number—have found an increase in altruism and reciprocity after disaster events (e.g., Brunsma et al., 2007; Douty, 1972; Poulin et al., 2009; Quarantelli & Dynes, 1997). For example, Sauri et al. (2003) found that altruism and reciprocity behaviors increased when family, friends, and neighbors were at risk. Yamamura's (2016) research on the Kobe earthquake in Japan revealed increased social capital among the residents affected by the earthquake. Dussaillant and Guzman (2014) studied social trust before and after the 2010 earthquake in Chile and found that a disaster represents an opportunity to strengthen interpersonal trust in the region.

Instead of either of these views providing a snapshot of the aftermath of disaster, some scholars claim that these opposing perspectives may not be mutually exclusive. For example, Kaniasty and Norris (1993, 2004) studied disaster victims' changing situations over time and suggested a comprehensive model that explains both the rise of *altruistic communities* and the deterioration of social support in disaster-stricken communities. The model postulates that (1) pre-existing socio-psychological conditions and resources affect the extent of exposure to a disaster and that (2) disaster events trigger a heroic, altruistic struggle to fulfill immediate needs, while (3) the distribution of resources and aid is not equitable, and therefore the victims of disaster eventually face the sad reality of declining social support over time (Norris & Kaniasty, 2004). Although this model is comprehensive and quite convincing, more studies are required to distinguish between the short-term and long-term timelines after a disaster, and the postulation should be tested and applied in diverse social and cultural settings. Also, Lee & Fraser (2019) suggest that residents' direct exposure to disaster and their perceived risk (or fear) of disaster have different effects on various types of social organizations. To confirm their finding, more tests on

other social behaviors and attitudes are needed to clarify the social impacts of natural hazards, which is a goal of the current study.

Among the various social behaviors and attitudes that may be affected by disaster events, individuals' trust in others is the focal point of this study. Trust has been widely studied among social scientists as the essence of social capital and as a contributing factor to social integration, economic growth, personal life satisfaction, and democratic stability (see Coleman, 1990; Delhey & Newton, 2003; Fukuyama, 1995; Putnam, 2001; Uslander, 2002; Whiteley, 1999). However, some scholars have stressed that a person's trust is a measure of his or her daily social environment and therefore that trust is based on concrete experiences of social interaction and participation (see Coleman, 1990; Hardin, 2002; Paxton, 2007; Putnam, 2000), while other studies argue that trust is a propensity that is innate or learned early in life and thus is primarily personal (Stolle & Hooghe, 2004; Uslaner, 1999; Yamagishi & Yamagishi, 1994). Building on these studies, Delhey and Newton (2003) suggest that one's level of trust depends on both social-psychological factors (such as personal demographic characteristics, social achievements, and well-being) and social-cultural factors (such as membership in voluntary associations, maintenance of social networks, and the characteristics of the community to which one belongs). Beyond the individual and community characteristics, Delhey et al. (2011) argued that cultural legacies, economic modernity, and institutional factors, such as rule of law, affect people's trust.

The more recent literature on trust has deeply investigated diverse forms of trust. Two distinct kinds of social trust have been identified with regard to their social scope: particularized and generalized trust (see Crepaz et al., 2016; Newton & Zmerli, 2011; Uslander & Conley, 2003). Particularized trust is found in close social proximity to individuals and is extended only to people the individual knows from everyday interactions (e.g., family members, friends, neighbors, and coworkers). Because it is found in inward-looking groups, particularized trust has often been called *in-group trust*. Generalized trust is the belief that most people in society, including unfamiliar people (e.g., foreigners, fellow citizens, and passersby), are trustworthy and are integral parts of society (Inglehart, 1999; Uslander, 2002); it has often been called *out-group trust*. For Putnam (2001), in-group trust is *thick* (i.e., it occurs within a small radius), whereas out-group trust is *thin* (i.e., it is extended to people who are more socially distant). He argues that out-group trust is a vital civic phenomenon that generates social virtues such as reciprocity, connectedness, tolerance, and inclusivity; therefore, a well-functioning society leads to more connectedness between people from diverse social groups (Putnam, 2001; also see Uslaner & Conley, 2003). Aldrich (2012) explains that thick trust is a key source of *bonding* social capital and thin trust is a key source of *bridging* social capital.

Regarding the terms *out-group trust* and *generalized trust*, however, some scholars simply equate them (see Freitag & Traunmüller, 2009; Newton & Zmerli, 2011; Welch, 2007; Yamagishi & Yamagishi, 1994), while others distinguished between the two (e.g., Crepaz et al., 2016; Delhey et al., 2011). For the latter group, generalized trust is an (overly) broad concept in comparison to out-group trust (see Gundelach, 2014; Sturgis & Smith, 2010; Torpe & Lolle, 2011). They assume that generalized trust constitutes *trust in most people* or represents an *average of other types of trust*; therefore, they use a special survey question of the General Social Survey to measure generalized trust: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"

Regarding the final form of trust—political trust—Putnam (2001) argues that people's trust in others *spills over* from one area to another and then *spills up* to trust in politicians and governing institutions by pressuring them to enhance their performance. However, other scholars have debated whether political trust comes directly from political institutions' performance (see Jackman & Miller, 1996; Lee & Yi, 2018; Liu & Stolle, 2017; Mishler & Rose, 2001, 2005). In disaster studies, only a few studies have investigated whether disaster events affect the public's political trust or change political outcomes, and their findings are conflicting. Arceneaux and Stein (2006) found that the residents of a disaster-stricken area lost their trust in local government and voted against the incumbent politicians in Houston, Texas. Focusing on China, Han et al. (2011) found that disaster victims believed that local governments abandoned their responsibility, which decreased people's trust in local government. However, Lazarev et al. (2014) found that disaster experience seemed to increase support for the central government in Russia, although massive government aid may have affected the increase in political trust.

Two bodies of literature—disaster studies and sociological studies on trust—are prominent, but they have not broadly communicated, and few studies have examined people's trust, especially different forms of trust, in the context of disasters caused by natural hazards. This study bridges the gap between the two literatures in a Chinese context by examining at two levels—individual- and province-level damage—the impacts of natural hazards on individual trust in its diverse forms.

Data, Variables, and Method

This study used data collected from two distinct sources. Individual-level data were collected from the Chinese General Social Survey (CGSS), which was conducted as part of the East Asian Social Survey (EASS) in 2012. The CGSS was carried out by the National Survey Research Center at Renmin

University of China between June 15, 2012 and December 10, 2012. A four-stage probability proportional to size sampling method was used, stratified by comprehensive socio-economic indicators and population size. In total, 5,819 respondents from 29 provinces of mainland China responded to the survey, with a response rate of 70.96%. The dataset was obtained through the Inter-University Consortium for Political and Social Research. The province-level dataset was constructed from statistical data published in the Chinese Statistical Yearbook on the Environment (*Zhongguo huanjing tongji nianjian*) between 2008 and 2012. The data were crosschecked with the Yearbooks of Meteorological Disaster in China (*Zhongguo qixiang zaihai nianjian*) published between 2008 and 2012. The yearbooks were accessed through the Universities Service Centre for China Studies at the Chinese University of Hong Kong.

Dependent Variables

The output variables are respondents' levels of trust. The CGSS asked about respondents' trust in various groups, including their family, friends, neighbors, work colleagues, people they had met for the first time, local government officials, and central government officials. The responses comprised four suggested levels of trust: "not at all," "not very much," "to some extent," and "a great deal." In addition, the CGSS included a common indicator of generalized trust: "Generally speaking, would you say that most people can be trusted?" The respondents were asked to choose answers using a 4-point Likert scale: "You almost always can't be too careful in dealing with people," "You usually can't be too careful in dealing with people," "People can usually be trusted," and "People can almost always be trusted." Table 2 shows the results of the principal component analysis of trust in eight distinct categories. The analysis yielded a two-component solution. One depended on the respondents' trust in known people, such as family, friends, neighbors, and work colleagues (i.e., in-group trust), and the other depended primarily on trust in local and central government officials (i.e., political trust). The other two types of trust—trust in people met for the first time and generalized trust—were not combined into a single category; therefore, trust in people met for the first time was considered as out-group trust distinct from generalized trust. This is consistent with previous studies that distinguished between out-group trust and generalized trust (Gundelach, 2014; Sturgis & Smith, 2010; Torpe & Lolle, 2011). Therefore, this study uses four dependent variables: in-group trust, out-group trust, generalized trust, and political trust.

Table 2. Principal component analysis of measures of trust with varimax rotation

	Component	
	1	2
Trust in family	0.560	> 0.001
Trust in friends	0.754	> 0.001
Trust in neighbors	0.708	0.204
Trust in work colleagues	0.634	0.179
Trust in people met for the first time	0.273	> 0.001
Trust in local government officials	0.174	0.675
Trust in central government officials	0.113	0.819
"In general, most people can be trusted"	0.299	0.215
Explained variance in %	24.9	15.8
Chi square	397.97 (13)	
p-value	p<0.01	

Note: For trust in the first seven groups of people, the CGSS asked, "How much do you trust the following people?" (C1). For trust in most people, the CGSS asked, "Generally speaking, would you say that most people can be trusted?" (C3). For both questions, respondents answered by choosing from four suggested levels of trust (1-4).

Individual-Level Variables

The respondents' disaster experience was the individual-level independent variable (see Chang, 2010; Toya & Skidmore, 2014). The CGSS asked respondents which channels they had used to obtain help when they encountered real (not hypothetical) disaster situations in the past. Those who chose "never had such a problem" were coded as 0, and those with other answers were coded as 1.

Other individual-level factors related to trust were also included, such as participation in an association (Delhey & Newton, 2003). The CGSS asked respondents whether they participated in any of the following organizations: political associations, residential or neighborhood associations, social service or volunteer groups, citizens' movements or consumer cooperative groups, religious groups, alumni associations, recreational associations, labor unions, and occupational, professional, or trade associations. The number of associations in which the respondents actively participated was measured.

Having friendly relationships and networks is also an important factor that affects an individual's level of trust. Therefore, a personal network variable was obtained from the questions that asked the respondents how many people they could ask for a favor, such as watering plants, feeding pets, and giving advice. The answers ranged from "0" to "10 or more."

To measure personal predispositions and life satisfaction (see Uslaner, 1999; Yamagishi & Yamagishi, 1994), individuals' levels of happiness and self-rated health conditions were measured. A question asked respondents to rate their level of happiness as "very unhappy," "unhappy," "happy," or "very happy." Also, respondents were asked to evaluate their health condition on a 5-item scale, including "very bad," "bad," "neither bad nor good," "good," or "very good."

Urbanization was included as a community characteristic that can affect individual trust (Delhey et al., 2011; Delhey & Newton, 2003). Urbanization was coded as follows based on an objective observation of the community by the person who conducted the survey: 1 = "a farm in a rural area," 2 = "a village in a rural area," 3 = "a town or small city," 4 = "outskirts of a big city," and 5 = "a big city."

As individual-level control variables, a respondent's age, gender, years of education, and household income were included. For gender, female was coded 1, and male was coded 0. The CGSS coded household income on a 5-point scale ranging from "far below average" (1) to "far above average" (5).

Province-Level Variables

At the province level, three disaster-related variables and one control variable were collected. First, the number of people affected by the disaster per hundred of population was obtained to indicate the range and degree of destruction caused by disasters in the provinces. Second, the number of deaths per million people was included to show the strength or deadliness of the disaster events in each province. Third, the economic losses of the provinces were added to indicate damage to crops, buildings, or infrastructure that caused economic loss. The population density of the provinces was included as a province-level control variable. In the context of China, high population density generally indicates the developed coastal provinces with high incomes and urban populations, while low population density is associated with less developed inner areas with relatively low incomes and rural settings (see Hu, 2002; Yang et al., 2016).

Because the dependent variables are from a survey conducted in 2012, the proper way to estimate the effects of the province-level damage of a disaster on those variables was to collect data from earlier than 2012. However, the single-year disaster data contained only a few disaster instances,

which was not enough to analyze patterns. Therefore, two aggregated sets of data were created for province-level damage from disaster events: the past 3 years of disaster damage (2009–2011) and the past 5 years of disaster damage (2007–2011). Using the data of two distinct time periods was expected to show whether a time-frame difference yielded different results. Also, the past 5 years' disaster damage included damage from the Great Sichuan Earthquake that caused almost 70,000 fatalities (for details, see Hui, 2009), which would show whether the impact of historical disaster events persisted.

Table 3 summarizes the variables. Linear mixed-effects analysis (fixed effects and random intercept) was performed to estimate the multilevel effects of individual and contextual (province-level) characteristics on four forms of trust. The variance inflation factor of all the models was below 3.0, which is acceptable for most social science research.

Table 3. Descriptive statistics for variables

	Min	Max	Average	Standard Deviation
Individual-level (2012)				
In-group trust	1	4	3.2	0.5
Out-group trust	1	4	1.7	0.6
Generalized trust	1	4	2.9	0.6
Political trust	1	4	2.9	0.7
Disaster Experience	0	1	0.6	0.5
Participation in associations	0	8	0.3	0.7
Personal network	1	5	2.9	1.4
Happiness	1	5	3.8	0.8
Self-rated health	1	5	3.5	1.1
Urbanization	2	5	3.5	1.3
Age	18	94	48.9	16.4
Education Years	0	19	8.4	4.8
Gender	0	1	0.5	0.5
Household Income	1	5	2.6	0.7
Province-level (2009-2011)				
Affected people (per hundred)	1.5	251.9	100.2	62.2
Deaths (per million)	0.003	488.1	22.5	90.3
Economic loss (100 million Yuan)	1.03	331.2	123.0	79.1
Population density (10,000/km^2)	7.8	3,606.4	449.9	673.3
Province-level (2007-2011)				
Affected people (per hundred)	2.5	377.4	167.0	99.5
Deaths (per million)	0.094	1,078.2	63.2	215.4
Economic loss (100 million Yuan)	1.71	1796.1	170.8	318.9
Population density (10,000/km^2)	7.7	3490.4	440.6	649.8

Results

Table 4 illustrates how in-group, out-group, generalized, and political trust are affected by individual disaster experience and provincial damage from disasters in the 3 years prior to 2012. For each form of trust, two models were structured. The first models (Models 1, 3, 5, and 7) included only the individual-level dependent variables, while the second models (Models 2, 4, 6, and 8) added province-level variables. This was to determine whether adding province-level variables significantly improved the goodness of fit of the models. Likelihood-ratio (LR) tests were conducted to compare the competing models.

First, the respondents' past experience of disaster showed a positive effect on out-group trust and a negative effect on trust in government officials. In Model 3, people with disaster experience showed a higher level of out-group trust than people without disaster experience ($b = 0.047$, $p < 0.01$). By contrast, in Model 7, Chinese people with disaster experience had lower levels of political trust than people without disaster experience ($b = -0.061$, $p < 0.01$). These results indicate that individuals' experiences of disaster may have extended their radius of trust but that the victims might also hold the government responsible for their experiences. However, as Models 1 and 5 indicate, individuals' in-group trust and generalized trust were not significantly affected by their disaster experience, as will be discussed below.

The second models (Models 2, 4, 6, and 8) added province-level variables. For in-group trust, the LR test between Models 1 and 2 shows that adding province-level variables improves the goodness of fit of the model (chi-square 8.54, $p < 0.10$). In Model 2, the number of affected people has a negative effect on in-group trust ($b = -0.001$, $p < 0.10$), and the number of deaths shows a negative effect on in-group trust ($b = -0.001$, $p < 0.10$). However, economic loss did not show a significant effect on in-group trust. The negative effects of province-level damage, as well as the insignificant effect of individual disaster experience on in-group trust, differ from a previous study that found that altruism and reciprocity behaviors increased when family, friends, and neighbors were at risk (Sauri et al., 2003). For out-group trust, the LR tests between Models 3 and 4 indicate that adding province-level variables significantly improved Model 4. Consistent with the individual-level finding, positive effects on out-group trust were found in all three province-level variables: affected people ($b = 0.001$, $p < 0.05$), deaths ($b = 0.001$, $p < 0.05$), and economic loss ($b = 0.052$, $p < 0.05$). For generalized trust, the LR test between Models 5 and 6 shows that province-level variables improved the goodness of fit (chi-square 8.32, $p < 0.05$). However, three province-level variables did not show a significant effect on generalized trust. For political trust, the LR test between Models 7 and 8 indicates that province-level variables improved the model's

goodness of fit (chi-square 22.50, $p < 0.01$). Deaths show a negative effect on political trust ($b = -0.001$, $p < 0.05$), and economic loss shows a negative association with political trust ($b = -0.061$, $p < 0.05$), which is consistent with the individual-level findings. However, the number of affected people did not show a significant effect on political trust.

Among non-disaster factors, individuals' participation in associations showed significant positive effects on generalized trust ($b = 0.045$, $p < 0.01$) in Model 6 and on political trust ($b = 0.063$, $p < 0.01$) in Model 8. This partially supports the assumption of social capital theories that social engagement and trust are closely associated. However, the effects of participation in associations on in-group and out-group trust were not statistically significant. Personal networks, measured by the number of people that respondents could ask for help, show significant positive effects on all forms of trust: in-group trust ($b = 0.054$, $p < 0.01$), out-group trust ($b = 0.031$, $p < 0.01$), generalized trust ($b = 0.039$, $p < 0.01$), and political trust ($b = 0.012$, $p < 0.10$). Happiness positively affects respondents' in-group trust ($b = 0.062$, $p < 0.01$), generalized trust ($b = 0.092$, $p < 0.01$), and political trust ($b = 0.083$, $p < 0.01$) but does not significantly affect out-group trust. Self-rated health shows a positive effect on in-group trust ($b = 0.017$, $p < 0.05$), but its effects on other forms of trust are not significant. Finally, people in urban areas show lower levels of political trust than people in rural areas ($b = -0.052$, $p < 0.01$), which is consistent with the province-level result.

Among individual control variables, a greater age increases trust in all forms—in-group trust ($b = 0.001$, $p < 0.05$), out-group trust ($b = 0.002$, $p < 0.01$), generalized trust ($b = 0.003$, $p < 0.01$), and political trust ($b = 0.006$, $p < 0.01$)—which also indicates that younger respondents had lower levels of social and political trust. Education expands people's radius of trust by increasing out-group trust ($b = 0.005$, $p < 0.05$), but more educated people have lower levels of trust in governmental officials ($b = -0.005$, $p < 0.10$). Females show low levels of out-group trust ($b = -0.039$, $p < 0.05$) but greater political trust ($b = 0.063$, $p < 0.01$). Finally, household income positively affects out-group trust ($b = 0.020$, $p < 0.10$) but does not show significant effects on other forms of trust.

The province-level control variable, population density, is negatively associated with in-group trust ($b = -0.044$, $p < 0.05$) and political trust ($b = -0.135$, $p < 0.01$), meaning that residents of urban/coastal provinces tend to have lower levels of in-group and political trust. Opposite effects of population density were found on out-group trust ($b = 0.105$, $p < 0.01$) and generalized trust ($b = 0.043$, $p < 0.05$).

Table 4. Multilevel regression of trust on individual disaster experience and provincial damage (2009-2011) from natural hazards

	In-group trust		Out-group trust		Generalized trust		Political trust	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fixed effects								
Individual-level (2012)								
Disaster Experience	0.016	0.017	0.047***	0.044***	-0.013	-0.014	-0.061***	-0.060***
	(0.014)	(0.014)	(0.016)	(0.016)	(0.017)	(0.017)	(0.020)	(0.020)
Participation in associations	0.015	0.015	0.006	0.006	0.044***	0.045***	0.064***	0.063***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.012)	(0.012)	(0.014)	(0.014)
Personal network	0.054***	0.054***	0.031***	0.031***	0.040***	0.039***	0.013*	0.012*
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Happiness	0.062***	0.062***	0.010	0.011	0.090***	0.092***	0.084***	0.083***
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.012)	(0.012)
Self-rated health	0.018**	0.017**	0.009	0.009	0.001	0.001	0.016	0.016
	(0.007)	(0.007)	(0.009)	(0.009)	(0.001)	(0.001)	(0.010)	(0.010)
Urbanization	-0.004	-0.005	-0.008	-0.007	-0.002	-0.001	-0.052***	-0.052***
	(0.006)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Age	0.001**	0.001**	0.002***	0.002***	0.003***	0.003***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education Years	-0.001	-0.001	0.005**	0.005**	0.0006	0.0003	-0.005*	-0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Gender (F=1, M=0)	0.004	0.004	-0.039**	-0.039**	-0.0006	-0.0003	0.063***	0.063***
	(0.014)	(0.014)	(0.016)	(0.016)	(0.017)	(0.017)	(0.019)	(0.019)
Household Income	-0.013	-0.014	0.020*	0.020*	-0.004	-0.005	-0.018	-0.018
	(0.010)	(0.010)	(0.012)	(0.012)	(0.012)	(0.012)	(0014)	(0014)
Province-level (2009-2011)								
Affected people (per hundred)		-0.001*		0.001**		0.0002		0.001
		(0.0003)		(0.0004)		(0.0003)		(0.001)
Deaths (per million)		-0.001**		0.001**		-0.0001		-0.001***
		(0.0002)		(0.0003)		(0.0003)		(0.0004)
Economic loss (log)		-0.010		0.052**		0.013		-0.061**
		(0.015)		(0.019)		(0.016)		(0.026)
Population density (log)		-0.044**		0.105***		0.043**		-0.135***
		(0.018)		(0.022)		(0.020)		(0.030)
Intercept	2.758***	3.128***	1.318***	0.356*	2.334**	2.008***	2.502***	3.509***
	(0.060)	(0.162)	(0.073)	(0.203)	(0.071)	(0.181)	(0.089)	(0.267)
Random effects (Variance)								
Intercept	0.006	0.004	0.018	0.008	0.006	0.005	0.035	0.015
Residual	0.250	0.250	0.337	0.338	0.357	0.357	0.485	0.485
Observations (provinces)	5,641 (29)	5,641 (29)	5,637 (29)	5,637 (29)	5.629 (29)	5,629 (29)	5.580 (29)	5,580 (29)
Log-likelihood	-4123.5	-4119.2	-4972.7	-4962.1	-5107.1	-5102.9	-5936.2	-5925.0
AIC	8273.0	8272.5	9971.5	9958.2	10240.2	10239.9	11898.5	11884.0
BIC	8359.3	8385.3	10057.8	10071.0	10326.5	10352.7	11984.6	11996.6
LR test		8.54*		21.28***		8.32**		22.50***

* p<0.10, **p<0.05, *** p<0.01

Table 5 presents another set of models, which were structured using province-level damage in the past 5 years (2007–2011) to examine the longer impacts of province-level disaster damage. The individual-level variables are exactly the same as in the models in Table 4; therefore, Models 1, 3, 5, and 7 of Table 5 were included only to compare the goodness of fit with Models 2, 4, 6, and 8. Again, LR tests were conducted to compare the goodness of fit between the competing models.

For in-group trust, the LR test between Models 1 and 2 shows that adding province-level variables does not improve the goodness of fit of the model, and the province-level variables do not show significant effects on in-group trust. For out-group trust, adding province-level variables improves the goodness of fit (chi-square 15.22, $p < 0.01$). In Model 4, out-group trust is positively associated with the number of affected people ($b = 0.0001$, $p < 0.10$) and economic loss ($b = 0.003$, $p < 0.10$), but loss of life does not show a significant effect. When compared to Model 4 in Table 4, the effects of 5-year province-level damage become weaker. For generalized trust, province-level variables improve the goodness of fit (chi-square 25.00, $p < 0.01$). Model 6 shows that the number of deaths has a strong positive effect on generalized trust ($b = 0.0002$, $p < 0.01$), but the number of affected people and economic loss do not show strong effects. Compared to Model 6 in Table 4, the effect of the number of deaths on generalized trust becomes stronger. Considering the fact that the Sichuan earthquake was included in this period, the deaths from the earthquake may have affected people's generalized trust for years. For political trust, the LR test shows that adding province-level variables improves the model (chi-square 10.75, $p < 0.05$), but no disaster-related variables show significant effects. Compared to the strong effects of province-level damage on political trust in Table 4, this result indicates that the effects do not last very long.

Similar to Table 4, the province-level control variable of population density shows positive effects on out-group trust ($b = 0.072$, $p < 0.01$) and a negative effect on political trust ($b = -0.062$, $p < 0.05$). The difference is a strong positive effect of deaths on generalized trust ($b = 0.052$, $p < 0.01$).

Table 5. Multilevel regression of trust on individual disaster experience and provincial damage (2007-2011) from natural hazards

	In-group trust		Out-group trust		Generalized trust		Political trust	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fixed effects								
Individual-level (2012)								
Disaster Experience	0.016	0.017	0.047***	0.044***	-0.013	-0.014	-0.061***	-0.060***
	(0.014)	(0.014)	(0.016)	(0.016)	(0.017)	(0.017)	(0.020)	(0.020)
Participation in associations	0.015	0.015	0.006	0.006	0.044***	0.044***	0.064***	0.063***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.012)	(0.012)	(0.014)	(0.014)
Personal network	0.054***	0.054***	0.031***	0.031***	0.040***	0.040***	0.013*	0.012*
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Happiness	0.062***	0.062***	0.010	0.011	0.090***	0.092***	0.084***	0.083***
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.012)	(0.012)
Self-rated health	0.018**	0.017**	0.009	0.009	0.001	0.001	0.016	0.016
	(0.007)	(0.007)	(0.009)	(0.009)	(0.001)	(0.001)	(0.010)	(0.010)
Urbanization	-0.004	-0.004	-0.008	-0.007	-0.002	-0.001	-0.052***	-0.052***
	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Age	0.001**	0.001**	0.002***	0.002***	0.003***	0.003***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education Years	-0.001	-0.001	0.005**	0.005**	0.0006	0.0003	-0.005*	-0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Gender (F=1, M=0)	0.004	0.004	-0.039**	-0.039**	-0.0006	-0.0003	0.063***	0.063***
	(0.014)	(0.014)	(0.016)	(0.016)	(0.017)	(0.017)	(0.019)	(0.019)
Household Income	-0.013	-0.014	0.020*	0.020*	-0.004	-0.005	-0.018	-0.018
	(0.010)	(0.010)	(0.012)	(0.012)	(0.012)	(0.012)	(0014)	(0014)
Province-level (2007-2011)								
Affected people (per hundred)		-0.0003		0.0001*		0.0001		0.001
		(0.0002)		(0.0003)		(0.0002)		(0.001)
Deaths (per million)		-0.00002		0.0008		0.0002***		0.002
		(0.0001)		(0.0001)		(0.0001)		(0.0004)
Economic loss (log)		0.004		0.003*		0.013		-0.028
		(0.016)		(0.002)		(0.012)		(0.030)
Population density (log)		-0.020		0.072***		0.052***		-0.065**
		(0.016)		(0.020)		(0.013)		(0.023)
Intercept	2.758***	2.907***	1.318***	0.633***	2.334**	1.938***	2.502***	2.912***
	(0.060)	(0.153)	(0.073)	(0.192)	(0.071)	(0.134)	(0.089)	(0.264)
Random effects (Variance)								
Intercept	0.006	0.006	0.018	0.010	0.006	0.002	0.035	0.022
Residual	0.250	0.250	0.337	0.338	0.357	0.357	0.485	0.485
Observations (Provinces)	5,641 (29)	5,641(29)	5,637 (29)	5,637(29)	5.629 (29)	5,629 (29)	5.580 (29)	5,580(29)
Log-likelihood	-4123.5	-4122.0	-4972.7	-4965.1	-5107.1	-5094.6	-5936.2	-5930.9
AIC	8273.0	8278.0	9971.5	9964.3	10240.2	10223.2	11898.5	11895.7
BIC	8359.3	8390.8	10057.8	10077.1	10326.5	10336.0	11984.6	12008.4
LR test		3.02		15.22***		25.00***		10.75**

* p<0.10, **p<0.05, *** p<0.01

Discussion and Conclusion

This study assessed how disaster experiences affect individuals' forms of trust in the context of mainland China. This study's main contribution to the literature lies in providing evidence that disasters have distinct impacts on various forms of trust. First, the experience of Chinese people with disaster is positively associated with trust in out-groups (people whom they meet for the first time). Individuals with actual disaster experience may have learned to work with strangers, extend trust to outsiders, and sympathize with people they did not know personally. This result of individuals' disaster experiences supports previous studies reporting that people respond to disaster events with increased bonds and solidarity (e.g., Brunsma et al., 2007; Poulin et al., 2009; Tedeschi & Calhoun, 1996; for other emergencies, see Collins, 2004; Hawdon et al., 2010). Social scientists have traditionally recognized the value of out-group trust, connecting it with civic culture, which is beneficial for social integration. The high out-group trust after a disaster was also found at the province level. The results show that when people were affected by disasters in their province, the average residents of the province tended to become more sympathetic to people they had never met before. The individual- and province-level results reinforce each other. These finding also suggests that studies should be cautious when they assess the role of pre-disaster social capital in the post-disaster recovery process. They should note that sympathy and altruism toward unknown or general others can increase in response to disaster and that disaster events themselves can generate social capital; therefore, scholars should avoid overestimating the role of pre-disaster social capital in their studies. Future studies can test this in other social/political contexts and investigate whether certain disaster characteristics stimulate and facilitate increased trust among residents in times of disaster.

This study also found that individuals have a lower level of political trust after an actual experience with disaster events, which is in line with the findings of Arceneaux and Stein (2006) and Han et al. (2011). Disasters require the allocation of physical and material resources, but these may be insufficiently distributed in some communities. As a result, people may lose trust in local and central government officials when trying to protect their properties and families. Decreased political trust is also found at the provincial level. Disasters that caused economic loss and many deaths at the provincial level also decreased people's trust in local and central government officials. However, this study was not able to examine how the government performed or how people evaluated the performance of the government during and after a disaster (c.f. Lazarev et al., 2014); therefore, the finding is insufficient to establish that disaster decreases political trust. Nevertheless, the finding indicates that, in the context of China, people's exposure to disaster is negatively associated with political trust, which may mean that

the Chinese people have held the government and its officials responsible for damage caused by disasters associated with natural hazards. Therefore, appropriately dealing with natural hazards, such as providing disaster relief, improve disaster risk management system, increase the role of civil society in disaster policymaking, is important for governing institutions, whether or not in a democracy, to secure their legitimacy.

In contrast to the results regarding out-group and political trust, questions still remain as to the insignificant/negative effects of disaster on in-group trust in China. It is commonly assumed that altruism and reciprocity behaviors increase when family, friends, and neighbors are at risk, but both the individual and province-level variables show negative or insignificant effects on in-group trust, which invites further studies. One possible explanation is China's high in-group trust compared to other East Asian countries, as shown in the results of the EASS (see other East Asian countries' in-group trust in Lee, 2019). It is possible that the already high level of trust in family, friends, and neighbors among the Chinese people may have been unaffected or even negatively affected by disaster experiences. Future studies could search for the factors that have led to a decrease of in-group trust after disaster in China.

Regarding generalized trust, both individual disaster experience and province-level damage do not show a significant effect, except in the case of the number of deaths from the past 5 years of disasters. The past 5 years of disasters included the Sichuan earthquake in 2008, which indicates that the huge loss of life from a tragic event such as an earthquake increases people's *trust in most people* and that the effects last longer than those of other disaster events and damage. However, the relatively weak effects of disaster on generalized trust, compared to out-group trust, requires further study. As discussed, some studies have equated out-group trust with generalized trust (e.g. Freitag & Traunmüller, 2009; Newton & Zmerli, 2011; Welch et al., 2007). Such studies would expect the same or similar effects of disaster experience on both out-group trust and generalized trust; however, the results were different. The difference may be due, in part, to the different wording of the survey questions for these two types of trust or due to Chinese respondents' different interpretations of the questions. Further studies should look more closely at the difference between out-group trust and generalized trust.

Another finding is that, when the impact of 3 years of disasters and that of 5 years of disasters were compared, the effects of province-level disasters on trust generally weakened as damage was aggregated for a longer period. This raises some questions regarding how long people's trust in unknown others and dissatisfaction with the government persist in relation to magnitude or types of natural hazards, which invites future studies.

Beyond the disaster variables, there are other noteworthy findings. As social capital theory suggests, participation in associations and personal networks are, in general, positively associated with both social and political trust. Among demographic characteristics, older people show greater trust in all forms than younger people, and educated Chinese tend to have higher levels of out-group trust and lower levels of political trust. Especially, the low political trust among educated young Chinese may threaten the legitimacy of the Chinese government. Urban residents also tend to be more skeptical about their governments. It is probably because urban residents are more likely to pay attention to officials' performances than residents in rural areas. Females, compared to males, have a lower level of out-group trust and a higher level of political trust. In an earlier study, Delhey and Newton (2003) found that females were less trusting in Switzerland and the United States, but they did not distinguish different form of trust. More comparative studies with other countries in East Asia or beyond will provide implications for these findings.

This study has a number of limitations. First, the data are by their nature insufficient to show a causal relationship between the independent and dependent variables. More data should be collected to compare pre-disaster trust and post-disaster trust to fully demonstrate the social impact of natural hazards. Moreover, the disaster variables in this study did not consider specific types of disaster events; the results illustrate only individuals' general responses to general disaster events. Further research is required to assess whether residents' attitudes toward and trust in others change depending on the type of disaster. Furthermore, because the findings of this study may reflect China's cultural characteristics, more comparative studies could deepen the understanding of diverse natural events that affect social behaviors and attitudes. Finally, the findings of this study could be compared with the findings of studies on other types of community emergencies, such as terrorism, crime, and community health, to give a broader understanding of community emergencies.

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