

The social impact of natural hazards: a multi-level analysis of disasters and forms of trust in mainland China

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This study aimed to assess the multi-level effects of natural hazards on trust in Chinese society. Drawing on the Chinese General Social Survey conducted in 2012 and provincial disaster damage records, it examined the association between individuals' past experiences of disasters and province-level damage (measured by the number of affected people, deaths, and economic loss) and various forms of trust: in-group; out-group; generalised; and political. The findings indicate that Chinese individuals with experience of disasters have higher levels of out-group trust but lower levels of political trust. Similarly, at the province level, damage owing to disasters over the past three years (2009–11) positively impacted on residents' out-group trust while negatively affecting their political trust. However, when provincial damage was aggregated for disasters over the past five years (2007–11), which included the devastating Sichuan earthquake on 12 May 2008, only total deaths had a positive effect on generalised trust.

Keywords: China, disaster, natural hazards, political trust, social trust

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 (see, for example, Nakagawa and Shaw, 2004; Adger et al., 2005; Dynes, 2006; Norris et al., 2008; Hawkins and Maurer, 2010; Cox and Perry, 2011; Aldrich, 2012, 2019; Wickes et al., 2015). They have focused on the pre-disaster social structures and conditions that determine a community's ability to adjust and to recover during and following a disaster. Yet, questions remain concerning post-disaster social capital, especially as some works have shown the depletion of social connections and trust after a disaster (see, for example, Miller, 2006; Papanikolaou et al., 2012), while others portray an increase in altruism and volunteer activities in the wake of a disaster (see, for example, Chang, 2010; Albrecht, 2018). This paper was motivated by the need for more research on post-disaster social capital that explains how social behaviour and attitudes are affected by extreme, hard-to-predict natural events, which can help one to define and develop theories on the social impact of such hazards. More broadly, understanding the social impact of natural events can also yield insights into how community members respond to various emergency situations.

In considering the social impacts of natural hazards, this study concentrated especially on trust, seen as an integral part of societies and the core of social capital (Coleman, 1990; Fukuyama, 1995; Inglehart, 1997; Putnam, 2000; 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 neighbours, whereas others trust a broader range of people, including fellow citizens and other individuals whom they have not met before (Uslaner and Conley, 2003; Welch, Sikkink, and Loveland, 2007; Realo, Allik, and Greenfield, 2008; Freitag and Traunmüller, 2009; Delhey, Newton, and Welzel, 2011; van Hoorn, 2015; Crepaz et al., 2017). Furthermore, one's trust spreads not only horizontally but also vertically to politicians and government officials (Putnam, 2000; Newton and Zmerli, 2011). In light of these diverse types of trust, this study questions how individuals' exposure to disaster affects their various forms of trust, a topic that has not been fully explored in previous analyses. Moreover, trust is shaped not only by individual experience but also by social circumstance (Delhey and Newton, 2003); a better means of testing trust and disaster, therefore, is to assess both the individual- and the group-level effects of the event. Consequently, this investigation, focusing on China, probes the ramifications of individual-level experiences and province-level damage resulting from natural hazards, such as deaths, affected lives, and economic losses, on individuals' in-group, out-group, generalised, and political trust.

This exploration contributes to the literature on disasters and natural hazards by using empirical evidence spanning all provinces in mainland China, which has been exposed to various events that have threatened a great number of people. Table 1 shows the amount of damage owing to natural hazards that occurred nationwide between 1993 and 2012. According to the data, flooding is the most frequent type of disaster and affects the most people. Although less common, storms and droughts have also affected large numbers of people. Earthquake is the deadliest kind of disaster, and floods and earthquakes generate the greatest economic losses. Although this study does not distinguish between disaster types, its key province-level variables—deaths, economic losses, and number of people affected—will provide some insights into them. Moreover, this study utilises other measurements that are commonly used in national and international social surveys; consequently, the methods employed here are easily replicable and applicable to areas outside of China, enabling comparison or generalisation of the results in future work. Furthermore, previous studies on post-disaster trust have not paid attention to the diverse forms of trust, which can reveal broader sociological and political implications. By analysing various kinds of trust in the context of disaster, this study bridges the gap between two bodies of literature. Finally, this study appraises disaster impacts at two distinct levels. Unlike individual-level disaster experiences, province-level disaster experiences do not necessarily require residents to be directly exposed to the events. The findings illustrate the ramifications of the direct and indirect effects of disasters, deepening understanding of the social repercussions of natural hazards.

Table 1. Damage due to natural hazards in China, 1993–2012

Type	Occurrence	Total number of people affected	Total number of deaths	Economic loss (USD)
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: author, based on information from the International Disaster Database (EM-DAT), <https://www.emdat.be/> (last accessed on 6 March 2020).

The aftermath of disaster and forms of trust

An increasing number of studies have reported on the relationship between social capital and community resilience to disasters (see, for example, Nakagawa and Shaw, 2004; Dynes, 2006; Norris et al., 2008; Hawkins and Maurer, 2010; Cox and Perry, 2011; Aldrich, 2012, 2019; Lee, 2019). In those works, scholars have emphasised 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 following a disaster (Hurlbert, Haines, and Beggs, 2000, p. 599; Wickes et al., 2015). Questions concerning post-disaster social capital remain relatively underexplored. Those issues, as Albrecht (2018) points out, include: whether the level of social capital changes owing to a natural hazard event; 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 matters are worth probing, as it seems that there are two opposing views regarding the aftermath of a 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, for example, Picou, Marshall, and Gill, 2004; Ritchie and Gill, 2007). For instance, Miller (2006) provides evidence of a decrease in trust near New Orleans, Louisiana, United States, after Hurricane Katrina, which pitted survivors against outsiders and neighbour against neighbour. Similarly, Papanikolaou et al. (2012) found that Greeks affected by wildfires in 2007 were less likely to trust and support one another than people who were not impacted by them. Picou, Marshall, and Gill, (2004) contend that members

of disaster-stricken communities in the US suffer from stress, loss of trust, and the disruption of social connections.

Meanwhile, a second group of studies—greater in number—has found an increase in altruism in the wake of a disaster (see, for example, Douty, 1972; Quarantelli and Dynes, 1977; Brunson, Overfelt, and Picou, 2007; Poulin et al., 2009). For instance, Sauri, Domingo, and Romero (2003) discovered that altruism and reciprocity behaviours amplified when family, friends, and neighbours were at risk. Yamamura's (2016) research on the earthquake in Kobe, Japan, on 17 January 1995 revealed enhanced social capital among affected residents. Dussailant and Guzmán (2014) examined social trust before and after the earthquake in Chile on 27 February 2010 and observed 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 a disaster, some scholars claim that these opposing perspectives may not be mutually exclusive. For instance, Kaniasty and Norris (1993, 2004) evaluated 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 (i) pre-existing socio-psychological conditions and resources affect the extent of exposure to a disaster and that (ii) disasters trigger a heroic, altruistic struggle to fulfil immediate needs, while (iii) the distribution of resources and aid is not equitable, and therefore the victims of a disaster eventually face the sad reality of declining social support over time (Norris and Kaniasty, 2004). Although this model is comprehensive and quite convincing, more research is required to distinguish between the short- and long-term timelines following a disaster, and the postulation should be tested and applied in diverse cultural and social settings. In addition, Lee and Fraser (2019) suggest that residents' direct exposure to a disaster and their perceived risk (or fear) of such an event have different effects on various types of social organisations. To confirm their finding, more tests of other social behaviours and attitudes are needed to clarify the social impacts of natural hazards, which is a goal of the current study.

Among the various social behaviours and attitudes that may be affected by a disaster, individuals' trust in others is the focal point of this analysis. Trust has been widely studied by social scientists as the essence of social capital and as a contributing factor to social integration, economic growth, personal life satisfaction, and democratic stability (Coleman, 1990; Fukuyama, 1995; Whiteley, 1999; Putnam, 2000; Uslaner, 2002; Delhey and Newton, 2003). 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 (Coleman, 1990; Putnam, 2000; Hardin, 2002; Paxton, 2007), whereas others assert that trust is a propensity that is innate or learned early in life and thus is primarily personal (Yamagishi and Yamagishi, 1994; Uslaner, 2002; Stolle and Hooghe, 2004). 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 of voluntary associations, maintenance of social networks, and the characteristics of the community to which one belongs). Beyond the individual and community characteristics, Delhey, Newton, and Welzel (2011) argue that cultural legacies, economic modernity, and institutional factors, such as rule of law, affect people's trust.

The more recent literature on trust has investigated diverse forms of trust in depth. Two distinct kinds of social trust have been identified with regard to their social scope: particularised and generalised trust (Uslander and Conley, 2003; Newton and Zmerli, 2011; Crepaz, Jazayeri, and Polk, 2017). Particularised trust is found in close social proximity to individuals and is extended only to people whom the individual knows from everyday interactions (such as family members, friends, neighbours, and co-workers). Since it is found in inward-looking groups, particularised trust has often been called *in-group trust*. By contrast, generalised trust is the belief that most people in society, including unfamiliar people (such as foreigners, fellow citizens, and passers-by), are trustworthy and are integral parts of society (Inglehart, 1997; Uslaner, 2002); it has frequently been called *out-group trust*. For Putnam (2000), in-group trust is *thick* (that is, it manifests within a small radius), whereas out-group trust is *thin* (that is, it is extended to people who are more socially distant). He contends 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, 2000; see also Uslaner and 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 *generalised trust*, however, some scholars simply equate them (see, for example, Yamagishi and Yamagishi, 1994; Welch, Sikkink, and Loveland, 2007; Freitag and Traunmüller, 2009; Newton and Zmerli, 2011), whereas others distinguish between the two (see, for example, Delhey, Newton, and Welzel, 2011; Crepaz, Jazayeri, and Polk, 2017). For members of the latter group, generalised trust is an (overly) broad concept in comparison to out-group trust (Sturgis and Smith, 2010; Torpe and Lolle, 2011; Gundelach, 2014). They assume that generalised trust constitutes *trust in most people* or represents an *average of other types of trust*; hence, they use a special survey question of the General Social Survey (developed in the US) to measure generalised 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 (2000) claims 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 (Jackman and Miller, 1996; Mishler and Rose, 2001, 2005; Liu and Stolle, 2017; Lee and Yi, 2018). In disaster studies, only a few works have investigated whether disasters 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, US. Focusing on China, Han, Hu, and Nigg (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 amounts of state aid may have affected the rise.

Two bodies of literature—disaster studies and sociological studies of trust—are prominent, but they have not broadly communicated, and few investigations have examined people's trust, especially different forms of trust, in the context of disasters triggered by natural hazards (Lee, 2019). This study bridges the gap between the two literatures in a Chinese context by examining at two levels—individual and province—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 15 June 2012 and 10 December 2012. A four-stage probability proportional to size sampling method was utilised, stratified by comprehensive socioeconomic 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 per cent. The dataset was obtained through the Inter-University Consortium for Political and Social Research. Meanwhile, 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 *Meteorological Disasters in China Yearbooks (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, neighbours, work colleagues, people they had met for the first time, and local 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 generalised trust: 'Generally speaking, would you say that most people can be trusted?'. The respondents were asked to choose answers using a four-point Likert scale: 'You almost always can't be too careful in dealing with people'; 'You

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

Horizontal and vertical trust	Component	
	1	2
Trust in family	0.560	>0.001
Trust in friends	0.754	>0.001
Trust in neighbours	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 percentage	24.9	15.8
Chi square	397.97 (13)	
p-value	p<0.01	

Notes: 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). Dark grey shading is used to highlight the groupings.

Source: author

usually can't be too careful in dealing with people'; 'People can usually be trusted'; and 'People can almost always be trusted'. Table 2 displays 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, neighbours, and work colleagues (that is, in-group trust), and the other depended primarily on trust in local and central government officials (that is, political trust). The other two types of trust—trust in people met for the first time and generalised 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 generalised trust. This is consistent with previous studies that distinguish between out-group trust and generalised trust (Sturgis and Smith, 2010; Torpe and Lolle, 2011; Gundelach, 2014). Consequently, this study uses four dependent variables: in-group trust; out-group trust; generalised trust; and political trust.

Individual-level variables

The respondents' disaster experience was the individual-level independent variable (Chang, 2010; Toya and 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 and Newton, 2003). The CGSS asked respondents whether they participated in any of the following organisations: political associations, residential or neighbourhood associations, social service or volunteer groups, citizens' movements or consumer cooperative groups, religious groups, alumni associations, recreational associations, labour 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. As a result, a personal network variable was obtained from the questions that asked the respondents how many people they could ask for a favour, such as watering plants, feeding pets, and giving advice. The answers ranged from '0' to '10 or more'.

To gauge personal predispositions and life satisfaction (Yamagishi and Yamagishi, 1994; Uslaner, 2002), 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'. In addition, respondents were asked to evaluate their health condition on a five-point Likert scale: 'very bad'; 'bad'; 'neither bad nor good'; 'good'; or 'very good'.

Urbanisation was included as a community characteristic that can affect individual trust (Delhey and Newton, 2003; Delhey, Newton, and Welzel, 2011). Urbanisation 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 as '1', and male was coded as '0'. The CGSS coded household income on a five-point Likert scale ranging from 'far below average' ('1') to 'far above average' ('5').

Province-level variables

Three disaster-related variables and one control variable were collected at the province level. First, the number of people affected by the disaster per 100 members of the population was obtained to indicate the range and degree of destruction caused by disasters in the provinces. Second, the number of deaths per one 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 show damage to crops, buildings, or infrastructure. The population density of the provinces was included as a province-level control variable. In the context of China, high population density generally signifies the developed coastal provinces with high incomes and urban populations, whereas low population density is associated with less developed inner areas with relatively low incomes and rural settings (Hu, 2002; Yang, Xu, and Long, 2016).

Since the dependent variables are from a survey conducted in 2012, the proper way to estimate the effects of province-level disaster damage on those variables was to collect data from earlier than 2012. However, the single-year disaster data contained only a few instances of events, which was not enough to analyse patterns. Consequently, two aggregated sets of data were created for province-level damage owing to disasters: the past three years of disaster damage (2009–11); and the past five years of disaster damage (2007–11). Using the data of two distinct periods was expected to show whether a time frame difference yielded alternative results. Furthermore, the

Table 3. Descriptive statistics for variables

	Minimum	Maximum	Average	Standard deviation
Individual level (2012)				
In-group trust	1	4	3.2	0.5
Out-group trust	1	4	1.7	0.6
Generalised 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
Urbanisation	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 (2009–11)				
Affected people (per 100)	1.5	251.9	100.2	62.2
Deaths (per one million)	0.003	488.1	22.5	90.3
Economic loss (CNY 100 million)	1.03	331.2	123.0	79.1
Population density (10,000 per square kilometre)	7.8	3,606.4	449.9	673.3
Province level (2007–11)				
Affected people (per 100)	2.5	377.4	167.0	99.5
Deaths (per one million)	0.094	1,078.2	63.2	215.4
Economic loss (CNY 100 million)	1.71	1796.1	170.8	318.9
Population density (10,000 per square kilometre)	7.7	3490.4	440.6	649.8

Source: author.

past five years of disaster damage included the Sichuan earthquake on 12 May 2008 that led to almost 70,000 fatalities (for details, see Hui, 2009), revealing whether the impacts of historical events persisted.

Table 3 summarises the variables. Linear mixed-effects analysis (fixed effects and random intercept) was performed to estimate the multi-level impacts 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.

Results

Table 4 illustrates how in-group, out-group, generalised, and political trust are affected by individual disaster experience and provincial damage due to disasters in the three years prior to 2012. For each form of trust, two models were structured. The first models (1, 3, 5, and 7) included only the individual-level dependent variables, whereas the second models (2, 4, 6, and 8) added province-level variables. This approach served 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.

With regard to the first models (1, 3, 5, and 7), the respondents' experience of disasters had a positive effect on out-group trust and a negative effect on trust in government officials. In Model 3, people with experience of disasters had a higher level of out-group trust than people without such 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 such experience ($b=-0.061$, $p<0.01$). These results indicate that individuals' experiences of disasters may have extended their radius of trust, but that the victims might also hold the government responsible for the events. However, as Models 1 and 5 reveal, individuals' in-group trust and generalised trust were not significantly affected by their disaster experience, as will be discussed below.

With regard to the second models (2, 4, 6, and 8), for in-group trust, the LR test between Models 1 and 2 demonstrates that adding province-level variables improves the goodness of fit of the model ($\text{chi-square}=8.54$, $p<0.10$). 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 has a negative effect on in-group trust ($b=-0.001$, $p<0.10$). However, economic loss did not have 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 behaviour increased when family, friends, and neighbours were at risk (Sauri, Domingo, and Romero, 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

Table 4. Multi-level regression of trust on individual disaster experience and provincial damage (2009–11) owing to natural hazards

	In-group trust		Out-group trust		Generalised trust		Political trust	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Fixed effects								
Individual level (2012)								
Disaster experience	0.016 (0.014)	0.017 (0.014)	0.047*** (0.016)	0.044*** (0.016)	-0.013 (0.017)	-0.014 (0.017)	-0.061*** (0.020)	-0.060*** (0.020)
Participation in associations	0.015 (0.010)	0.015 (0.010)	0.006 (0.011)	0.006 (0.011)	0.044*** (0.012)	0.045*** (0.012)	0.064*** (0.014)	0.063*** (0.014)
Personal network	0.054*** (0.005)	0.054*** (0.005)	0.031*** (0.006)	0.031*** (0.006)	0.040*** (0.006)	0.039*** (0.006)	0.013* (0.007)	0.012* (0.007)
Happiness	0.062*** (0.009)	0.062*** (0.009)	0.010 (0.010)	0.011 (0.010)	0.090*** (0.010)	0.092*** (0.010)	0.084*** (0.012)	0.083*** (0.012)
Self-rated health	0.018** (0.007)	0.017** (0.007)	0.009 (0.009)	0.009 (0.009)	0.001 (0.001)	0.001 (0.001)	0.016 (0.010)	0.016 (0.010)
Urbanisation	-0.004 (0.006)	-0.005 (0.007)	-0.008 (0.008)	-0.007 (0.008)	-0.002 (0.008)	-0.001 (0.008)	-0.052*** (0.009)	-0.052*** (0.009)
Age	0.001** (0.001)	0.001** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
Education years	-0.001 (0.002)	-0.001 (0.002)	0.005** (0.002)	0.005** (0.002)	0.0006 (0.002)	0.0003 (0.002)	-0.005* (0.003)	-0.005* (0.003)
Gender (female=1; male=0)	0.004 (0.014)	0.004 (0.014)	-0.039** (0.016)	-0.039** (0.016)	-0.0006 (0.017)	-0.0003 (0.017)	0.063*** (0.019)	0.063*** (0.019)
Household income	-0.013 (0.010)	-0.014 (0.010)	0.020* (0.012)	0.020* (0.012)	-0.004 (0.012)	-0.005 (0.012)	-0.018 (0.014)	-0.018 (0.014)

Table 4. Continued

Province level (2009–11)										
Affected people (per 100)	–	-0.001* (0.0003)	–	0.001** (0.0004)	–	0.0002 (0.0003)	–	–	0.001 (0.001)	–
Deaths (per one million)	–	-0.001** (0.0002)	–	0.001** (0.0003)	–	-0.0001 (0.0003)	–	–	-0.001*** (0.0004)	–
Economic loss (log)	–	-0.010 (0.015)	–	0.052** (0.019)	–	0.013 (0.016)	–	–	-0.061** (0.026)	–
Population density (log)	–	-0.044** (0.018)	–	0.105*** (0.022)	–	0.043** (0.020)	–	–	-0.135*** (0.030)	–
Intercept	2.758*** (0.060)	3.128*** (0.162)	1.318*** (0.073)	0.356* (0.203)	2.334** (0.071)	2.008*** (0.181)	2.502*** (0.089)	3.509*** (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	–	–
Likelihood ratio test	–	8.54*	–	21.28***	–	8.32**	–	22.50***	–	–

Notes: *p<0.10, **p<0.05, *** p<0.01. AIC=Akaike information criterion; BIC=Bayesian information criterion.

Source: author.

effects on out-group trust were identified 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 generalised trust, the LR test between Models 5 and 6 shows that province-level variables improved the goodness of fit ($\chi^2=8.32$, $p<0.05$). Three province-level variables, though, did not have a significant effect on generalised trust. For political trust, the LR test between Models 7 and 8 illustrates that province-level variables improved the model's goodness of fit ($\chi^2=22.50$, $p<0.01$). Deaths had a negative effect on political trust ($b=-0.001$, $p<0.05$), and economic loss had a negative association with political trust ($b=-0.061$, $p<0.05$), which is consistent with the individual-level findings. Yet, the number of affected people did not have a significant effect on political trust.

Among the non-disaster factors, individuals' participation in associations had significant positive effects on generalised trust ($b=0.045$, $p<0.01$) in Model 6 and on political trust ($b=0.063$, $p<0.01$) in Model 8. This supports in part the assumption of social capital theories that social engagement and trust are closely linked. However, the effects of participation in associations on in- and out-group trust were not statistically significant. Personal networks, measured by the number of people that respondents could ask for help, had significant positive effects on all forms of trust: in-group trust ($b=0.054$, $p<0.01$), out-group trust ($b=0.031$, $p<0.01$), generalised trust ($b=0.039$, $p<0.01$), and political trust ($b=0.012$, $p<0.10$). Happiness positively affects respondents' in-group trust ($b=0.062$, $p<0.01$), generalised trust ($b=0.092$, $p<0.01$), and political trust ($b=0.083$, $p<0.01$), but it does not significantly affect out-group trust. Self-rated health has a positive effect on in-group trust ($b=0.017$, $p<0.05$), but its effects on other forms of trust are not significant. Lastly, people in urban areas had 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 the individual control variables, a greater age increases trust in all forms— in-group trust ($b=0.001$, $p<0.05$), out-group trust ($b=0.002$, $p<0.01$), generalised 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 have low levels of out-group trust ($b=-0.039$, $p<0.05$) but greater political trust ($b=0.063$, $p<0.01$). Lastly, household income positively affects out-group trust ($b=0.020$, $p<0.10$) but does not have 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. The opposite effects of population density were found for out-group trust ($b=0.105$, $p<0.01$) and generalised trust ($b=0.043$, $p<0.05$).

Table 5 presents another set of models, which were structured using province-level damage in the past five years (2007–11) to examine the longer-term impacts

Table 5. Multi-level regression of trust on individual disaster experience and provincial damage (2007–11) owing to natural hazards

	In-group trust		Out-group trust			Generalised trust			Political trust	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 8	
Fixed effects										
Individual level (2012)										
Disaster experience	0.016 (0.014)	0.017 (0.014)	0.047*** (0.016)	0.044*** (0.016)	-0.013 (0.017)	-0.014 (0.017)	-0.061*** (0.020)	-0.060*** (0.020)	-0.060*** (0.020)	-0.060*** (0.020)
Participation in associations	0.015 (0.010)	0.015 (0.010)	0.006 (0.011)	0.006 (0.011)	0.044*** (0.012)	0.044*** (0.012)	0.064*** (0.014)	0.063*** (0.014)	0.063*** (0.014)	0.063*** (0.014)
Personal network	0.054*** (0.005)	0.054*** (0.005)	0.031*** (0.006)	0.031*** (0.006)	0.040*** (0.006)	0.040*** (0.006)	0.013* (0.007)	0.012* (0.007)	0.012* (0.007)	0.012* (0.007)
Happiness	0.062*** (0.009)	0.062*** (0.009)	0.010 (0.010)	0.011 (0.010)	0.090*** (0.010)	0.092*** (0.010)	0.084*** (0.012)	0.085*** (0.012)	0.085*** (0.012)	0.085*** (0.012)
Self-rated health	0.018** (0.007)	0.017** (0.007)	0.009 (0.009)	0.009 (0.009)	0.001 (0.001)	0.001 (0.001)	0.016 (0.010)	0.016 (0.010)	0.016 (0.010)	0.016 (0.010)
Urbanisation	-0.004 (0.006)	-0.004 (0.006)	-0.008 (0.008)	-0.007 (0.008)	-0.002 (0.008)	-0.001 (0.008)	-0.052*** (0.009)	-0.052*** (0.009)	-0.052*** (0.009)	-0.052*** (0.009)
Age	0.001** (0.001)	0.001** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
Education years	-0.001 (0.002)	-0.001 (0.002)	0.005** (0.002)	0.005** (0.002)	0.0006 (0.002)	0.0003 (0.002)	-0.005* (0.003)	-0.005* (0.003)	-0.005* (0.003)	-0.005* (0.003)
Gender (female=1; male=0)	0.004 (0.014)	0.004 (0.014)	-0.039** (0.016)	-0.039** (0.016)	-0.0006 (0.017)	-0.0003 (0.017)	0.063*** (0.019)	0.063*** (0.019)	0.063*** (0.019)	0.063*** (0.019)
Household income	-0.013 (0.010)	-0.014 (0.010)	0.020* (0.012)	0.020* (0.012)	-0.004 (0.012)	-0.005 (0.012)	-0.018 (0.014)	-0.018 (0.014)	-0.018 (0.014)	-0.018 (0.014)

Table 5. Continued

Province level (2007–11)										
Affected people (per 100)	–	-0.0003 (0.0002)	–	0.0001* (0.0003)	–	0.0001 (0.0002)	–	0.001 (0.001)	–	0.001 (0.001)
Deaths (per one million)	–	-0.00002 (0.00001)	–	0.0008 (0.0001)	–	0.0002*** (0.0001)	–	0.002 (0.0004)	–	0.002 (0.0004)
Economic loss (log)	–	0.004 (0.016)	–	0.003* (0.002)	–	0.013 (0.012)	–	-0.028 (0.030)	–	-0.028 (0.030)
Population density (log)	–	-0.020 (0.016)	–	0.072*** (0.020)	–	0.052*** (0.013)	–	-0.065** (0.023)	–	-0.065** (0.023)
Intercept	2.758*** (0.060)	2.907*** (0.153)	1.318*** (0.073)	0.633*** (0.192)	2.334** (0.071)	1.938*** (0.134)	2.502*** (0.089)	2.912*** (0.264)	–	2.912*** (0.264)
Random effects (variance)										
Intercept	0.006	0.006	0.018	0.010	0.006	0.002	0.035	0.022	–	0.022
Residual	0.250	0.250	0.337	0.338	0.357	0.357	0.485	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)	–	5,580 (29)
Log-likelihood	-4123.5	-4122.0	-4972.7	-4965.1	-5107.1	-5094.6	-5936.2	-5930.9	–	-5930.9
AIC	8273.0	8278.0	9971.5	9964.3	10240.2	10223.2	11898.5	11895.7	–	11895.7
BIC	8359.3	8390.8	10057.8	10077.1	10326.5	10336.0	11984.6	12008.4	–	12008.4
Likelihood ratio test	–	3.02	–	15.22***	–	25.00***	–	10.75**	–	10.75**

Notes: *p<0.10, **p<0.05, *** p<0.01. AIC=Akaike information criterion; BIC=Bayesian information criterion.

Source: author.

of province-level disaster damage. The individual-level variables are exactly the same as in Table 4; therefore, Models 1, 3, 5, and 7 in 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 illustrates that adding province-level variables does not improve the goodness of fit of the model, and the province-level variables do not have 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 have a significant effect. When compared to Model 4 in Table 4, the effects of five-year province-level damage become weaker. For generalised 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 generalised trust ($b=0.0002$, $p<0.01$), but the number of affected people and economic loss do not have strong effects. In comparison to Model 6 in Table 4, the effect of the number of deaths on generalised trust becomes stronger. Considering the fact that the Sichuan earthquake occurred in this period, the deaths due to this historic event may have affected people's generalised trust for years. For political trust, the LR test shows that adding province-level variables enhances the model (chi-square=10.75, $p<0.05$), but no disaster-related variables have significant effects. In contrast 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 has 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 generalised trust ($b=0.052$, $p<0.01$).

Discussion and conclusion

This study assessed how disaster experiences affect individuals' forms of trust in the context of mainland China. Its main contribution to the literature is that it provides evidence that disasters have distinct impacts on various forms of trust. First, the experience of Chinese people of 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 sympathise with people they did not know personally. This outcome of individuals' experiences supports previous studies reporting that people respond to disaster events with increased bonds and solidarity (see, for example, Brunsmma, Overfelt, and Picou, 2007; Poulin et al., 2009; for other emergencies, see Collins, 2004; Hawdon, Ryan, and Agnich, 2010). Social scientists have traditionally recognised the value of out-group trust, connecting it with civic culture, which is beneficial to social

integration. High out-group trust after a disaster was also pinpointed at the province level. The results show that when people were affected by a disaster in their province, the average residents there tended to become more sympathetic to people they had never met before. The individual- and province-level findings reinforce each other. In addition, they suggest that studies should be cautious when assessing the role of pre-disaster social capital in the post-disaster recovery process. They should note that sympathy and altruism towards unknown or general others can augment in response to a disaster and that disaster events themselves can generate social capital; scholars, therefore, should avoid overestimating the role of pre-disaster social capital in their research. Future studies can test this in other social/political contexts and investigate whether certain disaster characteristics stimulate and facilitate increased trust among residents in a time of disaster.

This study also found that individuals have a lower level of political trust following actual experience of a disaster, which is in line with the findings of Arceneaux and Stein (2006) and Han, Hu, and Nigg (2011). Disasters require the allocation of physical and material resources, but these may be insufficiently distributed in some communities. As a consequence, people may lose trust in local and central government officials when trying to protect their property and family. Decreased political trust is also present 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 (*cf.* Lazarev et al., 2014); hence, the finding is insufficient to establish that disaster decreases political trust. Nevertheless, it illustrates that, in the context of China, people's exposure to a disaster is negatively associated with political trust, which may mean that Chinese people have held the government and its officials responsible for damage caused by disasters triggered by natural hazards. Thus, dealing appropriately with natural hazards, such as providing disaster relief, improving a disaster risk management system, and increasing the role of civil society in disaster policymaking, is important for governing institutions to secure their legitimacy, whether or not within a democracy.

In contrast to the results on 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 behaviours increase when family, friends, and neighbours are at risk, but both the individual- and province-level variables point up negative or insignificant effects on in-group trust, inviting further research. One possible explanation is China's high in-group trust as compared to other East Asian countries, as shown in the results of the East Asian Social Survey—see other East Asian countries' in-group trust in Lee (2019). It is possible that Chinese people's already high level of trust in family, friends, and neighbours may have been unaffected or even negatively affected by disaster experiences. Future explorations could search for the factors that have led to a decrease in post-disaster in-group trust in China.

Regarding generalised trust, both individual disaster experience and province-level damage do not have a significant effect, except in the case of the number of deaths from the past five years of disasters. This time frame included the Sichuan earthquake in 2008, which indicates that huge loss of life owing to a tragic event such as an earthquake increases people's *trust in most people* and that the effects last longer than those of other disasters. However, the relatively weak effects of a disaster on generalised trust, as compared to out-group trust, requires further research. As discussed, some studies have equated out-group trust with generalised trust (see, for example, Welch, Sikkink, and Loveland, 2007; Freitag and Traunmüller, 2009; Newton and Zmerli, 2011). They would expect disaster experience to have the same or similar effects on both out-group trust and generalised trust; yet, 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 to Chinese respondents' different interpretations of the questions. Further studies should look more closely at the difference between out-group trust and generalised trust.

In addition, when the impacts of three and five 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 about how long people's trust in unknown others and dissatisfaction with the government persist in relation to the magnitude or type of natural hazard, warranting more investigation.

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 social and political trust. Among the demographic characteristics, older people have greater trust in all four forms (in-group, out-group, generalised, and political) than younger people, and educated Chinese tend to have higher levels of out-group trust and lower levels of political trust. In particular, the low political trust among educated young Chinese may threaten the legitimacy of the country's government. Urban residents also tend to be more sceptical about their governments, probably because they are more likely to pay attention to officials' performance than residents of rural areas. Females, as compared to males, have a lower level of out-group trust and a higher level of political trust. Delhey and Newton (2003) found that females were less trusting in Switzerland and the US, but they did not distinguish different forms of trust. More comparative studies involving other countries in East Asia or beyond will reveal the implications of these findings.

Finally, 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- and post-disaster trust and to demonstrate fully the social ramifications of natural hazards. Moreover, the disaster variables in this study did not consider specific types of events; the results illustrate only individuals' general responses to general disasters. Further research is required to appraise whether residents' attitudes towards and trust in others change depending on the type of disaster. Furthermore, because the findings may reflect China's cultural characteristics, more comparative works could deepen understanding of diverse

natural events that affect social behaviour and attitudes. Lastly, the findings could be compared with those of studies on other types of community emergencies, such as crime, health, and terrorism, to spawn a broader understanding.

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