Digital disparities and vulnerability: mobile phone use, information behaviours, and disaster preparedness in Southeast Asia

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This paper proposes an ecological view to investigate how disparities in mobile technology use reflect vulnerabilities in communities vis-à-vis disaster preparedness. Data (n=1,603) were collected through a multi-country survey conducted equally in rural and urban areas of Indonesia, Myanmar, Philippines, and Vietnam, where mobile technology has become a dominant and ubiquitous communication and information medium. The findings show that smartphone users' routinized use of mobile technology and their risk perceptions are significantly associated with disaster preparedness behaviour indirectly via disaster-related information sharing. In addition to disaster-specific social support, smartphone users' disaster-related information repertoires are another strong influencing factor. In contrast, non-smartphone users are likely to rely solely on receipt of disaster-specific social support as the motivator for disaster preparedness. The results also reveal demographic and rural–urban differences in disaster information behaviour and preparedness. Given the increasing shift from basic mobile phone models to smartphones, the theoretical and policy-oriented implications of digital disparities and vulnerability are discussed.

Keywords: digital disparities, disaster preparedness, information seeking, information sharing, mobile technology, social support

Introduction

Warning responses are seen as complex social processes that involve the steps of receiving and sharing information, engaging in dialogue, and making decisions under the constraints posed by physical and social environments (Drabek, 1999). Current research on disaster preparedness is often guided by the assumption that upon receiving warning messages and understanding the risks, people are more likely to engage in protective behaviour (Shaw et al., 2004). However, this assumption has been challenged (Paton and Johnston, 2001), with extant evidence thus far inconclusive (Shaw et al., 2004; Grothmann and Reusswig, 2006; Kapucu, 2008; Scolobig, De Marchi, and Borga 2012; Wachinger et al., 2013). Knowledge of a risk is not necessarily equated with the capacity or responsiveness to it (Eiser et al., 2012). Moreover, knowledge of risks may be acquired inequitably, reflecting existing social and structural inequalities (Viswanath and Finnegan, Jr., 1996). Yet, there appears to be a lack of empirical and theoretical consideration of the broader ecology within which disaster communication and information behaviour occurs (Perreault, Jouston, and Wilkins, 2014). Particularly acute is the limited applicability of existing models to understand the relationship between disaster communication and information behaviour and preparedness in developing countries.

The increasingly variable effects of climate change are leading to natural disasters with deleterious impacts for populous countries in Asia (CRED, 2016a), particularly on the most vulnerable people in low-income nations (CRED, 2016b).

In India, for instance, evacuation decisions are frequently linked to the community, whereas they are connected to the individual or the household in Western nations (Sharma, Patwardhan, and Parthasarathy, 2009). Likewise, family and community leaders in the Philippines play an important role in community-based preparedness (Allen, 2006). In rural areas, economic resource vulnerabilities are further complicated by accompanying socio-cultural conditions and informational constraints (Chib & Ale, 2009).

This ecology of geographical and socio-cultural variables increasingly includes individuals' use (or lack thereof) of available and familiar technology in everyday life. In developed countries, a well-established line of research has evidenced citizens' active use of advanced media technologies, such as the internet, social media, and mobile technology to obtain information about disasters (Boyle et al., 2004), to reconnect with others with similar concerns about the local community (Shklovski, Palen, and Sutton, 2008), or to pass received information on to other people via Twitter (Sutton et al., 2014). Mobile technology has emerged as a major tool in developing nations (Donner, 2008), One should note that the earlier critique of scant evidence applies similarly here— with electronic channels for delivering warning messages having low applicability (Ahsan et al., 2016).

While noting the disparities between regions, intra-nationally and internationally, this study contributes to the scholarly debate on mobilisation and normalisation effects of information and communication technologies (ICTs) on human action. Mobilisation refers to a situation where new technologies afford disadvantaged groups opportunities for social participation, whereas normalisation suggests that people who are socially advantaged benefit even more from technological progress (Chen, 2015). Of particular interest is whether digital disparities, or differentials in access and use of mobile technology, exacerbate or

mitigate existing differentials among individuals, which in turn affect their disaster preparedness capacities.

To be specific, the paper proposes an ecological view to investigate whether and how the use of smartphones (versus non-smartphones), coupled with demographic and geographic differences, reflect disparities in disaster information behaviour and preparedness. It evaluates and contrasts rural and urban areas of Southeast Asia, namely in Indonesia, Myanmar, Philippines, and Vietnam. These countries were selected because of their greater incidence of and vulnerability to natural disasters, their regional (that is, rural–urban) disparities, and the fast-growing penetration of mobile technology that they are experiencing (see the methodology section for detailed statistics).

An ecological view of disaster preparedness

In brief, the ecological view emphasises the human–environment relationship (Hawley, 1950; Bronfenbrenner, 1979), taking the form of multiple levels of influence on individual behaviour and vice versa (Sallis, Owen, and Fisher, 2008). The research on the emergency warning–response process suggests that individuals engage in a series of actions, including following, searching, and sharing received warning, before deciding whether or not to take protective action against an impending disaster (Mileti and Sorensen, 1990). Various factors may come into play to account for variations in this process, including the characteristics of the warning system (such as channels, content, style, and sources) and of the public (such as culture, demographics, proximity, resources, and social network) (Sharma, Patwardhan, and Parthasarathy, 2009).

The research tends to focus on information supply rather than on information demand. An uncommon exception is the study by Choo and Nadarajah (2014), which investigates the factors that influencing early warning information seeking,

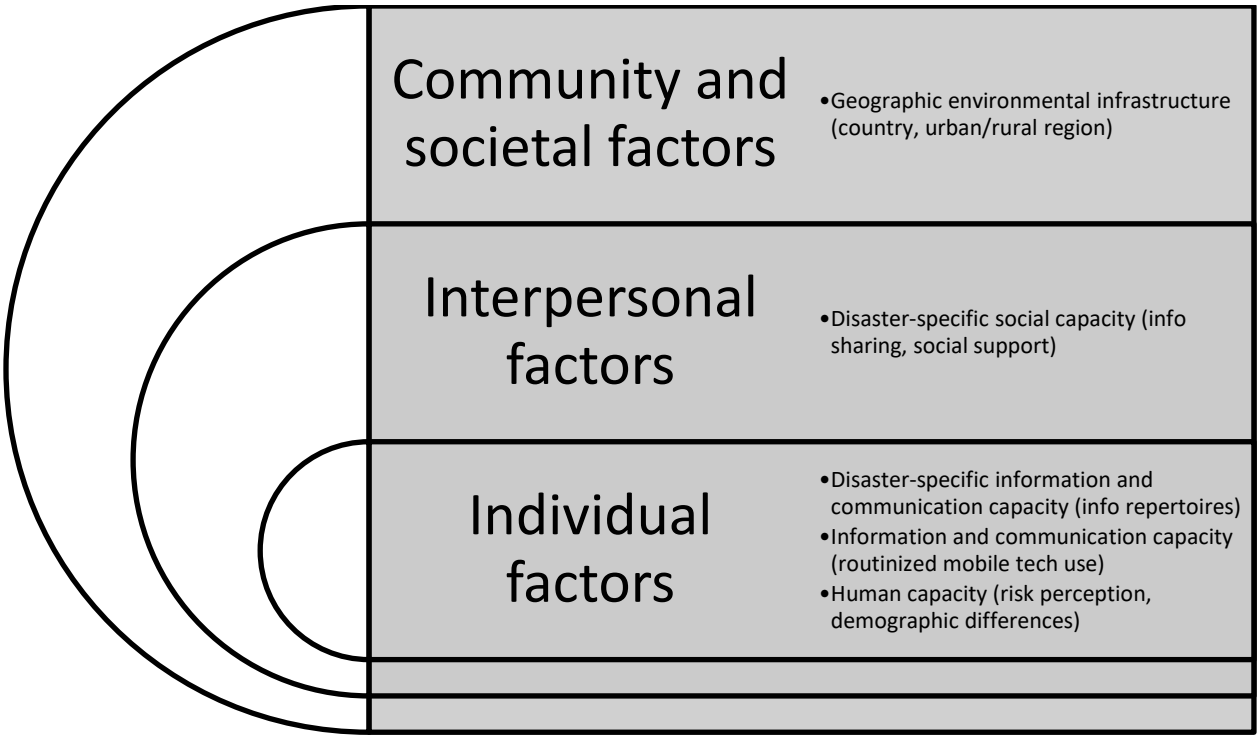
including cognitive (such as mental structures), affective (such as feelings), and situational (such as cultural and social context) factors, essentially echoing those posited by risk communication models.

The risk communication literature frequently references ecologically-oriented theories such as the model of communicating actionable risk (Wood et al., 2012). Here, information seeking is a function of information received through a diverse range of channels, knowledge, observation of preparedness, and perceived effectiveness of the action. In particular, this line of inquiry found that actionable information motivated people's preparedness action, while information seeking mediated information variables and preparedness action. After receiving information and seeing others taking action, people were more likely to discuss the matter with others (milling), and to act. Similarly, Spialek, Czlapinski, and Houston (2016) examined the ecology of disaster communication, composed of a multitude of communication resources, and found that connections established helped to provide information on, and prepare people for, the disaster, and offer post-disaster recovery support.

Although there is an established tradition of ecological perspectives in disaster research, a systematic assessment of certain fundamental points is missing: whether and how individuals have access to and use available technology to seek and share risk information and how this affects disaster preparedness in different geographical and socio-cultural settings. Building on the aforementioned literature on disaster warning, risk communication, and technology use, this paper presents an ecological view of disaster preparedness by considering personal (information repertoires, mobile technology use, risk perception) and social (disaster social support, information sharing) factors, in relation to specific vulnerabilities (demographic, geographic, international, intra-national) (see Figure 1), before setting out the research questions and associated hypotheses. It goes on to present

the methodology and the findings, before concluding with a discussion on the policy and theoretical implications. .

Figure 1. An ecological view of digital disparities and vulnerability in relation to disaster preparedness



Source: authors.

Information repertoires and disaster preparedness

Natural disasters pose personal risks that affect individuals directly. Hence they are likely to engage in goal-directed acquisition of knowledge of impending events. The literature on the warning–response process recommends disseminating warning messages through multiple channels to aid preparedness behaviour (Sharma et al., 2009; Sheppard, Janoske, and Liu, 2012). Little is known, though, about whether the tendency to utilise multiple channels also applies to voluntary information seeking. The model of information repertoires proposes that individuals use different sources (such as interpersonal communication,

newspapers, or television) to obtain information on a topic of interest (Reagan, 1996). This model of information repertoires has been applied to environmental crisis and post-disaster contexts (see, for example, O'Keefe, Ward, and Shepard, 2002). The work of Sommerfeldt (2015) reveals that people variously used the internet, newspapers, radio, short message service (SMS), television, and word of mouth to gather information after the earthquake in Haiti on 12 January 2010.

Central to information repertoires research are the influences of various motivational factors on media choice behaviours (Reagan, 1996). In the risk communication literature, risk perception often is considered to be an important factor that influences individuals' information seeking and -processing via different channels, that is, engagement in information repertoires (Kahlor et al., 2006; Bourque et al., 2012). Integrating the conceptualisation of risk perception with the model of information repertoires leads to the following hypothesis:

> A higher level of risk perception is positively associated with engagement in a wider scope of disaster information repertoires (H1).

In the existing literature on warning–response processes, individuals' possession of resources to gather information on potential risk influences how they respond to the danger and ultimately their protective behaviour (see a review in Dash and Gladwin, 2007). Under the ecological framework, technology use can be treated as part of individuals' information and communication capacity to gather information related to risks, laying the foundation for adaptive behaviour (Stokols et al., 2003). The use of increasingly ubiquitous mobile phones to access related information is a case in point. Yet, technology use frequently is intertwined with demographic factors such as age, income, and sex to reflect social vulnerability and inequality

among certain groups and their susceptibility to environmental hazards (Cutter, Boruff, and Shirley, 2003; Chib & Ale, 2009).

The knowledge gap hypothesis suggests that demographic differences may exacerbate inequitable knowledge acquisition among certain demographic groups, such as those with lower education or socioeconomic status (Viswanath and Finnegan, Jr., 1996). For instance, women in Indonesia and Myanmar were less likely to own mobile phones, reflecting their less privileged socio-economic situation and traditional gendered roles regarding access to technology (Zainudeen and Galpaya, 2015; Sylvester, 2016). In contrast, in Vietnam, women and young people were more likely to use the internet (Carsten, 2015).

Before testing the impact of mobile phones on information repertoires, we argue that the situation is more complex, and requires a nuanced examination. The first research question asks:

> How do demographic and geographic differences (such as age, education, income, location of residence, sex) reflect informational disparities, that is, differences in individuals' scope of disaster information repertoires (RQ1)?

The discussion of disparities in technology use and demographic differences invokes the debate between the mobilisation and normalisation theses, which proposes opposing views as to whether or not existing social gaps between advantaged and disadvantaged groups can be minimised or magnified by technological opportunities (Hirzalla, van Zoonen, and de Ridder, 2011). Research related to mobilisation shows that use of mobile technology affords disadvantaged groups opportunities for cultural participation on their mobile devices (Chen, 2015). However, research supporting normalisation shows that people with existing resource advantages (such as material, social, networking, knowledge,

skills) tend to use the internet or new technologies to enhance their network and social capacities, heightening the differences between themselves and with people who do not have either networking or technological competence (Ruppel and Burke, 2014).

Accordingly, the mobilisation thesis would call for a stronger relationship between mobile technology use and disaster information repertoires among those who have better access to mobile phones, whereas the normalisation thesis would suggest a weaker relationship. Moreover, digital disparities may exist not only because of access (have/have not) but also due to usage characteristics (Hargittai, 2002). It is necessary, therefore, to differentiate between routinized use of *basic* and *advanced* features of mobile technology when constructing information repertoires about disasters. Given our interest in informational vulnerabilities (Chib & Ale, 2009), or availability, access, and capacity to use information and communication resources, two hypotheses are proposed to examine the relationship between routinized use of mobile technology and disaster-related information repertoires:

> Routinized basic use of mobile technology is positively associated with engagement in a wider scope of disaster information repertoires (H2a).

> Routinized advanced use of mobile technology is positively associated with engagement in a wider scope of disaster information repertoires (H2b).

Informational vulnerability may further interact with other socio-structural conditions, particularly geographical location. The study by Choo and Nadarajah (2014) revealed that, compared to their rural counterparts, suburban dwellers were more likely to report giving thought or intending to respond to early warning on

bushfires, or have emergency plans. People who do not have sufficient access, capacity, or motivation to use smartphone features (Van Dijk, 2006), especially those living in rural areas, might use the basic functions of mobile technology to look for and share information on disasters. In rural areas of the four countries under review, especially the remote poor areas, feature phones are still the norm, even though the number of smartphone users has increased, particularly in urban areas of Indonesia and Vietnam (Akhtar and Arinto, 2009; Heimerl et al., 2015). This reasoning about rural–urban divides with regard to mobile technology use leads to the following hypotheses:

> The relationship between routinized basic use of mobile technology and engagement in a wider scope of disaster information repertoires differs by geographical region (H3a).

> The relationship between routinized advanced use of mobile technology and engagement in a wider scope of disaster information repertoires differs by geographical region (H3b).

Social processes and preparedness behaviour

Disaster preparedness behaviour is the result of a series of information and communication actions, which involve individuals receiving and sharing information, and making decisions on adopting preparedness measures (Mileti and Sorensen, 1990; Drabek, 1999). Advancing the model of information repertoires, we argue that seeking information from multiple sources and sharing the information received on impending disasters risks with one's social networks can enhance knowledge, skills, and motivation with regard to preparedness behaviour (Levac, Toal-Sullivan, and O'Sullivan, 2012). Indeed, proactive seeking of

information on particular environmental risks has been found to be a motivator of preparedness (Bourque et al., 2012; Kirschenbaum, Rapaport, and Canetti, 2017). Moreover, one is likely to discuss the matter with others after they have received the information (Becker et al., 2012). Such information sharing facilitates the social construction of risk and helps individuals to develop skills in preparing and responding to disasters (Becker et al., 2012; Wood et al., 2012). This leads to the following hypotheses:

> A wider scope of disaster-related information repertoires is positively associated with preparedness behaviour (H4).

> A higher level of disaster-related information sharing with one's core network is positively associated with preparedness behaviour (H5).

Seeking disaster-related information and sharing it with personal social networks creates a social environment in which attitudes and perceptions about impending disasters are formulated or changed. According to the ecological framework, the social environment is an important site in which multiple dimensions of influence converge (McLeroy et al., 1988). For instance, routinized use of mobile technology may serve as a foundation for building disaster-related information repertoires and sharing information with one's social network, which in turn facilitates preparedness behaviour. Risk perception can motivate individuals to engage in preparedness actions through seeking information on the hazards (Bourque et al., 2012). Yet, no explicit distinction is made between general and disaster-specific social environments in existing research that applies ecological models in disaster contexts (Kim and Kang, 2010).

What is more, there is a lack of systematic research on the mediating roles of information repertoires and information sharing with respect to technology use and disaster preparedness. As a result, the extent to which general and disaster-specific information repertoires and information sharing have differential mediating effects on individual factors and disaster preparedness is unclear. It is possible that smartphone and non-smartphone users may be influenced by the disaster-specific social environment differently. Hence, a research question is posed to assess the mediating roles of disaster information repertoires and disaster information sharing vis-à-vis the three predictors and preparedness behaviour, and to determine whether or not the mediating relationships are similar or different among smartphone and non-smartphone users:

> How do disaster-related information repertoires and information sharing mediate the relationships between the predictors—routinized use of mobile technology and risk perception—and preparedness behaviour, and what similarities or differences are there among smartphone and non-smartphone users, taking into account demographic and geographic factors (RQ2)?

Ecological frameworks assume that social networks serve as resources and/or vehicles to acquire resources that motivate individual behaviour (McLeroy et al., 1988). Numerous studies have revealed that individuals' social networks within a community (such as ties to family, friends, and local organisations) play an important supportive role in the building of their capacities to respond to, and recover after, disasters (Dynes, 2002; Nakagawa and Shaw, 2004; Murphy, 2007; Aldrich and Meyer, 2014;). For example, Hawkins and Maurer (2010) show that the close and weak connections of low-income survivors provided immediate and longer term support, respectively, after Hurricane Katrina struck the Gulf Coast of

the United States on 29 August 2005. Much less discussed, though, is the role of these social networks in pre-disaster preparedness. Notable exceptions include the study by Hausman, Hanlon, and Seals (2007), which found that individuals with greater social contacts within the local community were more likely to engage in disaster preparedness, and the study by Heller et al. (2005), which found that receipt of instrumental social support and discussion with social contacts were strong predictors of disaster preparedness. Yet again, however, there is little differentiation between general and disaster-specific social support. As mentioned, this study advances the importance of creating topic-specific social environments in motivating individual behaviour. This leads to the following hypothesis:

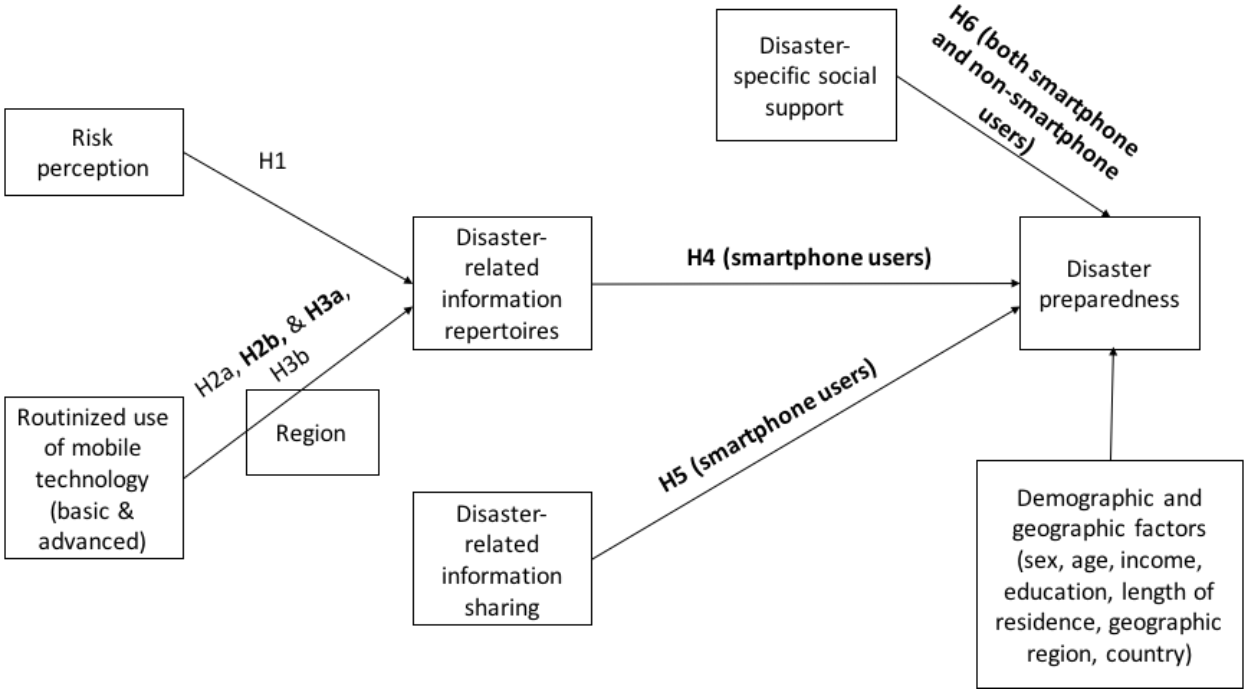
> Receipt of disaster-specific social support is positively associated with preparedness behaviour (H6).

Finally, experience of interpersonal communication can influence perceptions of the availability of social support related to disaster situations (Hurlbert, Haines, and Beggs, 2000). In other words, individuals' engagement in disaster-related information repertoires and activation of social ties for sharing information on impending disasters can be strengthened by the receipt of disaster-specific social support. Moreover, the ways in which social support is acted upon might differ among people who use basic mobile telephones and those who use advanced smartphones. This leads to the final research question:

> How does disaster-specific social support mediate the relationships between disaster-related information repertoires and information sharing and preparedness behaviour? Are these relationships similar or different among

smartphone and non-smartphone users, taking into account demographic and geographic factors (RQ3)?

Figure 2. The conceptual model of the study*



Notes: * The hypotheses in bold were supported.

Source: authors.

Methodology

This work was conducted for the Global Disaster Preparedness Center (GDPC)[1] to aid its plan to implement mobile telephone-based weather alert systems in four countries in Southeast Asia. Indonesia, Myanmar, Philippines, and Vietnam were selected because of their susceptibility to weather-related disasters and their rapid

[1] For more information see https://www.preparecenter.org/ (last accessed on 23 February 2018). **[OK?]**

adoption of mobile technology.[2] They rank among the top 10 countries by occurrence of disaster subgroup occurrences; with Indonesia and Vietnam further ranking similarly in terms of human impacts, measured by the number of deaths and affected inhabitants (CRED, 2016c). Mobile subscriptions per 100 inhabitants in Indonesia, Vietnam, and the Philippines reached 132, 130.6, and 118, respectively, in 2015, while the rate in Myanmar was 76, a significant improvement on the 13 of two years earlier (The World Bank, 2018).

Purposive sampling was performed because the objective of the research was to investigate the implications of differential access to and use of mobile technology for disaster preparedness by considering not only individual (demographic and psychological, inter alia) but also social and situational (geographic) factors. First, regions prone to weather-related disasters were identified in each country to elicit responses from individuals who had disaster-related experience, an important motivator of citizens' preparedness for disasters owing to an enhanced sense of risk (Helslott and Ruitenberg, 2004). Next, urban and rural areas were identified as the sites in which to recruit survey respondents within the selected regions, based on the preliminary understanding that adoption and use of mobile technology were different among rural and urban inhabitants in these four countries (Akhtar and Arinto, 2009; Heimerl et al., 2015). The World Bank's general definition of rural–urban areas was referenced: it suggests that rural areas are characterised by low population density and remoteness, and usually face developmental challenges (Chomitz, Buys, and Thomas, 2005). Local adjustments were made by following each country's definition of rural–urban areas, mostly determined by population density, inhabitant characteristics such as sources of

[2] Indonesia, Myanmar, Philippines, and Vietnam are defined as developing countries and belong to the category of lower middle-income (USD 1,046–4,125). For the latest classifications see The World Bank (n.d.).

employment (agriculture or not), and level of remoteness. An approximately equal percentage of the sample came from urban and rural areas in each country.[3]

Procedures and instrument

The survey was translated into local languages (Burmese, Filipino/Tagalog, Indonesian, and Vietnamese) and administered in a face-to-face format between December 2014 and February 2015. The total sample size was 1,603 (n=402 in Indonesia; n=401 in the Philippines; n=400 in Myanmar; n=400 in Vietnam) and was composed of an equal percentage of urban (n=802) and rural respondents (n=801). The approximately same sample size in each country allows for the making of more valid comparisons.

The average respondent was 39.28 years old and female (54.9 per cent). As a result of purposive sampling, 93.8 per cent of the respondents reported using mobile telephones, and more than one-half (55.8 per cent) adopted **[utilised?]** smartphones (n=833). As a point of comparison regarding mobile telephone use, less than one-half of the respondents used computers (36.1 per cent) and the internet (48.4 per cent). Moreover, an overwhelming majority (97 per cent) of the respondents reported personal experience of cyclones/typhoons or floods.

Measurements of all 15 variables, including seven demographic and geographic variables, are provided in Table 1.

Table 1. Zero correlations among the study variables

		1	2	3	4	5	6	7	8	9	10	11
1	Sex (woman)	1	–	–	–	–	–	–	–	–	–	–

[3] According to the database of the United Nations Educational, Scientific and Cultural Organization (UNESCO)—see http://uis.unesco.org/— rural populations account for 66, 66, 56, and 46 per cent of total in Myanmar, Vietnam, Philippines, and Indonesia, respectively. Hence, the purposive sample resulted in underrepresentation of rural populations in Vietnam and Myanmar. Please refer to the technical report for details of sampling and the locations of the fieldwork **[insert a reference now]**.

2	Age	-0.036	1	–	–	–	–	–	–	–	–	–
3	Income	-0.260***	-0.059*	1	–	–	–	–	–	–	–	–
4	Education	-0.045	-0.331***	0.209***	1	–	–	–	–	–	–	–
5	Length of residence	-0.146***	0.122***	0.112***	-0.143***	1	–	–	–	–	–	–
6	Region (rural)	0.007	0.029	-0.094***	-0.104***	0.041	1	–	–	–	–	–
7	Risk perception	0.216***	0.092***	-0.248***	-0.059*	-0.108***	0.061*	1	–	–	–	–
8	Basic mobile	0.012	-0.488***	-0.012	0.480***	-0.164***	-0.098***	0.095***	1	–	–	–
9	Advanced mobile	0.017	-0.227***	0.109**	0.243***	-0.136**	-0.135**	0.116**	0.431***	1	–	–
10	Information repertoires	-0.091***	-0.209***	0.307***	0.445***	-0.143***	-0.053*	0.017	0.350***	0.454***	1	–
11	Information sharing	0.026	-0.213***	0.080**	0.361***	-0.136***	-0.096***	0.207***	0.406***	0.328***	0.436***	1
12	Practical support	0.153***	-0.023	-0.184***	0.132***	-0.231***	0.028	0.335***	0.220***	0.265***	0.232***	0.331
13	emotional and informational support	0.151***	-0.032	-0.167***	0.152***	-0.245***	0.056*	0.380***	0.236***	0.300***	0.303***	0.380
14	Preparedness	0.063*	0.023	0.062*	0.129***	-0.147***	0.038	0.407***	0.174***	0.408***	0.394***	0.331

Notes: The country variable was not included owing to its multiple categories.

* p<0.05, ** p<0.01, *** p<0.001.

Source: authors.

X

Disaster information repertoires

Adapting scales from the existing research and the ways the variable of information seeking was operationalised (Perreault et al., 2014; Author A, 2015), 12 items covering traditional media, interpersonal channels, and new media were

used to measure respondents' information repertoires for impending disasters.[4] Respondents were asked whether they had received information on looming cyclones/typhoons or floods from the following: the print version of a local newspaper; a local television news broadcast; a local radio broadcast; a local government website; a website or a blog dedicated to the local community; a person or organisation via a social networking website; an e-mail listserv or newsletter about the local community; a print newsletter about the local community; word of mouth from close relatives; word of mouth from close friends; an internet search using a search engine; and a call to the local government office (0=no, 1=yes). A summed scale of *disaster information repertoires* was created, ranging from 0–12 (M (mean)=4.67, SD (standard deviation)=2.61).

Preparedness behaviour

Participants were asked whether they had engaged in any particular preparatory activities for the disaster experienced. Referencing existing scales (see, for example, Kim and Kang, 2010) and official education materials, such as the Ready Campaign,[5] initiatives included: built an emergency kit; made a family communication plan; made plans to secure the property; learned community evacuation routes; learned the elevation level of the property and whether the land was flood-prone; kept the radio or television on for the latest weather advisories; stored drinking water and food; checked on the availability of flashlights, batteries, or candles in the household; checked the function of portable radios; and being

[4] The measures of disaster information repertoires, preparedness behaviour, and routinised usage of mobile technology are formative (to indicate different facets of these constructs) and indices were used to accumulate scores. Consequently, the value of Cronbach's alpha associated with these variables is not reported (Petter, Straub, and Rai, 2007).

[5] See https://www.ready.gov/ (last accessed on 27 February 2018).

aware of the surroundings (0=no, 1=yes). A scale summing the scores of these 10 items was created, ranging from 0–10 (M=5.99, SD=3.61).

Risk perception

The study adapted the scale of McComas and Trumbo (2001) scale that measures respondents' level of risk perception through four questions requiring responses that are rated on semantic differential scales. Items included: how much cyclone/typhoon or flooding hazards they had personally faced by living in the area, rated on a seven-point scale (1=risk, 7=high risk); whether living near the area at risk of cyclone/typhoon or flooding hazards was something that they could think calmly about (1) or was something they constantly worried about (7); if the area caused cyclone/typhoon or flooding hazards, whether those risks might extend to future generations? (1=no, 7=yes); whether the risks of cyclone/typhoon or flooding hazards that might be posed by living near the community were decreasing (1) or increasing (7). The scale was validated through confirmatory factor analysis using Varimax rotation and retaining Eigenvalues of one or more, and reliability was achieved (Cronbach's α=0.76, M=4.65, SD=1.56).

Routinized use of mobile technology

The concept of routinized use of mobile technology was operationalised by identifying whether mobile technology had been used in a versatile way, in other words, multidimensional use (Author A, 2014). Respondents first selected five basic features of mobile telephones: making/receiving calls*;* sending/receiving text messages (SMS); listening to radio/music; taking/sending pictures or videos; and using the alarm clock (0=no, 1=yes). A summed scale of *routinized basic use of mobile technology* was created, ranging from 0–5 (M=3.63*,* SD=1.35). Next, smartphone users indicated usage of eight advanced mobile telephone features:

sending/reading e-mail; using mobile messaging (such as WhatsApp or LINE);[6] using location maps; accessing social networking websites; listening to web radios; watching/downloading videos; playing/downloading games; and playing/downloading music. A summed scale of *routinized advanced use of mobile technology* was created, ranging from 0–8 (M=4.83, SD=2.27).

Disaster information sharing

Respondents indicated whether they shared information received on impending disasters with their close friends and relatives through four means of communication: face-to-face conversation; telephone calls; text messaging; and online media (0=no, 1=yes). The concept of media multiplexity was harnessed to tap into the level of information sharing with one's social network in the form of multimodal communication. Media multiplexity suggests that the more frequently two people communicate, the stronger the tie, and the more types of media they use (such as e-mail and face-to-face conversation) (Haythornthwaite, 2005). Two items were created by aggregating the scores for information sharing with close relatives (M=2.10, SD=1.14) and close friends (M=1.97, SD=1.24). The *disaster information sharing* variable was then generated by averaging the values of these two items (M=2.03, SD=1.14).

Disaster social support

The scales of disaster-specific social support were adapted from the social support scale of the Medical Outcomes Study (Sherbourne and Stewart, 1991) and from Vaux, Riedel, and Stewart (1987). Four items measured the receipt of disaster-specific practical support (sample item: 'someone to help take them to an

[6] See https://www.whatsapp.com/ and https://line.me/en/ (last accessed on 27 February 2018).

evacuation site/shelter when a natural disaster happens') and five items measured the receipt of disaster-specific emotional/informational support (sample item: 'someone to help them look for information on what to do during a natural disaster'). These nine items were rated on a five-point scale where 1=never, 2=rarely, 3=sometimes, 4=often, and 5=always. The scales were validated through confirmatory factor analysis using Varimax rotation and retaining Eigenvalues of one or more, and reliability was achieved for disaster-specific practical support (Cronbach's α=0.90, M=2.78, SD=1.36) and disaster-specific emotional/informational support (Cronbach's α=0.96, M=2.89, SD=1.40).

Demographic and geographic factors

Seven demographic and geographic variables were measured: age; country; education; geographic location of residence; income; length of residence; and sex (1=man, 2=woman). Research has shown that demographic factors such as age, education, and sex are predictors of risk information seeking in routine and non-routine situations, as well as of disaster preparedness (see, for example, O'Keefe, Ward, and Shepard, 2002; Spence, Lachlan, and Burke, 2008; Perreault, Houston, and Wilkins, 2014; Sommerfeldt, 2015; Kirschenbaum, Rapaport, and Canetti, 2017). The level of monthly income was measured, where 1=less than USD 20, 2=USD 20 to less than 25, 3=USD 25 to less than 32, 4=USD 32 to less than 50, 5=USD 50 to less than 100, 6=USD 100 to less than 150, 7=USD 150 to less than 250, 8=USD 250 to less than 500, 9=USD 500 to less than 1,000, 10=more than USD 1,000 (M=4.32, SD=2.17). The level of education was measured, where 1=illiterate, 2=primary education, 3=lower secondary, 4=upper secondary, 5=tertiary or post-tertiary (M=3.66, SD=1.15). Income and education were tailored

to the specific standards in each country.[7] Data analysis adjusted local currency into US dollars and transformed country-specific educational levels to produce comparable scales. Length of residence was measured, where 1=less than 1 year, 2=1–5 years, 3=6–10 years, 4=11–20 years, 5=more than 20 years, and 6=whole of life (M=4.73, SD=1.43). Dummy coding was performed because country was a categorical variable, with Myanmar used as the reference category.

The two dependent variables (information repertoires and preparedness behaviour) were count variables (0–12, 0–10), but since they approximated a normal distribution, linear regression modelling was employed.[8] Two interaction terms were created (routinized basic use of mobile technology X region, routinized advanced use of mobile technology X region) and both routinized use of mobile technology variables were mean centred to avoid multicollinearity. Tests for indirect effects were conducted using the PROCESS macro (Hayes, 2013), which uses bootstrapping to generate confidence intervals to estimate indirect effects and thus does not impose the assumption of normality of the responses (Preacher and Hayes, 2008). The significance of indirect effects is determined by examining bias corrected 95 per cent confidence intervals. The effect is considered significant if the intervals do not contain zero.

Results

[7] Owing to the lack of a central and official system that classifies education and income in all four countries, the categories referenced multiple sources, including governmental and/or statistical authorities, or existing academic research and nationwide surveys.

[8] As a result of the small sample size of the grouping variable (four countries), which would render estimations of parameters less precise and less powerful (Garson, 2012), multilevel modelling was not employed for analysis. However, to confirm the results derived from ordinary least squares regression reported in the paper, one-way ANCOVA (analysis of covariance) with random effects models was used **[OK?]**. The results of both approaches are mostly identical except for country differences, probably due to the small grouping sample size.

The results of hierarchical linear regression showed that risk perception was not significantly associated with disaster-related information repertoires (β=0.028, p>0.10), meaning, therefore, that H1 was not supported. Routinised advanced use of mobile technology did have a significant effect on disaster-related information repertoires (β=0.202, p<0.001), but the same was true of basic use (β=0.043, p>0.10), hence H2a was not supported and H2b was supported (see Model 2 in Table 2). Although the relationship between routinized advance use of mobile technology and disaster-related information repertoires was not significantly moderated by region (β=-0.055, p>0.10), the effect of routinized basic use of mobile technology on disaster-related information repertoires was moderated by region (β=0.243, p<0.05) (see Model 3 in Table 2), so H3a was supported and H3b was not supported. In comparison to urban respondents, a clear upward association was discerned between rural respondents' use of a greater number of basic features of mobile technology and their expanded scope of disaster-related information repertoires.

Table 2. Results of linear regression on disaster information repertoires

	Model 1 Demographic and geographic factors	**Model 2 Predictors**	**Model 3 Predictors and interaction terms**
Sex (woman)	-0.045 (-0.260)	-0.032 (-0.187)	-0.033 (-0.193)
Age	0.054 (0.014)	0.104 (0.028)**	0.099 (0.026)**
Income	0.100 (0.138)**	0.086 (0.119)*	0.090 (0.125)*
Education	0.169 (0.607)***	0.132 (0.473)***	0.131 (0.470)***
Length of residence	-0.032 (-0.059)	-0.040 (-0.074)	-0.040 (-0.074)
Region (rural)	0.026 (0.156)	0.049 (0.290)	-0.044 (-0.356)
Country (Philippines)	0.609 (2.383)***	0.535 (2.095) ***	0.531 (2.080)***
Country (Vietnam)	0.198 (0.899)***	0.138 (0.629)**	0.132 (0.601)**
Country (Indonesia)	-0.286 (-1.230)***	-0.316 (-1.363)***	-0.312 (-1.346)***
Risk perception	–	0.028 (0.055)	0.025 (0.048)

Routinized basic mobile use	–	0.043 (0.168)	-0.176 (-0.694)
Routinized advanced mobile use	–	0.202 (0.264)***	0.264 (0.345)*
Routinized basic mobile use X region	–	–	0.243 (0.629)*
Routinized advanced mobile use X region	–	–	-0.055 (-0.048)
F-test	65.386***	55.187***	48.083***
Adjusted R^2	0.502	0.530	0.534
ΔR^2	–	0.031	0.005
ΔF	–	12.576***	3.052*

Notes: n=577. The coefficients in parentheses are unstandardized regression coefficients. Myanmar was used as the reference category for the variable of country.

* p<0.05, ** p<0.01, ***p<0.001.

Source: authors.

Apropos RQ1 on demographic and geographic differences reflected in informational disparities, the results showed that respondents who were older and had higher levels of education and income were likely to have a wider scope of disaster information repertoires (β=0.104, *p*<0.01; β=0.086, *p*<0.05; β=0.132, *p*<0.001) (see Model 2 in Table 2). Country differences in disaster-related information repertoires were also revealed. Compared to respondents in Myanmar, those in the Philippines (β=0.535, *p*<0.001) and Vietnam (β=0.138, *p*<0.001) were likely to utilise expanded disaster-related information repertoires. The results suggest more matured adoption of a variety of advanced media technologies for seeking disaster-related information among respondents in the Philippines and Vietnam. In contrast, the limited scope of information repertoires among respondents in Indonesia and Myanmar echoes the statistics, highlighting slower adoption of the internet and mobile technologies in these two countries (International Telecommunications Union, 2016; The World Bank, 2016).

The results also showed that the scope of disaster-related information repertoires was significantly related to preparedness behaviour among the group of

smartphone users (β=0.106, p<0.001; β=0.085, p<0.01), even after controlling for the social support variables (see Models 5 and 6 in Table 3), meaning that H4 was supported. Disaster information sharing significantly predicted preparedness (β=0.082, p<0.001), but the effect disappeared after the inclusion of the social support variables (β=0.043, p>0.10), hence H5 was partially supported. Disaster-specific practical and emotional support were significantly related to preparedness behaviour (β=0.116, p<0.001; β=0.125, p<0.001) (see Model 6 in Table 3), so H6 was supported.

Older respondents tended to prepare themselves more for disasters than their younger counterparts (β=0.112, p<0.001) (see Model 6 in Table 3). Similarly, respondents who had lived in the neighbourhood **[area?]** for a long time were **[more?]** likely to engage in preparedness behaviour than those who had resided there for a shorter period (β=0.047, p<0.05).

Regional and country differences were also revealed. Rural residents exhibited a higher likelihood of preparing themselves for disasters than their urban counterparts (β=0.050, p<0.01). This finding is consistent with prior research on the resilience of rural communities in contrast to their urban or suburban counterparts (Andrew et al., 2016). Respondents in Vietnam (β=0.519, p<0.001) and the Philippines (β=0.171, p<0.001) were more likely to engage in preparedness behaviour than those in the other two countries.

Table 3. Results of linear regression on preparedness behaviour for smartphone users

	Model 4 Demographic and geographic factors	**Model 5 Predictors**	**Model 6 Predictors**
Sex (woman)	0.030 (0.225)	0.027 (0.204)	0.024 (0.178)
Age	0.117 (0.037)***	0.115 (0.037)***	0.112 (0.036)***

Income	0.046 (0.083)	0.026 (0.047)	0.025 (0.045)
Education	0.009 (0.032)	-0.023 (-0.083)	-0.006 (-0.021)
Length of residence	0.044 (0.111)*	0.046 (0.115)*	0.047 (0.117)*
Region (rural)	0.059 (0.446)**	0.061(0.461)**	0.050 (0.373)**
Country (Philippines)	0.354 (1.691)***	0.268 (1.280)***	0.171 (0.815)***
Country (Vietnam)	0.506 (2.796)***	0.487 (2692)***	0.519 (2.866)***
Country (Indonesia)	0.110 (0.571)**	0.082 (0.255)**	0.034 (0.177)
Disaster information repertoires	–	0.106 (0.140)***	0.085 (0.113)**
Disaster information sharing	–	0.082 (0.255)***	0.043 (0.132)
Disaster practical social support	–	–	0.116 (0.314)***
Disaster emotional/informational social support	–	–	0.125 (0.326)***
F-test	202.843***	175.854***	166.770***
Adjusted R^2	0.700	0.712	0.734
ΔR^2	–	0.012	0.023
ΔF	–	16.843***	33.912***

Notes: n=780. The coefficients in parentheses are unstandardized regression coefficients. Myanmar was used as the reference category for the variable of country.

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

Source: authors.

The same regression model was run on the non-smartphone subsample. The results showed that compared to smartphone users, disaster information repertoires were not a significant predictor of preparedness behaviour in the non-smartphone group (β=0.019, $p>0.10$; β=-0.001, $p>0.10$) (see Models 8 and 9 in Table 4). Similar to what was observed in the smartphone group, disaster information sharing significantly predicted preparedness among non-smartphone respondents (β=0.073, $p<0.01$), but the effect disappeared after including the social support variables (β=0.024, $p>0.10$). Nonetheless, the effect of disaster-related social support on preparedness behaviour was still observed (β=0.131, $p<0.001$; β=0.128, $p<0.001$) (see Model 9 in Table 4).

Table 4. Results of linear regression on preparedness behaviour for non-smartphone users

	Model 7 Demographic and geographic factors	**Model 8 Predictors**	**Model 9 Predictors**
Sex (woman)	0.000 (0.002)	0.008 (0.060)	-0.010 (-0.070)
Age	0.042 (0.012)	0.048 (0.014)*	0.037 (0.011)
Income	0.062 (0.101)*	0.051 (0.082)	0.044 (0.071)
Education	0.038 (0.122)	0.023 (0.073)	0.029 (0.093)
Length of residence	-0.001 (-0.001)	-0.005 (-0.014)	-0.007 (-0.018)
Region (rural)	0.005 (0.036)	0.006 (0.046)	-0.007 (-0.051)
Country (Philippines)	0.437 (2.420)***	0.417 (2.308)***	0.313 (1.731)***
Country (Vietnam)	0.524 (2.524)***	0.526 (2.533)***	0.569 (2.738)***
Country (Indonesia)	-0.017 (-0.084)	-0.033 (-0.165)	-0.107 (-0.534)**
Disaster information repertoires	-	0.019 (0.033)	-0.001 (-0.003)
Disaster information sharing	-	0.073 (0.274)**	0.024 (0.090)
Disaster practical social support	-	-	0.131 (0.347)***
Disaster emotional/informational social support	-	-	0.128 (0.326)***
F-test	157.030***	131.274***	129.359***
Adjusted R^2	0.690	0.694	0.725
ΔR^2	-	0.005	0.032
ΔF	-	5.398**	36.432***

Notes: n=633. The coefficients in parentheses are unstandardized regression coefficients. Myanmar was used as the reference category for the variable of country.

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

Source: authors.

The effects of demographic and geographic variables on preparedness behaviour were strikingly different in the non-smartphone group. Age, length of residence, and region were not significant predictors of preparedness behaviour (β=0.037, $p>0.10$; β=-0.007, $p>0.10$; β=-0.007, $p>0.10$) (see Model 9 in Table 3), yet country differences were still observed. Respondents in Vietnam (β=0.569,

$p<0.001$) and the Philippines ($\beta=0.313$, $p<0.001$) were more likely to engage in preparedness behaviour than those in the other two countries.

RQ2 asked whether the relationships between routinized use of mobile technology and risk perception and preparedness behaviour were mediated by disaster-related information repertoires and information sharing. The results demonstrated that smartphone users' advanced use of mobile technology helped to motivate their preparedness behaviour through disaster-related information repertoires and information sharing (bias corrected 95 per cent confidence intervals: 0.0069–0.0589; 0.0033–0.0392; see Table 5). Their routinized basic use of mobile technology also influenced preparedness behaviour, but only indirectly through information sharing (bias corrected 95 per cent confidence interval: 0.0112–0.1117). Similarly, the relationship between risk perception and preparedness behaviour was mediated by information sharing (bias corrected 95 per cent confidence interval: 0.0080–0.0664) but not by information repertoires. In other words, individuals' risk perceptions were accentuated by sharing disaster information with their core network, which in turn facilitated preparedness behaviour for impending disasters. In the non-smartphone group, routinized use of mobile technology and risk reception were not significantly related to preparedness behaviour through either information repertoires or information sharing, as shown by the confidence intervals containing zeros.

Table 5. Results of indirect effect tests on disaster preparedness behaviour via information repertoires and information sharing

	Disaster information repertoires	**Disaster information sharing**
	Bias corrected 95 per cent confidence intervals	**Bias corrected 95 per cent confidence intervals**

	Point estimate	**Lower**	**Upper**	**Point estimate**	**Lower**	**Upper**
Smartphone users						
Risk perception	0.0089	-0.0037	0.0319	**0.0292**	**0.0080**	**0.0664**
Routinised basic mobile use	0.0223	-0.0006	0.0683	**0.0502**	**0.0112**	**0.1117**
Routinised advanced mobile use*	**0.0282**	**0.0069**	**0.0589**	**0.0158**	**0.0033**	**0.0392**
Non-smartphone users						
Risk perception	0.0020	-0.0021	0.0154	0.0173	-0.0016	0.0445
Routinised basic mobile use	0.0063	-0.0035	0.0269	0.0155	-0.0005	0.0429

Notes: * Advanced mobile use was only applicable for the smartphone group. n=555 for smartphone users and n=606 for non-smartphone users. In each of the tests, the demographic and geographic variables and other predictors were included as covariates. The two mediators were entered as parallel mediators in the model. The numbers in bold represent significant indirect effects.

Source: authors.

RQ3 investigated the indirect effects of disaster-related information repertoires and information sharing on preparedness behaviour through disaster-specific social support. The receipt of disaster-specific emotional/informational social support served as an important mediator that enhanced the effects of disaster information repertoires and information sharing on preparedness behaviour in both smartphone (bias corrected 95 per cent confidence intervals: 0.0074–0.0472; 0.0266–0.1271; see Table 6) and non-smartphone groups (bias corrected 95 per cent confidence intervals: 0.055–0.0588; 0.0403–0.1872). However, the receipt of disaster-specific practical support was only salient as a mediator between information sharing and preparedness in the smartphone group (bias corrected 95 per cent confidence interval: 0.0225–0.1030) and the non-smartphone group (bias corrected 95 per cent confidence interval: 0.0377– 0.1504). That is, sharing disaster-related information with one's close relatives and friends facilitated

individuals' preparedness behaviour if they had received disaster-specific practical social support from their social contacts.

Table 6. Results of indirect effect tests on disaster preparedness behaviour via social support

	Disaster practical social support			**Disaster emotional/ informational social support**		
	Bias corrected 95 per cent confidence intervals			**Bias corrected 95 per cent confidence intervals**		
	Point estimate	**Lower**	**Upper**	**Point estimate**	**Lower**	**Upper**
Smartphone users						
Disaster information repertoires	0.0050	-0.0066	0.0204	**0.0224**	**0.0074**	**0.0472**
Disaster information sharing	**0.0561**	**0.0225**	**0.1030**	**0.0668**	**0.0266**	**0.1271**
Non-smartphone users						
Disaster information repertoires	0.0120	-0.0058	0.0369	**0.0240**	**0.0055**	**0.0588**
Disaster information sharing	**0.0820**	**0.0377**	**0.1504**	**0.1019**	**0.0403**	**0.1872**

Notes: n=780 for smartphone users and n=633 for non-smartphone users. In each of the tests, the demographic and geographic variables and other predictors were included as covariates. The two mediators were entered as parallel mediators in the model. The numbers in bold represent significant indirect effects.
Source: authors.

Taken together, these results revealed a similarity among smartphone and non-smartphone users in terms of the importance of receipt of disaster-specific social support in aiding disaster preparedness. Compared to non-smartphone users, though, smartphone users' disaster-related information repertoires had direct effects on disaster preparedness. That is, information repertoires appeared to be equally as important as receipt of social support in motivating smartphone users to engage in disaster preparedness. In contrast, after taking into account the demographic and geographic factors, non-smartphone users' reliance on social

support appeared to be a major source of influence on their engagement in disaster preparedness.

Discussion

This study proposes an ecological view to understand whether and how digital disparities vis-à-vis access to and use of mobile technology mitigate or exacerbate existing differentials among individuals in terms of their disaster preparedness capacities. Overall, the data provide strong evidence to support the normalisation hypothesis. Two patterns emerged with regard to how digital disparities are intertwined with social and structural vulnerabilities, which, in turn, result in variations in disaster information and preparedness behaviour.

First, digital disparities may exist even within the seemingly more resourceful group (smartphone users). The level of routinely used advanced mobile technology features was positively associated with engagement in disaster information repertoires. In other words, the level of user sophistication in using smartphones could be a source of disparity (Hargittai, 2002), reflected here in gaps in acquiring disaster information . Moreover, even within the group of smartphone users, socioeconomic differentials are still salient as individuals who were older and had higher levels of education and income were more likely to engage in disaster information repertoires.

Second, digital disparities manifest differently when associated with personal and socio-structural factors, which, in turn, are linked to disaster vulnerabilities. The results of this study showed that non-smartphone users' employment of a variety of channels to receive information on impending disasters or to share the information with social contacts was not as powerful a driver of preparedness as it was for smartphone users. This is indicated by the lack of significant direct effects from non-smartphone users' disaster information

repertoires and information sharing on preparedness. In addition, there is also a lack of indirect effects of non-smartphone users' risk perceptions and routinized use of mobile technology on preparedness through disaster information repertoires and information sharing. Moreover, smartphone users who were older, lived in rural areas, resided in the same place for longer periods, and had a wider scope of disaster information repertoires were more likely to engage in preparedness behaviour. Yet, these effects are less salient for non-smartphone users. Indeed, the results echo to some extent the global trend towards rapid urbanisation and smartphone substitution, particularly in Asia, thus creating problems for young rural migrants who move to cities and more exposed to natural hazards (Economic and Social Commission for Asia and the Pacific, 2016).

Despite the prevailing evidence supporting the normalisation hypothesis, this study highlights the possible ways in which the impacts of digital disparities may be mitigated in the context of disaster preparedness. Specifically, disaster vulnerabilities owing to digital disparities may be addressed by building social support systems. While smartphone users had the advantage of engaging in a wide range of disaster information repertoires, non-smartphone users relied on their social networks for disaster-specific social support as a possible motivator for disaster preparedness. From the standpoint of preparedness programmes, making use of the social environment to elicit conversations about disasters among community members would be a feasible approach to motivate non-smartphone users to prepare for impending disasters.

Parsing the demographic variables, using different outlets and sources to disseminate risk-related information would be a more effective way of reaching young urban migrant smartphone users, and facilitating their preparedness behaviour. As these smartphone users also engage in information sharing with their social contacts, preparedness programmes should go through them to reach out to

other non-smartphone users in a community where smartphone adoption is not prevalent among residents .

Rural respondents' use of a greater number of basic features of mobile technology facilitated their engagement in information seeking through multiple sources on impending disasters. Considering the moderate to high proportions of rural populations in these four countries (46–66 per cent), and the projected rapid decline in rural populations by 2050 in all but the Philippines (United Nations, 2015), this finding is especially informative.

The study suggests ways to address rural populations' needs and to use available resources to engage in disaster preparedness, such as through the use of basic mobile technology. Future research should build on its findings and investigate how urban and rural users appropriate specific features and functions of mobile technology for routine and non-routine information seeking and sharing. The inquiry provides practical insights for the humanitarian sector and the community members into the ways of incorporating mobile technology in initiatives to develop long-term resilience to different kinds of environmental threats, such as chronic climate change.

The findings revealed differences in disaster preparedness in the four countries under review. Compared to respondents in Indonesia and Myanmar, those in the Philippines and Vietnam had a more diverse palette of channels for seeking information on disasters, as well as a higher level of preparedness behaviour, probably reflecting the greater rate of adoption of smartphones and the shift from traditional media to mobile internet services for the procurement of news and information in these two countries (Stryjak, Sharma, and Hatt, 2014; Gallup, 2015). Certainly, more granular research is needed to pinpoint further regional and country differences in terms of people's habits regarding media, as

they are likely to affect the ways in which individuals seek and share disaster-related information and prepare for disasters.

Limitations

This study has three key limitations that need to be addressed in future research. First, the ecological approaches entail the co-evolving and reciprocal influences between human behaviours and environments. Owing to the cross-sectional design, the insights are limited to explicating how environmental influences shape individual behaviour, but not the other way around.

Second, the use of purposive sampling rendered an overrepresented picture of smartphone users. The challenge of identifying precisely urban and rural samples in the four countries with limited statistical data resulted in underrepresentation of rural populations in Vietnam and Myanmar. Future research needs to employ more systematic ways of obtaining representative urban and rural samples in order to refine the findings of this study. Furthermore, resource and time constraints resulted in a moderate sample size from each country and a small sample size for the higher-level grouping variables (county, region), preventing a statistical examination of different levels of influence .

Third, despite conceptual reasoning, most of the measurements in this study are aggregated indices of dichotomised items, which in some ways reflect the challenges encountered in field data collection. There is a fine balance between reducing the cognitive burden on the respondents and ensuring the validity of the instrument.

These limitations could be addressed by using an expanded sample size, refined measurements, and a longitudinal design. Specifically, longitudinal observation will lead to a more solid understanding of the reciprocal linkage

between information seeking, information sharing, and adaptive preparedness behaviour.

Conclusion

The imperative of comprehending the implications of digital disparities in disaster preparedness led to this study taking an ecological view. It examined how variations in the use of mobile technology are connected to social and structural disparities, which in turn reflect differentials in disaster information behaviour and preparedness. In support of the normalisation hypothesis, data analysis reveals that digital disparities exacerbate existing inequalities in light of the trends pertaining to urbanisation and the increasing uptake of smartphones in the four developing countries (Indonesia, Myanmar, Philippines, and Vietnam). Even among smartphone users, potential digital disparities exist as individuals' disaster information acquisition varies depending on user sophistication and demographic factors, such as age, education, and income.

The study also provides evidence of how digital disparities manifest themselves differently when associated with personal and socio-cultural factors. For example, smartphone users' age, engagement in disaster information repertoires, length and location of residence, risk perceptions, and routinized use of mobile technology were associated with preparedness behaviour. These effects, though, are less salient for non-smartphone users.

This study is an initial empirical and theoretical endeavour to address the relation between digital disparities and disaster vulnerability in developing nations by delving into the environmental, individual, and social determinants of disaster preparedness . Case control and prospective and comparative studies could be the next step to verify further the ecological model examined here and to enhance knowledge of digital disparities and disaster preparedness. Regardless, more

research is needed to augment understanding of how vulnerable communities can build resilience over time in response to short-term weather-related disasters and long-term environmental hazards.

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