

Cheng, John W.; Mitomo, Hitoshi

Conference Paper

Multi-channel information dissemination for disaster evacuees – the case of the 2016 Kumamoto Earthquake in Japan

29th European Regional Conference of the International Telecommunications Society (ITS): "Towards a Digital Future: Turning Technology into Markets?", Trento, Italy, 1st - 4th August, 2018

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Cheng, John W.; Mitomo, Hitoshi (2018) : Multi-channel information dissemination for disaster evacuees – the case of the 2016 Kumamoto Earthquake in Japan, 29th European Regional Conference of the International Telecommunications Society (ITS): "Towards a Digital Future: Turning Technology into Markets?", Trento, Italy, 1st - 4th August, 2018, International Telecommunications Society (ITS), Calgary

This Version is available at:

<http://hdl.handle.net/10419/184937>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

[Working paper¹] *Multi-channel information dissemination for disaster evacuees – the case of the 2016 Kumamoto Earthquake in Japan for the 29th ITS European Conference, Trento, Italy, 1st – 4th August 2018*

John W. Cheng² and Hitoshi Mitomo³

Keywords

Multi-channel information dissemination, disaster risk reduction, media consumption across platforms

Abstract

This study examines factors that affect disaster evacuees' usage of different media in a multi-channel media environment, which means that people can receive similar content from multiple media channels. Using the 2016 Kumamoto Earthquake in Japan as the case study, we find that that multi-channel information dissemination is indeed an effective means to provide information to disaster evacuees. Specifically, it is found that traditional broadcast media and Internet media can complement each other rather than displacing. In addition, Internet media such as online TV, video streaming websites and Internet radio are effective alternatives to traditional broadcast media for providing official information to victims in severely damaged areas, which broadcast media might not be available.

Introduction

Studies have shown the importance of effective information dissemination in disaster risk reduction. Thus, governments, news media, and telecommunication providers especially in disaster-prone countries are spending great efforts to secure multiple channels for disseminating information to the public in the wake an emergency. For example, in Japan, citizens can now receive real-time disaster information from different media channels ranging from conventional off-air broadcasting to online simulcasting and streaming.

That said, when facing a disaster, while some studies (e.g., Shklovski, et al., 2010) show that people will make the most out of available technologies, other (e.g., Zlatanova & Fabbri, 2009) find that many people are reluctant to rely on unfamiliar ones. Thus, in a multi-channel media environment, in which people can access similar content from multiple media channels, whether disaster victims will utilise different media channels or they rather rely on tried-and-true ones is an important question for resource planning in disaster risk reduction, which calls for more empirical studies.

¹ Working paper - please do not quote or cite without author's permission

² School of Political Science and Economics, Waseda University, Japan. Email: cwljwc@aoni.waseda.jp

³ Graduate School of Asia-Pacific Studies, Waseda University, Japan. Email: mitomo@waseda.jp

The aim of this study is to empirically examine underlying factors that affect people's usage of different media channels for obtaining disaster news information in a multi-channel information environment. Specifically, it focuses on disaster evacuees because they have particularly higher demands for information (McCaffrey, Velez, & Briefel, 2013).

We choose the 2016 Kumamoto Earthquake – the most severe earthquake that occurred in Japan since the devastating 2011 Great East Japan Earthquake as of today – as the case study. This is because learned from the experiences from the 2011 disaster, the government, news media, and telecommunication providers were better prepared this time, and were able to disseminate disaster news information over multiple channels (Ministry of Internal Affairs and Communications, Japan, 2017).

2016 Kumamoto Earthquake

The 2016 Kumamoto Earthquake comprises of two strong earthquakes measured at Magnitude 6.5 (Japanese Seismic Intensity level 7) and Magnitude 7.3 (Japanese Seismic Intensity level 7) that occurred near the town of Mashiki in Kumamoto prefecture on 14 April and 16 April, 2016, respectively. The seismic waves destroyed many buildings and infrastructures in Kumamoto prefecture as well as the neighbouring Oita and Fukuoka prefectures. In total, 8,667 buildings were totally destroyed, 34,643 were partially destroyed, and 162,460 were damaged. As of 14 February, 2018, 258 people were killed and 1,190 were seriously injured directly and indirectly by the disaster (Fire and Disaster Management Agency, Japan, 2018).

Large number of evacuees

The two main shocks were followed by 140 strong aftershocks that measured between Japanese Seismic Intensity levels 4 and 6 upper in the following days. As a result, on top of those whose houses were damaged or destroyed, many people had fled from their homes as there were fears that more strong quakes would occur. According to the official figures, during the peak, on 17 April, 183,882 people, approximately 10% of the total population in Kumamoto prefecture, were in evacuation (Fire and Disaster Management Agency, Japan, 2018).

Local evacuation centres were soon overwhelmed by the large number of evacuees, and some evacuees decided to take shelter in their cars instead (The Nippon Foundation, 2016). Because those who took shelter in cars were scattered over different locations, local governments could not get hold of the exact number and their whereabouts, and hence faced great difficulties to provide support and resources to them. In fact, the abovementioned official number of evacuees did not include those who took shelter in cars. It was later estimated that around 12% of all evacuees were staying in cars (The Nippon Foundation, 2016; Disaster Management, Cabinet Office, 2015).

Despite some people chose to take shelter in their cars instead of evacuation shelters because of privacy concerns or other personal reasons, they also felt isolated and helpless. According to Inazuki (2016), 20% of those who took shelter in a car reported that they could not receive essential information from authorities and 15% felt that there were no one they could ask for help. Furthermore, the contained environment in a vehicle added both physical and psychological strains to the evacuees, especially elderlies and people with health conditions.

As a matter of fact, about 25% of the victims who died in this disaster were died from medical conditions such as economy class syndromes while they were in evacuation in a car (The Japan Times, 2017).

Information dissemination

Learned from the 2011 Great East Japan Earthquake, in which information dissemination over conventional channels was severely hindered by infrastructure damages and network congestions, the government have realised the utmost urgency of securing multiple information dissemination channels in disasters. Thus, this time, on top of the fact that infrastructure damages were much less severe than 2011, ICT advancements such as digital broadcasting, smartphone, SNS, and mobile broadband Internet had helped the government and news media to provide information over multiple media channels.

For instance, this was the first time the government deployed the L-Alert system – a centralised system that allows multiple agencies to broadcast disaster information to specific areas over multiple channels including broadcast media, mobile networks and the Internet simultaneously (Udagawa, 2017). In addition, TV broadcasters were also able to simultaneously broadcast (i.e., simulcast) disaster news information over the Internet and off-air. This allowed victims in areas that could not receive TV broadcast because of damaged transmitter towers to receive news information (Ministry of Internal Affairs and Communications, Japan, 2016).

As a result, different from the 2011 disaster, in which the availability of information channels was intermittent and limited, this time, all key channels including mobile communication (e.g., smart and mobile phones), broadcast media (e.g., TV and radio), and Internet media (e.g., SNS, homepage) were all available to the victims. Among different media, mobile/smart phone was used the most used, followed by broadcast TV, SNS, broadcast radio and Internet homepages. In addition, special arrangements such as free Wi-Fi and mobile phone battery chargers were also available in evacuation shelters for the evacuees (Mitsubishi Research Institute, n.d.; Ministry of Internal Affairs and Communications, Japan, 2017).

Literature review

Information needs of disaster evacuees

Studies have found that comparing with non-evacuees, disaster evacuees have higher demands for information because they face a higher level of uncertainties. For instance, McCaffrey, Velez, & Briefel (2013) compare the information needs between evacuees and non-evacuees in two bushfires in the US in 2010. They find that the evacuees tend to be more critical towards official information, seek information more actively and desire more interactivity in the process. Similarly, using the 2008 Hurricane Ike in the US as a case study, Lin, Siebeneck, Lindell, Wu, & Huang (2014) find that the evacuees' utilisation of different media channels and their reliance on media information changed throughout the course of evacuation. In addition, they also find that the evacuees' level of compliance to official information was low and thus, stress that authorities need to find more effective ways to communicate with disaster evacuees. Even in a multi-channel environment such as the 2016 Kumamoto Earthquake, Kimura, Ohtomo, & Hirata (2017) also find that despite information

was available from multiple channels, some evacuees were confused by the contradictory information from the local and central governments.

Multi-channel media environment

In a multi-channel media environment, in which audience can access similar content from multiple media channels, there are two main theories that can predict people's media usage behaviours.

First is media displacement effect theory, which predicts that audience's consumption of one media comes at the expense of another because they have limited time and attention (Newell, Pilotta, & Thomas, 2008). This effect has been observed in many studies, especially those that examine relations between the rise of the Internet media and the decline of traditional media (e.g., Lee & Leung, 2008; Lee, Lee, & Kim, 2016).

The second theory is media complementary effect theory, which suggests the otherwise. It argues that for specific content, consumption of one media will increase the consumption of another (Holbert, 2005; Dutta-Bergman, 2004). The core presumption of this argument is that the content has to be of interest to the audience and can fulfil their needs and gratifications. In the case of a disaster, Cheng, Jeon, Otsuka, & Mitomo (2014) examine people's usage of different media for obtaining disaster information and find that traditional and Internet media can interact and complement with each other. Furthermore, in a later study (Cheng, Mitomo, Otsuka, & Jeon, 2016), they find that the usage of traditional and Internet media were positively correlated. In addition, both Kirschenbaum, Rapaport, & Canetti (2017) and Feldman, et al. (2016) find that in disaster risk communication, people's usage of traditional and social media as well as formal and information sources are affected by their age and also trust towards different media sources.

From a theoretical perspective Taneja, Webster, Malthouse, & Ksiazek (2012) explain that in a multi-channel environment, audience's usage of different media are affected by both structural factors – the accessibility of media, as well as psychological factors – the audience's needs for information.

Theoretical framework and hypotheses

We constructed a theoretical framework based on the literature to examine factors that can affect disaster evacuees' usage of different media in a multi-channel media environment using the 2016 Kumamoto Earthquake as the case study.

First, we set 'media usage' as the dependent variable, which represents the evacuees' usage of different media channels for obtaining news information while they were in evacuation. According to Ministry of Internal Affairs and Communications, Japan (2017), we assume there are 7 main types of media that the evacuees had access to during the 2016 Kumamoto Earthquake, which include 1 – broadcast TV; 2 – online TV (e.g., simulcast or streaming); 3 – video streaming websites (e.g., Youtube, NicoNico etc.); 4 Internet radio (e.g., radiko.jp etc.); 5 Internet websites (e.g., government homepages, portal sites etc.); 6) SNS (e.g., Facebook, Twitter, LINE etc.); and 7) Broadcast radio (e.g., community radio etc.).

Next, following Taneja, Webster, Malthouse, & Ksiazek's (2012) framework, we assume the evacuees' usage of media were affected by both structural and psychological factors.

In this case, we have identified two key structural factors – 'number of media devices' and 'evacuation in cars.' First, 'number of media devices' refers to the number of different types of media device the evacuees had access to during evacuation. We anticipate this would affect their usage of different media because according Ministry of Internal Affairs and Communications, Japan (2017) and Mitsubishi Research Institute (n.d.), we can assume that information was available from different media, thus, whether the evacuees would access the information would depend on whether they had access to the necessary media devices.

According to the displacement effect theory, having access to multiple media may reduce one's usage of certain media. In this case, however, we anticipate the complimentary effect will prevail because we believe that disaster evacuees will have higher demands for information and hence, will utilise multiple media channels if they can. Therefore, we hypothesise that:

H1 – the more different types of media devices the evacuees had access to increased their usage of different media.

This hypothesis is further divided into 7 sub-hypotheses to represent the 7 types of media mentioned above, which were H1-1 broadcast TV; H1-2 online TV; H1-3 video streaming websites; H1-4 Internet radio; H1-5 Internet websites; H1-6 SNS; and H1-7 broadcasting radio.

Second, 'evacuation in cars' refers to whether the evacuees took shelter in a car or in other locations while they were in evacuation. We assume that evacuees who took shelters in a car would face more difficulties in accessing information comparing with those who stayed in other locations because of limited electricity supply and physical space in a vehicle. Thus, we hypothesise that:

H2 – staying in a car during evacuation reduced the evacuees' usage of media comparing with staying in other locations.

Same as H1, this hypothesis is also divided into 7 sub-hypotheses to represent the 7 types of media.

For the psychological factors, we have also identified two key factors – 'evacuated compulsively' and 'duration of evacuation.' First, 'evacuated compulsively' refers to whether the evacuees were evacuated compulsively or voluntarily. This is because we assume that those who were evacuated compulsively came from more severely damaged areas and thus, would have higher needs for information than those who evacuated voluntary. Specifically, we hypothesise that

H3 – having evacuated compulsively increased the evacuees' usage of different media.

This hypothesis is also divided into 7 sub-hypotheses same as H1 and H2.

Second, 'duration of evacuation' refers to how long the evacuees had stayed in evacuation. This is because according to (Lin, Siebeneck, Lindell, Wu, & Huang, 2014), we can assume that

the longer the evacuees have stayed in evacuation, the more information they will need. Thus, we hypothesise that

H4 – the duration of evacuation increased the evacuees’ usage of different media.

Again, same as other hypotheses, H4 is also divided into 7 sub-hypotheses.

Finally, gender and age are included as control variable. The overall model is shown in Figure 1.

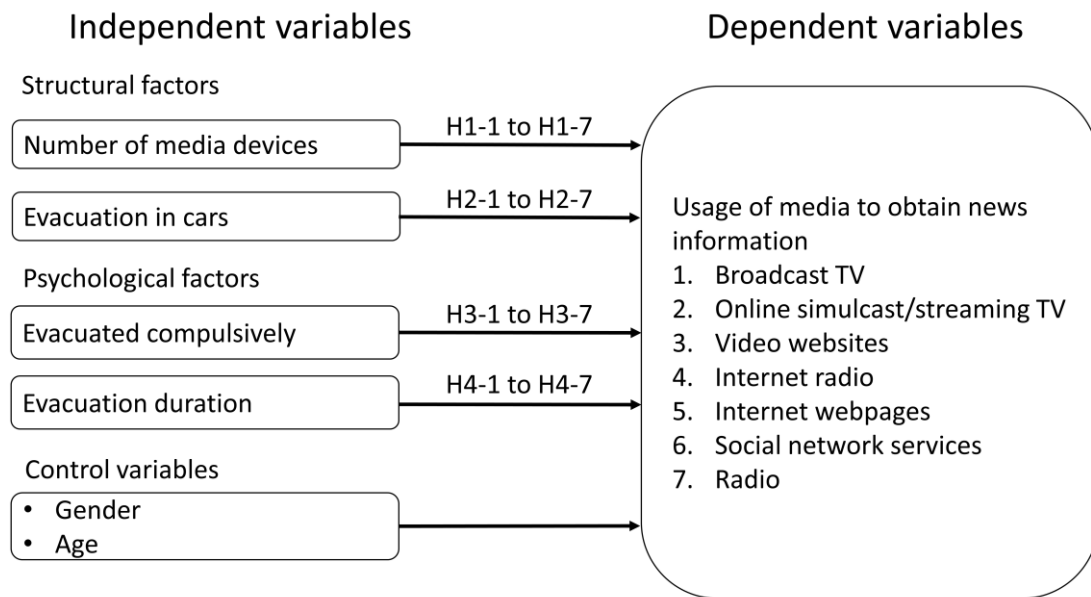


Figure 1 Theoretical model

Method and data

We used structural equation modelling to test the hypotheses as our model consisted of multiple dependent and independent variables. The data were collected from an online questionnaire survey with questions representing the variables in the model.

First, the dependent variable ‘media usage’ was operationalised by asking the respondents their usage of the 7 types of media for obtaining disaster news information while they were in evacuation in a 7-level Linkert scale (1-never to 7-always).

Second, the independent variable ‘number of media devices’ was represented by asking the respondents while they were in evacuation did they have access to the following 6 types of media device and then we summed up the total number. 1 – radio (including Internet radio); 2 – TV (including mobile phone TV; portable TV and car TV); 3 – PC or notebook PC; 4 – tablet PC; 5 –smartphone; and 6 – mobile phone.

Third, the independent variable ‘evacuated in cars’ was operationalised by asking the respondents while they were in evacuation whether they stayed in a car or in other locations, which included designated evacuation centre (outdoor and indoor), house of family and friends, or workplace. In the case that they had stayed in multiple locations, we asked them to

report the first one. Those who reported stayed in a car were recorded as 1s and those reported otherwise were recorded as 0s.

Fourth, the independent variable ‘evacuation reason’ was operationalised by asking the respondents whether they were evacuated compulsively (e.g., followed the government’s evacuation order or because of imminent dangers) or voluntarily (e.g., followed the government’s evacuation advice or advice from friends and families or by own judgement). Those who reported they were evacuated compulsively were recorded as 1s and those reported otherwise were recorded as 0s.

Fifth, the independent variable ‘evacuation duration’ was represented by asking the respondents how long they had been in evacuation from 1 – one day or less to 7 – still in evacuation.

The survey was conducted in April 2017, approximately one year after the disaster. It was carried out by a professional survey company, which has a representative survey panel with more than 1 million registered respondents across the country. The targeted samples were people who had evacuated during the 2016 Kumamoto Earthquake. Thus, first, a screening question was sent to 10,986 respondents who were living in Kumamoto prefecture from the survey panel asking whether they had evacuated from their homes during the 2016 Kumamoto Earthquake.

744 respondents replied and were selected for the questionnaire survey. Their average age was 44 years old ($SD = 13.66$). The youngest were 19 and the oldest were 80. 48.1% of them were male and 51.9% were female. 13% reported that either they themselves or someone in their families were injured by the disaster. 77.7% reported that their houses were damaged by the disaster, among them 2.4% were totally destroyed, 15.9% were partially damaged, and 57.4% were slightly damaged.

Result

The data were analysed using IBM SPSS version 24 and IBM AMOS version 24.

Descriptive statistics

Media usage – we found that among the 7 types of media, broadcast TV and SNS were the most frequently used among the respondents for obtaining disaster news information. They were followed other Internet media including Internet webpages, online TV, and video streaming websites. On the other hand, radio was the least used with Internet radio and broadcast radio ranked at the second least and least used, respectively.

Number of media devices - on average, the respondents had access to 2.19 media devices ($SD = 1.03$). 1.7% of them had access to none of the 6 types of device and 2.2% had access to all 6 types. Among different devices, smartphone was the most accessible, followed by radio, TV, mobile phone, PC and tablet PC. This implies that having access to a media device does not mean that people will use that media. For instance, we can see that although broadcast TV was the most frequently used media, TV was not the most accessible media. Similarly, despite 57.7% of the respondents had access to a radio, broadcast radio was the least used media source.

Evacuation in cars – 27% of the respondents had stayed in a car while they were in evacuation, while the other 73% stayed in designated indoor or outdoor evacuation locations, houses of their relatives or friends, or their workplaces.

Evacuation duration – the median evacuation duration of the respondents was 2 to 3 days, with 26.5% of them were in evacuation for one night or less, 26.9% for 2 to 3 days, 20% for approximately a week, 14.4% for approximately 2 weeks, 4.6% for approximately 3 weeks, and 7.7% for a month or longer.

Evacuated compulsively – 16% of the respondents were evacuated compulsory because of evacuation order from local governments or imminent dangers. The other 84% evacuated voluntarily because of the local governments’ evacuation advisory, advice from friends and families, or their own judgements.

Result analysis

First, we examined the VIFs between the variables for multicollinearity check and found that all of them were less than 4, thus, according to Hair, Black, Babin, & Anderson (2014), we could assume that there was no concern for multicollinearity. Next, we constructed a structural equation model to represent the theoretical model shown on Figure 1.

After co-varying the error terms of several dependent variables according to the modification indices suggested by AMOS, the model fit indices ($\chi^2/df=3.844$, $p=0.000^4$, CFI=0.968, GFI=0.985, SRMR=0.043, RMSEA=0.062, PCLOSE=0.084) were all satisfactory according to the criteria recommended by Hair, Black, Babin, & Anderson (2014). We then tested the hypotheses by examining the standardised beta-coefficients and their significances between the dependent and independent variables.

H1-1 to H1-7 hypothesise the number of media devices the evacuees had access to increased their usage of different types media. The results are summarised in Table 1, in which all except H1-7, broadcast radio, were supported. The beta-coefficients of all H1-1 to H1-6 were all positive, which indicates these media complemented each other instead of displacing. In particular between broadcast TV (H1-1), SNS (H1-6) and Internet website (H1-5), which had the highest, second highest, and third highest beta-coefficients, respectively.

Table 1 Hypotheses H1-1 to H1-7

Hypothesis	Independent variable		Dependent variable	standardised beta-coefficient	Significance	Result
H1-1	Number of media devices	increases	Usage of broadcast TV	0.306	***	Supported
H1-2			Usage of online TV	0.083	**	Supported
H1-3			Usage of video	0.141	***	Supported

⁴ For models with 400 samples or more (as in this case), the chi square is almost always significant (Kenny, 2014).

			streaming websites			
H1-4			Usage of Internet radio	0.112	***	Supported
H1-5			Usage of Internet websites	0.164	***	Supported
H1-6			Usage of SNS	0.169	***	Supported
H1-7			Usage of broadcast radio	0.053	NS	Rejected
***p ≤ 0.01; **p ≤ 0.05; NS-not significant.						

H2-1 to H2-7 assume that staying in a car during evacuation reduces the evacuees' usage of media. The results are summarised in Table 2. Despite some of the coefficients were negative (e.g., H2-1 broadcast TV and H2-4 Internet radio), all 7 hypotheses were insignificant. Thus, all H2s were rejected, in other words, staying in a car during evacuation had no significant effect on the respondents' usage of any media.

Table 2 Hypotheses H2-1 to H2-7

Hypothesis	Independent variable		Dependent variable	standardised beta-coefficient	Significance	Result
H2-1	Evacuation in cars	reduces	Usage of broadcast TV	-0.021	NS	Rejected
H2-2			Usage of online TV	0.005	NS	Rejected
H2-3			Usage of video streaming websites	0.005	NS	Rejected
H2-4			Usage of Internet radio	-0.43	NS	Rejected
H2-5			Usage of Internet websites	-0.012	NS	Rejected
H2-6			Usage of SNS	-0.007	NS	Rejected
H2-7			Usage of broadcast radio	0.038	NS	Rejected
***p ≤ 0.01; **p ≤ 0.05; NS-not significant.						

H3-1 to H3-7 hypothesise that evacuees who were evacuated compulsively would have higher usage of media. The results are summarised in Table 3, in which H3-2 online TV, H3-3 video streaming websites, H3-4 Internet radio, and H3-7 broadcast radio were supported. In other words, those who were evacuated compulsively had higher usage of these media compared with those who evacuated voluntarily.

Table 3 Hypotheses H3-1 to H3-7

Hypothesis	Independent variable		Dependent variable	standardised beta-coefficient	Significance	Result
H3-1	Evacuated compulsively	Increases	Usage of broadcast TV	-0.052	NS	Rejected
H3-2			Usage of online TV	0.126	***	Supported
H3-3			Usage of video streaming websites	0.074	**	Supported
H3-4			Usage of Internet radio	0.114	***	Supported
H3-5			Usage of Internet websites	0.011	NS	Rejected
H3-6			Usage of SNS	-0.001	NS	Rejected
H3-7			Usage of broadcast radio	0.080	**	Supported
***p ≤ 0.01; **p ≤ 0.05; NS-not significant.						

H4-1 to H4-7 hypothesise that the longer the evacuees had stayed in evacuation the higher their usage of media would be. The results are summarised in Table 4, interestingly, all 7 hypotheses were rejected. In other words, duration of evacuation had no impact to the respondents' usage of any media.

Table 4 Hypotheses H4-1 to H4-7

Hypothesis	Variables		Dependent variable	standardised beta-coefficient	Significance	Result
H4-1	Evacuation duration	Increases	Usage of broadcast TV	0.048	NS	Rejected
H4-2			Usage of online TV	0.057	NS	Rejected

H4-3			Usage of video streaming websites	0.004	NS	Rejected
H4-4			Usage of Internet radio	0.035	NS	Rejected
H4-5			Usage of Internet websites	0.025	NS	Rejected
H4-6			Usage of SNS	-0.019	NS	Rejected
H4-7			Usage of broadcast radio	-0.012	NS	Rejected
***p ≤ 0.01; **p ≤ 0.05; NS-not significant.						

The effects of the control variables age and gender are summarised in Table 5. The results show that age was negatively related to the usage of Internet websites and SNS. In other words, these two media were used more frequently by younger respondents. The results also indicate that gender was negatively related to all types of media except Internet websites and SNS. Noting that males were recorded as 1s and females were recorded as 2s, the results mean that male respondents generally had higher usage of all media except Internet websites, which were indifferent, and SNS, which females had higher usage.

Table 5 Control variables

Control variable	Dependent variable	standardised beta-coefficient	Significance
Age	Usage of broadcast TV	-0.041	NS
	Usage of online TV	0.024	NS
	Usage of video streaming websites	0.015	NS
	Usage of Internet radio	-0.006	NS
	Usage of Internet websites	-0.089	**
	Usage of SNS	-0.347	***
	Usage of broadcast radio	0.020	NS
Gender	Usage of broadcast TV	-0.087	**
	Usage of online TV	-0.091	**
	Usage of video streaming websites	-0.145	***
	Usage of Internet radio	-0.108	***
	Usage of Internet websites	-0.050	NS
	Usage of SNS	0.112	***
	Usage of broadcast radio	-0.097	**
***p ≤ 0.01; **p ≤ 0.05; NS-not significant.			

Discussion and conclusion

The aim of this study is to examine factors that affect disaster evacuees' usage of different media in a multi-channel media environment. Using the 2016 Kumamoto Earthquake in Japan as the case study, we have identified 2 key findings.

Multichannel information dissemination is effective

The first key finding is that multi-channel dissemination was an effective means to provide disaster information to evacuees. This is because first, from the results of H1-1 to H1-7, we have found that having access to multiple media devices did not reduce the evacuees' usage of any media. Instead, the more different types of device they had access to increased their usage of almost all types of media, except broadcast radio. Thus, it implies that there was no displacement effect between different media in this particular multi-channel media environment. Instead, there seems to be a complementary effect between the media, which included both traditional broadcast TV and Internet media including Internet websites, SNS, video streaming websites, Internet radio, and online TV. One highly plausible explanation is that disaster information from different media complemented each other. For instance, while broadcast TV provided official information, Internet media provided localised and personalised information. Thus, for those who could access multiple media, they would. This is in line with the findings by Shklovski, Burke, Kiesler, & Kraut (2010), which argue that in disasters, people would utilise all available technologies for information and communication.

The second reason is that the results of H2-1 to H2-7 show that taking shelters in cars during evacuation did not reduce the evacuees' usage of any media. This implies the evacuees could access various media sources regardless whether they took shelters in a car or in other locations. That being said, being able to access the media does not mean that people can obtain the information they needed. Considering that Kimura, Ohtomo, & Hirata (2017) find that some evacuees reported that they received contradictory and insufficient information. Therefore, although multi-channel dissemination appears to be an effective means, government authorities and supporting organisations still need to synergise and synchronise the information they distribute over different media channels.

Official information over new media channels

The second finding is the kind of media information the evacuees needed from different media channels. Specifically, first, the results of H3-1 to H3-7 show that for those who were evacuated compulsively, i.e., assumingly from more severely damaged areas, had higher usage of online TV, video streaming websites, Internet radio, and broadcast radio. The common characteristic of these media is that they all can provide broadcast-information, which in most cases, including this one, information from official sources.

Traditionally broadcast TV should be the main source of official source, however, considering that many severely damaged areas had no access to electricity and hence, no access to broadcast TV, the results show that the victims could still obtain broadcast media from other source. This interpretation is further support by the fact that H3-1 broadcast TV was rejected. Another traditional media channel that could fulfil this role is broadcast radio, however, as shown by the results, the usage of radio was very low. With ICT advancements, specifically wireless Internet, from the results of H3s, we can see that Internet media can serve the purpose of providing broadcast-official-information. Therefore, both government authorities and news media should further utilise these new media channels for broadcasting official information in disasters.

Second, interestingly, the results of H4-1 to H4-7 show that duration of evacuation had no effect of the evacuees' usage of all types of media. This is contradictory to earlier studies, which find that evacuees' usage of different media channels change over time. For instance, Lin, Siebeneck, Lindell, Wu, & Huang (2014) and Ministry of Internal Affairs and Communications, Japan (2017) find that evacuees tend to rely more on formal sources in the early phase and switch to informal ones in latter phases. We contend that this finding further proves the versatility of the Internet media because as the results have shown, the respondents could obtain both formal and informal information from multiple sources consistently throughout the course of evacuation.

Finally, moving forward, our next step is to consolidate the findings and further develop their implications for disaster risk reduction and preparedness planning for government authorities, news media and telecommunication providers.

References

- Cheng, J. W., Jeon, S. Y., Otsuka, T., & Mitomo, H. (2014). The Effects of the Use of Web 2.0 Applications and Television on Social Capital in Post-Disaster Recovery. *Journal of Information and Communication Research*, 32(2), 51-66.
- Cheng, J. W., Mitomo, H., Otsuka, T., & Jeon, S. Y. (2016). Cultivation effects of mass and social media on perceptions and behavioural intentions in post-disaster recovery—The case of the 2011 Great East Japan Earthquake. *Telematics and Informatics*, 33(3), 753-772.
- Disaster Management, Cabinet Office. (2015). *Heisei 28 nendo kumamoto jishin niokeru hinansho uneitō no jirei [in Japanese]*. Retrieved Jul 13, 2018, from <http://www.bousai.go.jp/updates/h280414jishin/h28kumamoto/pdf/h281025sanko05.pdf>
- Dutta-Bergman, M. J. (2004). Complementarity in consumption of news types across traditional and new media. *Journal of Broadcasting & Electronic Media*, 48(1), 41-60.
- Feldman, D., Contreras, S., Karlin, B., Basolo, V., Matthew, R., Sanders, B., & Serrano, K. (2016). Communicating flood risk: Looking back and forward at traditional and social media outlets. *International Journal of Disaster Risk Reduction*, 15, 43-51.
- Fire and Disaster Management Agency, Japan. (2018). *kumamoto ken kumamoto chihō o shingen to suru jishin (dai 111 hō) [in Japanese]*. Retrieved Jul 13, 2018, from <http://www.fdma.go.jp/bn/2bc2c37fda1de345bb15715eed431b9e4a667ede.pdf>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis: Pearson New International Edition* (7th ed.). Pearson.
- Holbert, R. L. (2005). Intramedia mediation: The cumulative and complementary effects of news media use. *Political Communication*, 22(4), 447-461.
- Inazuki, T. (2016). *kumamoto jishin niokeru shachū hinansha no jittai to sonogo no shien nitsuite, dai 12 kai fukuoka ken bōsai kōenkai [in Japanese]*. Retrieved Jul 13, 2018

- Kenny, D. (2014). *Measuring Model Fit*. Retrieved Jul 13, 2018, from <http://davidakenny.net/cm/fit.htm>
- Kimura, R., Ohtomo, S., & Hirata, N. (2017). A Study on the 2016 Kumamoto Earthquake: Citizen's Evaluation of Earthquake Information and Their Evacuation and Sheltering Behaviors. *Journal of Disaster Research*, 12(6), 1117.
- Kirschenbaum, A. A., Rapaport, C., & Canetti, D. (2017). The impact of information sources on earthquake preparedness. *International journal of disaster risk reduction*, 21, 99-109.
- Lee, P. S., & Leung, L. (2008). Assessing the displacement effects of the Internet. *Telematics and Informatics*, 25(3), 145-155.
- Lee, S. Y., Lee, S. W., & Kim, C. (2016). Time displacement effect of online video services on other media in South Korea. *Telematics and Informatics*, 33(2), 247-255.
- Lin, C. C., Siebeneck, L. K., Lindell, M. K., Wu, H. C., & Huang, S. K. (2014). Evacuees' information sources and reentry decision making in the aftermath of Hurricane Ike. *Natural hazards*, 70(1), 865-882.
- McCaffrey, S., Velez, A., & Briefel, J. (2013). Differences in information needs for wildfire evacuees and non-evacuees. *International Journal of Mass Emergencies & Disasters*, 31(1), 4-24.
- Ministry of Internal Affairs and Communications, Japan. (2016). *Heisei 28 nen kumamoto jishin e no taiō [in Japanese]*. Retrieved Jul 13, 2018, from Available at: http://www.soumu.go.jp/main_content/000424424.pdf
- Ministry of Internal Affairs and Communications, Japan. (2017). *White Paper 2017*. Retrieved Jul 13, 2018, from <http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2017/2017-index.html>
- Mitsubishi Research Institute. (n.d.). *kumamoto jishin niokeru ICT ri katsuyō jōkyō nikansuru chōsa [in Japanese]*. Retrieved Jul 13, 2018, from http://www.soumu.go.jp/main_content/000478777.pdf
- Newell, J., Pilotta, J. J., & Thomas, J. C. (2008). Mass media displacement and saturation. *The International Journal on Media Management*, 10(4), 131-138.
- Shklovski, I., Burke, M., Kiesler, S., & Kraut, R. (2010). Technology adoption and use in the aftermath of Hurricane Katrina in New Orleans. *American Behavioral Scientist*, 53(8), 1228-1246.
- Taneja, H., Webster, J., Malthouse, E., & Ksiazek, T. (2012). Media consumption across platforms: Identifying user-defined repertoires. *New Media & Society*, 14(6), 951-968.
- The Japan Times. (2017, Apr 14). *Nearly a quarter of indirect Kumamoto quake deaths linked to sheltering in vehicles*. Retrieved Jul 13, 2018, from <https://www.japantimes.co.jp/news/2017/04/14/national/nearly-quarter-indirect-kumamoto-quake-deaths-linked-sheltering-vehicles/#.W0caLdUzaUk>

The Nippon Foundation. (2016). *nippon zaidan saigai fukkō shien sentā mashiki machinai no hinanshōyobi setai no jōkyō chōsa bunseki kekka [in Japanese]*. Retrieved Jul 13, 2018, from <https://www.nippon-foundation.or.jp/news/pr/2016/img/59/1.pdf>

Udagawa, S. (2017). A case study of utilization of L-alert for providing life support information during the emergency restoration period [in Japanese]. *Journal of social safety science*, 31, 213-219.

Zlatanova, S., & Fabbri, A. (2009). Geo-ICT for risk and disaster management. In N. van Manen, H. J. Scholten, & R. van de Velde, *Geospatial Technology and the Role of Location in Science* (pp. 239-264). Dordrecht: Springer.