4.1 Public perception of risk

Teun Terpstra, Ann Enader, Jan Gutteling, Christian Kuhlicke

4.1.1 Introduction

As with any scientific domain, the field of risk perception also embraces many subfields and topics. These have been discussed in literature reviews that have sometimes focused on particular hazards, such as seismic hazards (Lindell and Perry, 2000), flood hazards (Kellens et al., 2012), genetically modified foods (Pin and Gutteling, 2008) or multiple hazards (Wachinger et al., 2013; Shreve et al. 2014).

Others have focused on theoretical frameworks such as people's protective action decisions (Mileti and Sorensen, 1990; Lindell and Perry, 2004; 2012), their information seeking (Griffin et al., 2004; Ter Huurne, 2008), how risk is culturally construed (e.g. Steg and Sievers, 2000; Engel et al., 2014) and socially amplified (Kasperson and Kasperson, 1996), or on specific psychological mechanisms such as the role of trust (e.g. Midden

and Huijts, 2009; Frewer et al., 2003; Haynes et al, 2008), perceived responsibility (e.g. Mulilis and Duval, 2003; Terpstra and Gutteling, 2008), fear and efficacy beliefs (e.g. Witte, 1994) and cognition and affect (Slovic et al., 2007; Loewenstein et al, 2001).

Understanding how people perceive risks is an important factor contributing to successful risk communication.

Understanding how people perceive risks is one important factor contributing to successful risk communication (e.g. Frewer, 2004; McComas, 2006; Slovic, 2000). However, this chapter is not an attempt to review the risk perception literature. Instead we focus on different approaches in risk communication and illustrate

the working of perceptual factors by presenting a number of topical cases. To set the ground, the Chapter 4.1.2 presents different approaches in risk communication. The presented cases comprise capacity building (Chapter 4.1.3), evacuation (Chapter 4.1.4), emergency alerts (Chapter 4.1.5), social media (Chapter 4.1.6) and news media (Chapter 4.1.7). Although some of these chapters focus on certain risks in particular, it is not so much the risk but rather the described socio-psychological processes that are relevant. We conclude with some general remarks (Chapter 4.1.8).

4.1.2 Approaches in risk communication

A long tradition in risk communication has relied on the idea that simply informing and educating lay people will increase their understanding and awareness of risk. This one-way information flow from expert to lay is often associated with the so-called

deficit model, as experts holding superior knowledge communicate to the less informed.

Many communicative activities are nowadays intending to change behaviour; others are concerned with norms and values. In addition, risk communication can take place in a disengaged (one-way) and in a more engaged (two-way) manner.

For a number of years a broad shift has been taking place throughout Europe (and beyond), characterised by, on the one side, 'a right to know', and on the other side by a stronger focus on 'individual responsibility' of citizens to be prepared for incidents and disasters. As a result, communicative activities that place responsibility for preparedness actions in the hands of citizens are gaining relevance (Wachinger et al., 2013; Walker et al., 2014; Begg et al., 2016). Many are now following a rather instrumentalist rationale intending to change behaviour or attitudes; others are rather concerned with norms and values that underpin, for example, established governance and decision-making structures. At the same time, risk communication can take place in a disengaged, one-way manner as well as in a more engaged, two-way manner (Treurniet et al., 2015). Based on these two dimensions, four approaches of risk communication can be distinguished (based on Demeritt and Nobert, 2014; Wardman, 2008): risk message, risk dialogue, risk govern- ment and instrumentalist risk. These approaches can be seen as archetypes suggesting different ways to achieve one's risk communication goals. In practice, examples of risk communication often contain features of multiple approaches (for more details see Kuhlicke et al., 2016).
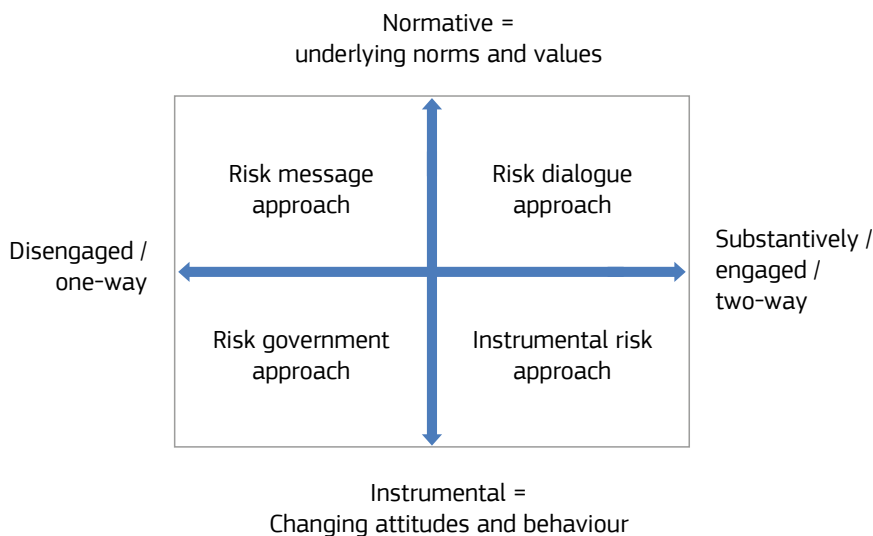
4.1.2.1
Risk message approach

This type of risk communication is a one-way flow of information concerned with 'transmitting risk information without distortion, bias or misunderstanding' (Demeritt and Nobert, 2014). Fundamentally, this model is based on the idea that responsible organisations are transparent about how they assess risks, what kind of outcomes risk assessments generate and how risks are managed. For instance, by designing risk maps in a way that renders them intuitively understandable, the sender tries to encode the message in such a manner as to increase the likelihood that the receiver will be able to decode the message and draw his or her own conclusion on what to do or not to do (Meyer et al., 2012).

4.1.2.2
Risk dialogue approach

In the risk dialogue approach the distinction between senders and recipients or between certified risk experts and the at-risk lay public is a blur. Exchange forms are based on the assumption that both have a say in the decision-making process. The design of participatory processes depends on its purpose. A common typology is to distinguish between a substantive and an instrumentalist rationale

FIGURE 4.1

Different approaches in risk communication.
Source: Based on Wardman (2008) and Demerit and Nobert (2014)

(Stirling, 2006). The substantive rationale usually aims at increasing the breadth and depth of knowledge that contributes to a decision, as participation allows for the inclusion of tacit or local knowledge that can improve the quality of risk assessments and risk maps, as well as of the management process itself (see Meyer et al., 2012). In the instrumentalist rationale, there is a stronger focus on building trust between actors and on raising awareness and motivation for taking actions to mitigate the impacts of hazards (see Wachinger et al., 2013). The relevance of dialogical forms of communication is also highlighted by many national and European legalisations (Höppner et al., 2010).

4.1.2.3
Risk government approach

Communication within the risk government approach aims at changing attitudes and behaviours, but it does so in a less instrumentalist and explicitly persuasive manner compared to the instrumentalist risk approach. While the latter is opaque about its intention, the government model relies on '… logics of individual choice and self-discipline, rather than explaining new norms of conduct as being imposed from above through coercion' (Demeritt and Nobert, 2014).

In many European countries insurance companies, for instance, offer more affordable insurance premiums if clients voluntarily participate in regular preventive medical check-ups and, by doing so, aim at activating individuals' personal risk awareness and inviting them to consider the nega-

tive consequences of smoking or of excessive lifestyle choices; thus creating awareness of their own choices and decisions and the negative consequences these might have on their lives.

4.1.2.4
Instrumentalist risk approach

The instrumentalist risk approach aims at actively changing people's behaviour and pays close attention to the 'interactions between information, attitudes and behaviour' (Demeritt and Nobert, 2014). Due to the increasing prominence of this model, many empirical studies focus on understanding the factors that motivate individuals to take responsibility and action in order to increase their preparedness (Shreve et al., 2014). This type of communication may take many different forms. Quite common are the use of printed booklets or brochures that encourage residents at risk to increase their preparedness. The EU project Tactic has collected a multitude of such examples, which can be accessed through the online platform (TACTIC project, 2017). Also more formalised ways of trying to change people's habits are increasingly established. For instance, in the German state of Saxony citizens are required by law to take precautionary actions to increase their preparedness (Ueberham et al., 2016).

4.1.3
Capacity building through one-way risk communication

The EU Seveso and Floods Directives

have made public risk communication an obligatory task of risk management in EU countries. Government websites, dedicated hazard and risk maps and brochures are common methods to inform the general public about risk and possible ways to increase their preparedness. These methods provide information about risks in a non-dialogic fashion and can be seen as examples of the 'risk message approach'. Transmitting risk information without distortion, bias or misunderstanding is a challenge, however, both from a normative and a practical perspective.

From a normative perspective, 'without distortion, bias or misunderstanding' does not mean that the content and tone of the risk communication is 'value free'. Senders of risk messages, either risk experts or policymakers, have their own perceptions of the problem and interests. These are informed by societal norms, political agendas and personal opinions — which are hardly ever universally shared in society. In addition, providing information that is to be understood by many people with different backgrounds often requires focusing on the most 'important' (i.e. certain) aspects and simplification of information. This results in deliberate and chance choices in content (wording and images) and tone, which in turn influences people's perceptions and attitudes in different gradations (also see Chapter 4.1.5).

From a practical perspective, 'transmitting risk information' is hardly ever an objective on its own. A common complementary objective of providing information is to enhance risk awareness and to provide infor-

mation about individual preparedness actions. This reflects a cross-over between risk message and risk government approaches. The goal is usually to convey a message drafted by a responsible organisation to those who are 'supposed to need' this message in order to be better prepared for disasters.

While such measures have a relatively low cost (Lundgren and McMakin, 2013) and are in many cases essential for getting a certain message across (e.g. warning), non-dialogic risk communication on its own seems limited in its impact on most people's attitudes, active engagement and preparedness behaviour (Moser, 2010). The reason is that changes in attitudes and behaviour are the end result of a complex social-psychological process, and the route to this end result differs greatly between people and communities. Risk communication from authorities will not lead to protective action decision-making unless people receive, heed and comprehend the socially transmitted risk information (Lindell and Perry, 2004). For people to act upon a risk message they must perceive its relevance as well as a sense of urgency. What is relevant or urgent for one person may not be so for others. For instance, changing the battery of a smoke detector may be linked to a personality trait (e.g. high risk aversion or a prevention orientation; e.g. De Boer et al., 2014), previous experience with fire risk, willingness to adhere to a perceived social norm (e.g. "I should have a working smoke detector") or because of practical circumstances (e.g. being a smoker). However, even with these factors present, one may fail to take action. For instance, dealing with risk

may arouse negative affect in people, which may in turn result in attempts to control their feelings instead of taking action (e.g. denial), as one may feel unable to perform required actions (low self-efficacy), have little faith in the protective action itself or action is hampered due to practical response barriers (e.g. having other priorities).

There is no such thing as 'one size fits all' in risk communication. Resilient behaviour is more likely when there is a mix of communicative approaches and other types of measures in place. Risk communication is based on a thorough understanding of risk perceptions and capacities that are shaped through the historical and local context.

Evaluations of a campaign about communicating flood risk, organised by the city of Zurich, showed that one-way risk communication can improve flood preparedness to some extent; i.e. home owners' flood awareness and their intentions to implement protective actions did increase (Maidl and Buchecker, 2015).

The majority of respondents felt better informed after the information campaign (only 17 % reported that the campaign did not increase their

knowledge) and regression analyses revealed that the perceived usefulness of the material provided had the strongest effects on flood preparedness intentions. A perceived need for information had greater effects on preparedness intentions than risk awareness itself, underlining that the motivation to do something increased through the information campaign. However, since the overall effect of the information campaign was rather low, the authors argued that a single-event campaign is unlikely to have profoundly positive effects on preparedness behaviour and therefore needs to be embedded in a long-term risk communication campaign.

Empirical studies also indicate that it is not so much the information itself that is of relevance but rather the wider context within which such information is communicated. Engel et al. (2014), for instance, focus on the role of disaster subculture as a way to explain how two neighbouring communities have developed different strategies and practices to deal with flood events. These subcultures featured differences in beliefs, knowledge, symbols and preparedness and response patterns. Their findings suggest risk communication would require different approaches in both communities.

Therefore, what is feasible and effective in one context may be difficult or ineffective somewhere else. There is no such thing as 'one size fits all' in risk communication. Resilient behaviour is more likely when there is a mix of communicative approaches and other types of measures in place based on a thorough understanding of risk perceptions and capacities that

4.1.4
Developing flood evacuation strategies through dialogue

In an attempt to hit the right note in risk communication, this paragraph presents a case study that tested effects of different risk communication storylines on citizens' flood evacuation intentions in the city of Dordrecht (Terpstra and Vreugdenhil, 2015). Dordrecht is located on an island in the Dutch river delta. A potentially dangerous situation occurs when high river discharges result in high water levels that are suddenly further increased by a storm surge pushing sea water into the river delta. Evacuation models indicate that in such a case only between 10-20 % of the population will be able to leave the city before the levees break. When they do, water depths may vary between 2-5 metres and the best chance of survival is to seek shelter in homes on a higher floor or in a high building in the neighbourhood. To reduce the potential number of casualties, the authorities aim to develop and communicate a strategy based on sheltering at home or in a public building.

In 2015 the municipality started a risk dialogue by involving citizens in focus groups to understand their flood perceptions, their evacuation attitudes and their concerns and suggestions. To gain further insight into

the level of support for 'staying at home' or 'going to a public shelter', a questionnaire survey was performed. The questions asked were embedded in two different storylines, which reflected two different communication frames that emerged from previously held focus groups. 'Framing' in communication refers to the systematic use of words and symbols reflecting underlying norms and values. For a risk dialogue it is important that people are able to relate to the norms and values and support the frame that is used. Framing can also be regarded as a form of nudging. Nudging refers to '…any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any option or significantly changing their economic incentives.' (Thaler, Sunstein, 2009). A more pessimistic 'Self-frame' emphasised that in case of a flood, people are on their own for a few days and food, water and utilities are unavailable and they eventually have to evacuate from the flooded area on their own.

Cognitive (beliefs) and affective (feelings) factors are important predictors of attitudes. These are influenced by the way risk information is framed in communication messages.

The more optimistic 'Together-frame' emphasised the community perspective meaning that people are in it together and will try to help each other,

and authorities will assist in evacuation where needed and arrange basic stocks of food, water and utilities in shelters. All respondents (about 625 citizens) answered questions related to their efficacy beliefs, feelings and support for two evacuation options (staying at home, going to a public shelter) and their current evacuation intentions. More questions were asked, but for our purposes we will discuss this subset. On a 1-10 scale, both strategies received higher rates in the Together-frame—i.e. staying at home (Self-frame: 6.2 vs. Together-frame: 6.3) and going to a public shelter (Self-frame: 5.2 vs. Together-frame: 6.0). Remarkable, however, is the fact that both strategies were rejected by a substantial number of respondents: about 27-28 % rejected staying at home while 36-52 % rejected going to a shelter (upper limit % reflects rejection in the Self-frame).

To further explain these results, the authors evaluated respondents' efficacy beliefs and fear-related feelings. Efficacy beliefs reflect the extent to which a person believes a protective action is effective in the protection of people and/or property (e.g. Lindell and Perry, 2004, 2012). Fear-related feelings such as dread is a negative affective state. Affective states influence people's judgements (Loewenstein et al., 2001; Slovic et al., 2007) and can be unlocked by framing information (Terpstra et al., 2014). For instance, Finucane et al. (2000) performed framing experiments to influence perceived risks and benefits of nuclear power, natural gas and food preservatives. Their experiments showed that when information portrayed the benefits as high (or risks as low), the subsequent experience of positive affect

caused subjects to perceive risks of nuclear technology as low (or benefits as high). Conversely, when risks were framed as high (or benefits as low), the subsequent experience of negative affect caused subjects to perceive benefits of nuclear technology as low (or risks as high).

In line with experiments of Finucane et al., additional analyses of the Dutch flood risk data showed that respondents held more favourable attitudes in the more optimistic Together-frame since this frame resulted in lower negative affect/fear and higher efficacy beliefs. Specifically, staying at home received a (marginally) higher score in the Together-frame because it evoked slightly lower levels of negative affect/fear. Going to a public shelter received a higher score in the Together-frame because this frame evoked

lower levels of negative affect/fear and higher trust in the efficacy ('being safe') of a public shelter.
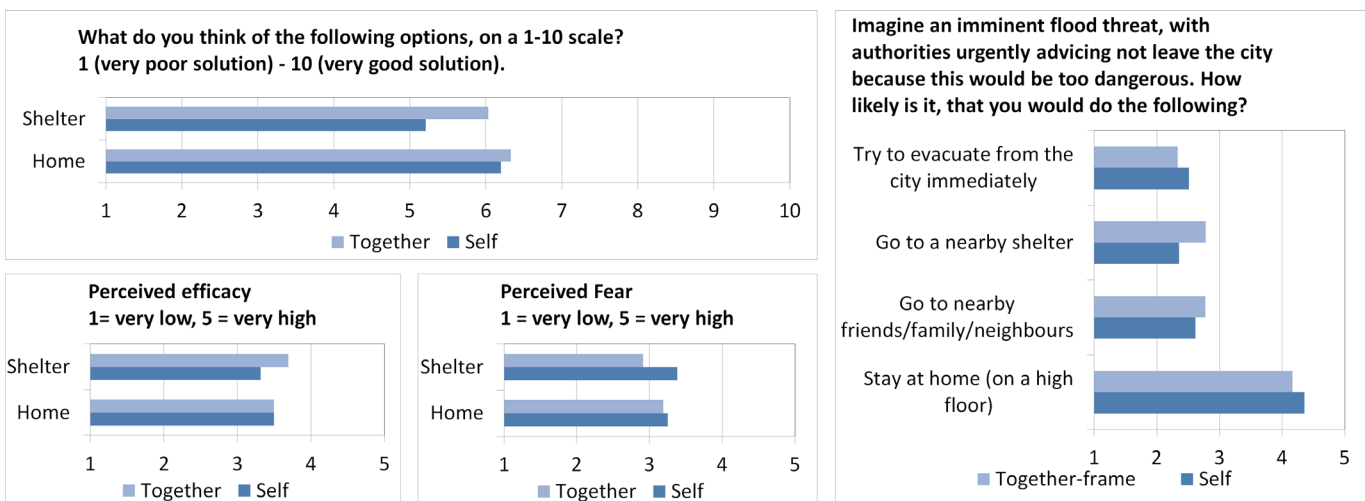
Respondents' intentions also revealed an interesting pattern. Staying at home was regarded as likely by about 88 % of the respondents, while going to a nearby shelter or going to family, friends or neighbours was regarded as likely by a substantially smaller number of people (25 % and 28 %, respectively). So even though attitudes towards staying at home and going to a public shelter are similar (at least in the Together-frame), the majority preferred to stay at home. Finally, the fact that 19 % of the respondents considered leaving the city, even though the authorities urge them not to, is remarkable. These people may unnecessarily risk their lives. Their intention to flee the city is correlated with their

attitude towards staying at home or going to a public building. That is, respondents who hold less favourable attitudes towards staying at home or going to a shelter are more likely to flee the city in case of an urgent flood threat.

Overall, the meagre level of support for staying at home or going to a public shelter suggests that these strategies can be further detailed. A clear action plan on how citizens are supported prior to a flood (e.g. food and water supply and setup and arrangements in shelters) and afterwards (e.g. a rescue plan) is an important starting point. Based on a further risk dialogue with citizens, experts in flood risk management, utilities, medical and rescue services, it seems that such a plan can be developed. In addition, developing a positive yet realistic storyline for risk

FIGURE 4.2

Perceived fear, efficacy, support and intentions regarding flood evacuation.
Source: Terpstra and Vreugdenhil (2015).

communication based on the capacities available in the local communities (e.g. neighbourhoods) can help to gain further support among citizens and reduce chances that people risk their lives by fleeing the city while the levees are about to break.

4.1.5
Facilitating public response through wireless emergency alerts

In the case of an imminent threat, authorities require communication channels that deliver warnings accurately and quickly to a potentially large number of people. A relatively new development is the so-called Wireless Emergency Alerts (WEA). Several countries have started sending out WEA to mobile phones and other devices aiming to alert people at risk and help them to react adequately (Gutteling et al., 2014). As one-way communication tools, WEA are an example of the risk government model. Many of these systems are based on the mobile phone broadcast technology. There is no need to have Wi-Fi or internet or to subscribe to the service. However, technological development and its implementation has outpaced studies on the effectiveness and limitations (Bean et al., 2015). To date, only a few studies have evaluated mobile device-delivered warning messages (Sutton et al., 2014; Terpstra et al, 2012).

A United States report lists several general insights necessary to facilitate adequate public reactions to WEA, among which: (1) effects should be studied after real events, not in hypothetical situations; (2) people need to be trained to properly understand the warning system; (3) the alert needs to attract attention; (4) people seek social confirmation of a warning message before taking protective action; and (5) warnings must contain information that is important to the public (Committee on Public Response, 2013). This chapter describes a recent Dutch study on the public's reactions, which is partly based on these general insights.

In the study people were questioned some time after the implementation of the WEA system in real local emergency situations in three Dutch cities. In the first two cases the emergencies were large fires in non-residential industrial areas with a release of potentially hazardous smoke and soot particles to nearby residential areas. The third situation was a large fire in a historic city centre, causing one casualty. Randomly selected mobile and land-line phone numbers of people living in the broadcast area were dialled by trained agency interviewers, asking whether they had received the WEA. In the Netherlands the WEA system is known as NL-Alert. If they had, some additional questions were asked (e.g. their self-reported behaviour) and people were invited to complete an additional online questionnaire measuring psychological and behavioural determinants derived from conceptual models on risk communication (Witte and Allen, 2000; Floyd et al., 2000; Lindell and Perry, 2012).

These models suggest that receivers of warning messages first assess the threat level, creating some level of personal urgency, and subsequently assess their ability to personally cope with the emergency situation. Coping appraisal is related to one's belief to be able to perform the recommended behaviour and one's belief in the adequacy of the provided advice. When the threat is seen as personally relevant, and the coping appraisal is positive then one will decide to execute the recommended adaptive behaviour. However, when the threat is seen as relevant but coping is seen as impossible, some psychological reframing of the situation (e.g. psychological denial or defensive behavioural avoidance) is a likely reaction. In recent years, studies have shown that in emergency situations the individual is an information seeker but also an information source for others. Existing research suggests that perceived information sufficiency — that is, to which level one is satisfied with one's information position — predicts additional information seeking and information sharing. Also, the perceived quality of the warning message is an important indicator of its effectiveness (Renn and Levine, 1991; Earle, 2010).

Wireless emergency alerts (WEA) are a relatively new method to deliver warnings to a potentially large number of people.

Looking in more detail at the public's reactions to receiving the WEA, some findings are noteworthy. An example of the WEA is this message that was sent to inhabitants:

NL-Alert 20-01-2013 14.50 Setheweg Meppel. Major fire. Keep clear of the smoke!

Close windows and doors. Turn off ventilation. New message follows.

The structure of all Dutch WEAs is similar: sender (NL-Alert date and time), threat (major fire), location (Setheweg Meppel) and advice (*Keep clear of the smoke! Close windows and doors. Turn off ventilation. New message follows*). The respondents' reactions were measured on five-point scales (see Table 4.1).

Overall, the scores indicate that the emergencies had relatively little personal impact for most participants. However, even in these relatively low impact situations, there are some noteworthy findings. On average, respond-

ents valued their coping abilities as relatively high and clearly indicated that the included message components (sender, threat, location and advice) were regarded as clear, complete and reliable (message quality). In addition, respondents did not perceive high expectations to be knowledgeable and responsible with regard to their behaviour in these situations (social norms). In absolute terms, perceived fear and perceived threat were not high, although they were somewhat higher in the Leeuwarden case. This seems reasonable since the Meppel and Oisterwijk fires occurred at some distance from residential areas, while the fire in Leeuwarden took place in the historic city centre. In addition, compared to the Meppel and Oisterwijk cases, respondents from Leeuwarden were somewhat less satisfied with the information received and re-

ported more avoidance (i.e. to continue with what one was doing) and less adaptive behaviour (i.e. to comply with the advice and seek and share information). Two alternative explanations come to mind. First, emergency services in Leeuwarden failed to describe the location of the fire, which may have caused lower levels of satisfaction with the information provided, and they did not mention any personal threat, which resulted in higher disinterest in the situation. Second, higher levels of perceived threat and fear may have caused stronger fear control responses, resulting in more avoidance reactions and less adaptive behaviour. Even though the sample was small and these incidents had relatively little personal impact, correlations did provide some support for these explanations. Adaptive behaviour was predicted by higher perceived fear, seeking social

TABLE 4.1

Mean (standard deviation) for the measured determinants after three WEA cases.
Source: Gutteling et al. (2014)

	Case 1 (Meppel)	Case 2 (Oisterwijk)	Case 3 (Leeuwarden)
N=	175	181	287
Self-reported Behaviour			
Adaptive (a)	1.71 (0.26)	1.69 (0.29)	1.55 (0.29)
Avoidance (b)	1.17 (0.38)	1.12 (0.33)	1.46 (0.50)
Perceived social norms (c)	2.37 (1.10)	2.30 (1.03)	2.13 (0.99)
Efficacy beliefs (c)	3.93 (0.93)	3.90 (1.06)	3.97 (1.04)
Perceived threat (c)	2.41 (0.82)	2.59 (0.86)	2.90 (0.82)
Perceived fear (c)	1.72 (0.62)	1.69 (0.57)	2.32 (0.69)
Perceived message quality (c)	4.31 (0.77)	4.37 (0.75)	4.32 (0.81) (e)
Perceived information sufficiency (d)	3.59 (1.11)	3.63 (1.11)	2.98 (0.82)

a. telephone: 1 = none of the adaptive actions taken, 2 = all adaptive actions taken
b. telephone: 1 = no avoidance, 2 = complete avoidance
c. online: 1 = low, 5 = high
d. online: 1 = dissatisfied, 5 = satisfied
e. In Leeuwarden the component 'location' was missing and therefore not evaluated

confirmation and perceived warning quality. Stronger avoidance was predicted by higher levels of perceived risk, fear and higher perceived expectations from one's social environment. Overall, the study presents a favourable impression of the public's evaluation of the WEA system; however, more research is needed with other types of emergency situations to fully understand the psychological, behavioural and communicative reactions of receivers.

4.1.6 Effects of interaction on social media in emergencies

Social media (Twitter, Facebook, blogs, etc.) have been under the attention of risk and disaster managers longer than WEA. Social media and WEA provide similar possibilities to inform the public of imminent emergencies. However, social media also allow for feedback in the form of user-generated content (opinions, observations, etc.) or geospatial information (Palen et al., 2009; Terpstra et al., 2012; Feldman et al., 2016; Houston et al., 2014; Committee on Public Response to Alerts and Warnings using Social Media, 2013; and many others). This chapter aims to describe studies on the effectiveness of social media in emergencies. The use of social media with the objective to influence people's behaviour is therefore an example of the instrumentalist risk
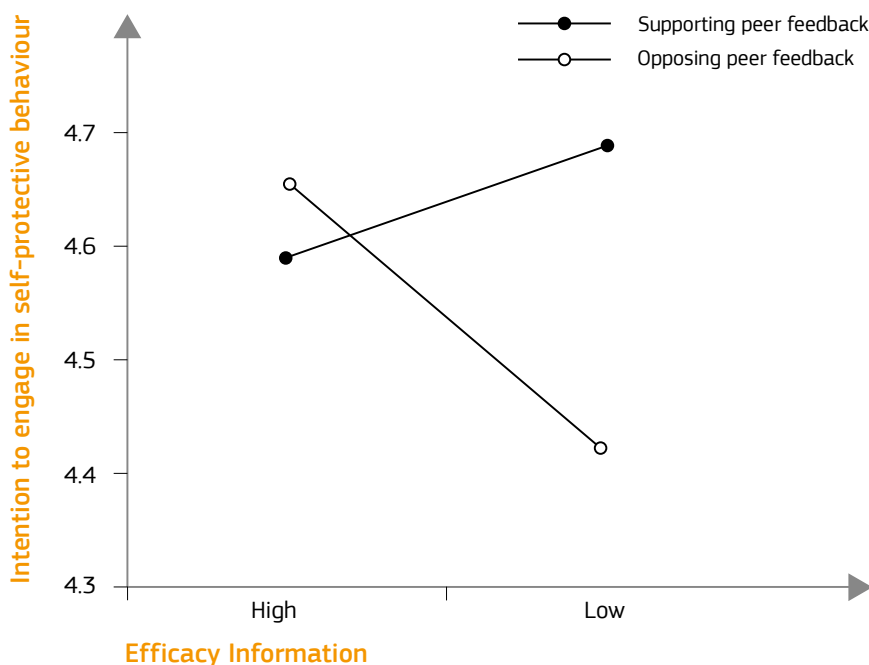
approach.

Social media are intensively used in times of crises to share information and support or oppose opinions. A recent study indicates that when official information is regarded as effective, peer feedback is less influential.

As with WEA, there are few empirical studies indicating at a general level what the impact of social media disaster information is or how social media can be designed to be effective disaster-warning tools. The number of studies that have analysed social media messages after real incidents and disasters is steadily growing. A United States study analysing the use of Twitter after a disaster (the Tennessee River dam break) indicated that the amount of information shared by citizens — even those not in the direct vicinity of the emergency location — is considerably greater than the 'official' information from governmental organisations and the company (Sutton, 2010).

Twitter users also tended to be critical toward the official information and corrected wrong information. Starbird and Palen (2010) studied Twitter messages after the Red River flood of 1997 and the the Oklahoma wildfires and found that Twitter messages from those directly involved in the situation

FIGURE 4.3

Interaction effect between efficacy beliefs and peer feedback on the intention to engage in self-protective behaviour.
Source: Verroen et al. (2013)

are retweeted relatively often. Information provided by local news media are also retweeted relatively often. A Dutch study analysed Twitter messages just before, during and immediately after a huge storm which hit a large public open air music event (Terpstra et al, 2012). In the Twitter messages, weather predictions were found as well as rumours and messages that were focusing on providing help after the emergency. When the scale of the emergency became evident, one person took the initiative to organise the inhabitants of a nearby town to provide help (places to spend the night, food and drink, showers, clothing, Wi-Fi, etc.). The data suggested that some of the Good Samaritans were Twitter novices.

An important downside of analysing communication after real events is the difficulty in analysing cause–effect relations of communication messages. This requires communication experiments in a controlled setting where researchers can manipulate perceptual factors by providing different information to separate groups and compare their responses. Although such studies are quite common in communication research, applications to social media are scarce.

Verroen et al. (2013) focused on a typical characteristic of social media communication: people's positive and negative feedback on an earlier distributed message. The message contained emergency information in the context of a high-impact risk, namely the derailment of a freight train carrying a highly flammable and toxic substance. These authors were interested in the interplay of the perceived efficacy of the emergency information

and peer feedback, such as responses on social network sites (e.g. Twitter) and the effect of this interplay on the intention to engage in self-protective behaviour.

The study pitted high- and low-efficacy information messages against supporting (positive) and opposing (negative) peer feedback (N =242). Although the study used a hypothetical emergency situation, the participants were selected based on the fact that they lived in an area close to an existing railroad track used by these high-risk trains. Results showed a significant interaction effect between efficacy information in a news article and peer feedback from Twitter messages on both the intention to engage in self-protective behaviour (see Figure 4.2) and the levels of involvement.

Participants who received the news article with more efficacy information were similarly influenced by supporting or opposing peer feedback via Twitter messages.

However, among those who received a low efficacious news article, the effect of peer feedback on these two variables was significantly stronger. Supporting peer feedback (that is peer feedback that supported the advice in the news article) resulted in a significantly higher intention to take protective measures (and involvement) than opposing peer feedback (that is feedback that questioned the advice in the news article). Apparently, when in doubt about how to act to mitigate risk, the tone of peer feedback on social media is important for one's decision making.

4.1.7
Role of news media in defining human responses to crises

In this final case we discuss the role of the news media. This case is not an example of one of the four risk communication approaches in particular. Rather that news media can be regarded as a (highly) influencing factor in each of these approaches, as they reflect on the norms, values and behaviour of people and organisations in relation to risks, incidents and crises. People may be influenced not only by how information about the actual risks is framed, but also by how different frames concerning reactions and behaviours to risks and dangers are put forward in media articles and reports after critical events. The role of media in contributing to erroneous beliefs and myths about human behaviour in stressful situations has been discussed for some decades in the social science literature, culminating in a number of critical analyses of the reporting of reactions to Hurricane Katrina in 2005 (Tierney et al, 2006). More recent work has further demonstrated how subtle and implicit framing can define the portrayal of human reactions, potentially influencing the expectations and evaluations of both the public in general and risk and crisis professionals in particular. In an analysis of media reporting from six different crisis events affecting Swedish society, including natural disasters, antagonistic threats and diffuse threats, Nilsson et al. (2016) identified three dynamic interrelated processes simultaneously at work in framing public reactions.

The first process, that of identification, concerned individuals and groups that were referred to as affected, and in what context. For example, in the natural disaster events, some groups were described as vulnerable and affected by serious losses in terms of economic value of forestry, while others with less tangible losses were barely mentioned. The second process refers to characterisation of how different individuals and groups reacted and coped with the situation. In this process certain characteristics tended to be attributed collectively to groups among the public, creating ingroups and outgroups. This pattern was particularly evident in the case of antagonistic events (one case concerned street shootings in a major city), separating the fear reactions of law-abiding citizens from those of victimised groups with suggested criminal links.

News media reports play a very important role in effective communication and support public needs in stressful situations.

Finally, evaluation processes that provided signals could be identified, sometimes quite subtle, as to which reactions and behaviours could be considered as expected, accepted or stigmatised. For example, the choice of certain words or references could suggest that individuals are either reacting logically, are not reacting sufficiently responsibly or are overreacting. Such suggestions indirectly communi-

cate expectations and evaluations of correct or incorrect behaviour. Thus, for example in the case of the influenza A (H1N1) pandemic and the issue of vaccination, quite subtle semantics could reflect evaluations of who reacted sensibly (and got vaccinated) and who did not. Interestingly, these evaluations were somewhat reversed when cases of narcolepsy were linked to the vaccination campaign, leading to a new and somewhat different media debate (Scott and Enander, 2016). Taken together, these findings demonstrate a need to examine critically frames which may distort a realistic view of public needs and reactions when faced with risks, thus leading to ineffective communication and support.

4.1.8 Conclusions and key messages

In this chapter we presented different approaches to risk communication and acceptance of risk communication and addressed a number of socio-psychological concepts that have been shown to influence people's perceptions, attitudes and behaviour in the face of a wide variety of risks. Based on the pillars of the Disaster Risk Management Knowledge Centre, we conclude with the following three key messages.

Partnership

For a number of years now, a broad shift has been taking place throughout Europe (and beyond), characterised on one side by 'a right to know' and on the other side by a stronger focus on 'individual responsibility' of citi-

zens to be prepared for incidents and disasters. Risk communication that is based on one-way media campaigns alone, telling people how to prepare, is hardly effective. In terms of partnerships, engaging in a dialogue with local communities to understand the historical and local contexts is an important basis for future risk communication that focuses on stimulating resilient behaviour.

Knowledge

Sound knowledge of the effects of communication messages based on communication experiments and tests is indispensable for delivering effective communication. In addition, there are many best practices available that have been identified by EU projects, such as Tactic and CapHazNet, that may offer inspiration.

Innovation

In some cases a more fundamental approach may be needed to set up and monitor communication effects and improve communication practice. This is especially important where it concerns innovative methods such as the use of new communication tools (e.g. WEA), complex topics (e.g. flood evacuation strategies), activities that cause great societal unrest (e.g. CO_2 storage) or where norms and values are at stake (e.g. stigmatisation in media reports). In such cases, profound insight from communication research can be useful to support further decision-making.

REFERENCES CHAPTER 4

Introduction

Aitsi-Selmi, A., Blanchard, K., Murray, V., 2016. Ensuring science is useful, usable and used in global disaster risk reduction and sustainable development: a view through the Sendai framework lens. Palgrave Communications 2, Article number: 16016.

Ben-Haim, Y., 2006. Info-gap decision theory: decisions under severe uncertainty. Amsterdam, Oxford: Elsevier.

Boersma, F.K., Wagenaar, P., Wolbers, J.J., 2012. Negotiating the 'Trading Zone'. Creating a Shared Information Infrastructure in the Dutch Public Safety Sector. Journal of Homeland Security and Emergency Management 9(2), Article 6.

Bradley, D.T., McFarland, M., Clarke, M., 2014. The effectiveness of disaster risk communication: a systematic review of intervention studies. PLoS currents, 6.

Castells, M., 2009. Communication Power. Oxford, New York: Oxford University Press.

Dickinson, C., Aitsi-Selmi, A., Basabe, P., Wannous, C., Murray, V., 2016. Global Community of Disaster Risk Reduction Scientists and Decision Makers Endorse a Science and Technology Partnership to Support the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. International Journal of Disaster Risk Science 7(1), 108-109.

Hartman, J.L., McCambridge, J., 2011. Optimizing millennials' communication styles. Business Communication Quarterly 74(1), 22-44.

Höppner, C., Whittle, R., Bründl, M., Buchecker, M., 2012. Linking social capacities and risk communication in Europe: a gap between theory and practice?. Natural hazards 64(2), 1753-1778.

Krimsky, S., 2007. Risk communication in the internet age: The rise of disorganized skepticism. Environmental hazards, 7(2), 157-164.

Lundgren, R.E., McMakin, A.H., 2013. Risk communication: A handbook for communicating environmental, safety, and health risks. New Jersey: John Wiley & Sons.

Shklovski, I., Palen, L., Sutton, J., 2008, November. Finding community through information and communication technology in disaster response. In Proceedings of the 2008 ACM conference on Computer supported cooperative work, ACM, 127-136.

Slovic, P., 1993. Perceived risk, trust, and democracy. Risk analysis 13(6), 675-682.

Stal, M., 2013. Disaster and Crisis Communication: Trend Analysis of Technologies and Approaches. Input Paper Global Risk Forum GRF Davos.

Tang, C., Rundblad, G., 2015. The potential impact of directionality, colour perceptions and cultural associations on disaster messages during heatwaves in the UK. PLoS currents, 7.

Taubenböck, H, Goseberg, N., Setiadi, N., Lämmel, G., Moder, F., Oczipka, M., Klüpfel, H., Wahl, R., Schlurmann, T., Strunz, G., Birkmann, J., Nagel, K., Siegert, F., Lehmann, F., Dech, S., Gress, A., Klein, R., 2009. 'Last-Mile' preparation for a potential disaster–Interdisciplinary approach towards tsunami early warning and an evacuation information system for the coastal city of Padang, Indonesia. Natural Hazards and Earth System Sciences 9(4), 1509-1528.

Terpstra, T., Lindell, M.K., Gutteling, J.M., 2009. Does Communicating (Flood) Risk Affect (Flood) Risk Perceptions? Results of a Quasi-Experimental Study. Risk analysis 29(8), 1141-1155.

Treurniet, W., Messemaker, M., Wolbers, J.J, Boersma, F.K., 2015. Shaping the societal impact of emergencies: striking a balance between Control and Cooperation. International Journal of Emergency Services 4(1), 129-151.

4.1 Public perception of risk

TACTIC project, 2017. Tactic on-line platform. https://www.tacticproject.eu/tosap/, [accessed 27 April, 2017].

Bean, H., Sutton, J., Liu, B.F., Madden, S., Wood, M.M., Mileti, D., 2015. The Study of Mobile Public Warning Messages: A Research Review and Agenda, Review of Communication 15(1), 60-80.

Begg, C., Ueberham, M., Masson, T., Kuhlicke, C., 2016. Interactions between citizen responsibilization, flood experience and household resilience: insights from the 2013 flood in Germany. International Journal of Water Resources Development online first, 1-16.

Committee on Public Response to Alerts and Warnings Using Social Media, 2013. Public response using social media to alerts and warnings. Washington, National research Council.

De Boer, J., Botzen, W.J.W., Terpstra, T., 2014. Improving flood risk communication by focusing on prevention-focused motivation. Risk Analysis 34(2), 309-22.

Demeritt, D., Nobert, S., 2014. Models of best practice in flood risk communication and management. Environmental Hazards 13, 313-328.

Earle, T.C., 2010. Trust in risk management: a model-based review of empirical research. Risk Analysis, 30(4):541-574.

Engel, K., Frerks, G., Velotti, L., warner, J., weijs, B., 2014. Flood disaster subcultures in the Netherlands: The parishes of Borgharen and Itteren. Nat Hazards 73(2), 859–82.

Feldman, D., Contreras, S., Karlin, B., Basolo, V., Matthew, R., Sanders, B., Houston, D., Cheung, W., Goodrich, K., Reyes, A., Serrano, K., Schubert, J., Luke, A., 2016. Communicating flood risk: Looking back and forward at traditional and social media outlets. International Journal of Disaster Risk Reduction 15, 43-51.

Finucane, M.L., Alhakami, A., Slovic ,P., Johnson, S.M., 2000. The affect heuristic in judgments of risks and benefits. Journal of Behavioral Decision Making 13(1),1-17.

Floyd, D.L., Prentice-Dunn, S., Rogers, R.W., 2000. A meta-analysis of research on protection motivation theory. Journal of Applied Social Psychology 30(2), 407-429.

Frewer, L., 2004. The public and effective risk communication. Toxicology Letters 149(1-3), 391-7.

Frewer, L.J., Scholderer, J., Bredahl, L., 2003. Communicating about the risks and benefits of genetically modified foods: The medi-

ating role of trust. Risk Analysis 23(6), 1117-33.

Griffin, R.J., Neuwirth, K., Dunwoody, S., Giese, J., 2004. Information sufficiency and risk communication. Media Psychology 6(1), 23-61.

Gutteling, J.M., J. Kersholt, T. Terpstra, van As, N. 2014. Bereik en effecten van NL-Alert. Enschede: Universiteit Twente. Onderzoek in opdracht van Wetenschappelijk Onderzoeks- en Documentatie Centrum van het Ministerie van Justitie en Veiligheid.

Haynes, K., Barclay, J., Pidgeon, N., 2008. The issue of trust and its influence on risk communication during a volcanic crisis. Bulletin of Volcanology 70(5), 605-21.

Höppner, C., Buchecker, M., Bründl, M., 2010. Risk communication and natural hazards. CapHaz project. Birmensdorf, Switzerland.

Houston, J.B., Hawthorne, J., Perreault, M.F., Park, E.H., Goldstein Hode, M., Halliwell, M.R., Turner McGrowen, S.E., Davis, R., Vaid, S., McElderry, J.A., Griffith, S.A., 2014. Social media and disasters: a functional framework for social media use in disaster planning, response, and research. Disasters 39 (1), 1–22.

Kasperson, R.E., Kasperson, J.X., 1996. The social amplification and attenuation of risk. Annals of the American Academy of Political and Social Science 545, 95-105.

Kellens, W., Terpstra, T., De Maeyer P., 2012. Perception and communication of flood risks: A systematic review of empirical research. Risk Analysis 33(1), 24-49.

Kuhlicke, C., Begg, C., Müller, A., Karanci, A.N., Doğulu, C., Konieczny, R., Walczykiewicz, T., Siudak, M., Madej, P., Shreve, C., Anson, S., Watson, H., Wadhwa, K., Mante, C., 2016. Report on the long-term learning framework for a multi-hazard context, TACTIC-Report, Leipzig.

Lindell, M.K., Perry, R.W., 2000. Household adjustment to earthquake hazard. A review of research. Environment And Behavior 32(4), 461-501.

Lindell, MK., Perry, R.W., 2004. Communicating environmental risk in multiethnic communities. WB Gudykunst; S Ting-Toomey, editors. Thousand Oaks, California: Sage Publications, Inc.

Lindell, M.K., Perry, R.W., 2012. The protective action decision model: Theoretical modifications and additional evidence. Risk Analysis 32(4), 616-32.

Loewenstein, G.F., Weber, E.U., Hsee, C.K., Welch, N., 2001. Risk as feelings. Psychological Bulletin, 127(2), 267-86.

Lundgren, R.E., McMakin, A.H., 2013. Risk communication: A handbook for communicating environmental, safety, and health risks. John Wiley & Sons, Piscataway, N.J.

Maidl, E., Buchecker, M., 2015. Raising risk preparedness by flood risk communication. Nat. Hazards Earth Syst. Sci. 15, 1577-1595.

McComas, K.A., 2006. Defining moments in risk communication research: 1996-2005. Journal of Health Communication 11(1), 75-91.

Meyer, V., Kuhlicke, C., Luther, J., Fuchs, S., Priest, S., Dorner, W., Serrhini, K., Pardoe, J., McCarthy, S., Seidel, J., Palka, G., Unnerstall, H., Viavattene, C., Scheuer, S., 2012. Recommendations for the user-specific enhancement of flood maps. Nat. Hazards Earth Syst. Sci. 12, 1701-1716.

Midden, C.J.H., Huijts, N.M.A., 2009. The role of trust in the affective evaluation of novel risks: the case of CO_2 storage 29(5), 743-751

Mileti, D.S., Sorensen, J.H., 1990. Communication of emergency public warnings. A social science perspective and state-of-the-art assessment. Colorado State University.

Moser, C., 2010. Communicating climate change: history, challenges, process and future directions. WIREs Climate Change 1, 31-53.

Mulilis, J.P., Duval, T.S., 2003. Activating effects of resources relative to threat and responsibility in person-relative-to-event theory of coping with threat: An educational application. Journal of Applied Social Psychology 33 (7), 1437-56.

Nilsson, S., Alvinius, A., Enander, A., 2016. Frames of public reactions in crisis. Journal of Contingencies and Crisis Management 24(1), 14-26.

Palen, L., Vieweg, S., Liu, S.B., Hughes, A.L., 2009. Crisis in a Networked World Features of Computer-Mediated Communication in the April 16, 2007, Virginia Tech Event. Social Science Computer Review 27(4), 467-480.

Pin, R.R., Gutteling, J.M., 2008. The development of public perception research in the genomics field. An empirical analysis of the literature in the field. Science Communication 31, 57-83.

Renn, O., Levine, D., 1991. Credibility and trust in risk communication. In: Kasperson, R.E., Stallen, P.J.M., (Eds.), 1991. Communication Risks to the Public. Kluwer, the Netherlands, 1745-218.

Scott, D., Enander, A.,2016. Postpandemic nightmare: A framing analysis of authorities and narcolepsy victims. In: Helsloot, I., (Eds.), 2016. Journal of Contingencies and Crisis Management, preprint.

Slovic, P., 2000. The perception of risk. Science, New Series 236(4792), 280-285.

Slovic, P., Finucane, M.L., Peters E., MacGregor, D.G., 2007. The affect heuristic. European Journal of Operational Research 177(3), 1333-1352.

Shreve, C., Fordham, M., Anson, S., Watson, H., Hagen, K., Wadhwa, K., Begg, C., Müller, A., Kuhlicke, C., Karanci, N., 2014. Report on risk perception and preparedness, TACTIC project, North Umbria University.

Starbird, K., Palen, L., 2010. Pass it on?: Retweeting in mass emergency. Paper presented at the 7th International ISCRAM Conference, Seattle, USA.

Steg, L., Sievers, I., 2000. Cultural theory of individual perceptions of environmental risks. Environment and Behavior 32(2), 248-67.

Stirling, A., 2006. Analysis, participation and power: justification and closure in participatory multi-criteria analysis. Land Use Policy 23, 95-107.

Sutton, J., 2010. Twittering Tennessee: Distributed networks and collaboration following a technological disaster. Paper presented at the 7th International ISCRAM Conference, Seattle, USA.

Sutton, J., Spiro, E.S., Johnson, B., Fitzhugh, S., Gibson, B., Butts, C.T., 2014. Warning tweets: serial transmission of messages during the warning phase of a disaster event, Information, Communication & Society 17(6), 765-787.

Ter Huurne, E.F.J., 2008. Information seeking in a risky world. The theoretical and empirical development of FRIS: A framework of risk information seeking. Thesis [Dissertation].

Terpstra, T., Gutteling, J.M., 2008. Households' perceived responsibilities in flood risk management in the Netherlands. International Journal of Water Resources Development 24(4), 555-565.

Terpstra, T., Zaalberg, R., De Boer, J., Botzen, W.J.W., 2014. You Have been framed! How antecedents of information need mediate the effects of risk communication messages. Risk Analysis 34(8), 1506–1520

Terpstra, T., de Vries, A., Stronkman, R., Paradies, G.L., 2012. Towards a realtime Twitter analysis during crises for operational crisis management. In: Rothkrantz, L., Ristvej, J., Franco, Z., (Eds.), 2012. Proceedings of the 9th International ISCRAM Conference — Vancouver, Canada, April 2012.

Terpstra, T., Vreugdenhil, H., 2015. Schuilen op zolder, in een shelter, in een versterkt compartiment of buitendijks? Draagvlak voor verticale evacuatie onder bewoners op het Eiland van Dordrecht. In opdracht van MIRT kernteam Eiland van Dordrecht. Lelystad: HKV Consultants.

Thaler, R., Sunstein, C., 2009. Nudge: Improving Decisions About Health, Wealth and Happiness. Penguin Books.

Tierney, K., Bevc, C., Kuligowski, E., 2006. Metaphors Matter: Disaster Myths, Media Frames and their Consequences in Hurricane Katrina. The Annals of the American Academy of Political and Social Science 604(1), 57-81

Treurniet, W., Messemaker, M., Wolbers, J., Boersma, F. K., 2015. Shaping the societal impact of emergencies: striking a balance between control and cooperation. International Journal of Emergency Services 4(1), 129-151.

Ueberham, M., Kabisch, S., Kuhlicke, C., 2016. Resilienz, Risikokommunikation und Verantwortung in der Hochwasservorsorge — Zum Verhältnis zwischen öffentlichem Schutz und privater Eigenvorsorge in überschwemmungsgefährdeten Gebieten, Hydrologie und Wasserbewirtschaftung 60, 135–145

Verroen, S., J.M. Gutteling, P.W. de Vries, 2013. Enhancing self-protective behavior: Efficacy beliefs and peer feedback in risk communication. Risk Analysis 33(7), 1252- 1264.

Wachinger, G., Renn, O., Begg, C., Kuhlicke, C., 2013. The risk perception paradox: implications for governance and communication of natural hazards. Risk Analysis 33, 1049–1065.

Walker, G., Tweed, F., Whittle, R., 2014. A framework for profiling the characteristics of risk governance in natural hazard contexts. Nat. Hazards Earth Syst. Sci. 14, 155-164.

Wardman, J.K., 2008. The Constitution of Risk Communication in Advanced Liberal Societies. Risk Analysis 28, 1619-1637.

Witte, K., 1994. Fear control and danger control — a test of the extended parallel process model (eppm). Communication Monographs 61(2), 113-34.

Witte, K., Allen, M., 2000. A meta-analysis of fear appeals: Implications for effective public health campaigns. Health Education and Behavior 27(5), 591-615.

4.2 Decision-making under uncertainty

Adrot, A., 2010. What Support Does Information and Communication Technology (Ict) Offer to Organizational Improvisation During Crisis Response?. In: Computer & Information Systems. Atlanta, Paris: Georgia State University — Paris Dauphine University, 317 pp.

Argote, L., 1982. Input Uncertainty and Organizational Coordination in Hospital Emergency Units. Administrative Science Quarterly 27(3), 420-434.

Biquet, J.-M., 2013. Haïti: Entre Urgence Et Reconstruction. Une Réponse Insatisfaisante. International Development Policy| Revue internationale de politique de développement 4(3).

Brown, A. D., Kornberger, M., Clegg, S. R., and Carter, C., 2010. 'Invisible Walls' and 'Silent Hierarchies': A Case Study of Power Relations in an Architecture Firm. Human Relations 63(4), 525-549.

Butler, D., 2013. Crowdsourcing Goes Mainstream in Typhoon Response. Nature News (20).

Comes, T., 2011. Decision Maps for Distributed Scenario-Based Multi Criteria Decision Support. In: IIP. Karlsruhe: KIT.

Comes, T., 2016a. Cognitive and Motivational Biases in Humanitarian Sensemaking and Decision-Making. San Diego: IEEE, 56-62.

Comes, T., 2016b. Designing for Networked Community Resilience. Procedia Engineering 159, 6-11.

Comes, T., Hiete, M., Schultmann, F., 2013. A Decision Support System for Multi-Criteria Decision Problems under Severe Uncertainty. Journal of Multi-Criteria Decision Analysis 20(1), 28-49.

Comes, T., Hiete, M., Wijngaards, N., Schultmann, F., 2011. Decision Maps: A Framework for Multi-Criteria Decision Support under Severe Uncertainty. Decision Support S.ystems 52(1), 108-118.

Comes, T., Van de Walle, B., 2015. RefugeesWelcome: How Smartphones and Social Media Empower Refugees and EU Citizens and Bring Change to European Refugee Policies: http://atha.se/blog/refugeeswelcome-smartphones-and-social-media-empower-refugees-and-citizens, [Accessed 12 April 2017].

Comes, T., Van de Walle, B., 2016. Information Systems for Humanitarian Logistics: Concepts and Design Principles. in Supply Chain Management for Humanitarians: Tools for Practice, G. Kovacs, K. Spens and I. Haavisto (eds.). London: Kogan Page, 259-284.

Comes, T., Vybornova, O., Van de Walle, B., 2015a. Bringing Structure to the Disaster Data Typhoon: An Analysis of Decision-Makers ' Information Needs in the Response to Haiyan. AAAI Spring Symposium, Stanford, 7-11.

Comes, T., Wijngaards, N., Van de Walle, B., 2015b. Exploring the Future: Runtime Scenario Selection for Complex and Time-Bound Decisions. Technological Forecasting and Social Change 97, 29-46.

Comfort, L. K., 2007. Crisis Management in Hindsight: Cognition, Communication, Coordination, and Control. Public Administration Review 67, 189-197.

Crozier, M., Friedberg, E., 1977. L'acteur Et Le Système. Paris: Seuil.

Dawes, S. S., Cresswell, A. M., Cahan, B. B., 2004. Learning from Crisis — Lessons in Human and Information Infrastructure from the World Trade Center Response. Social Science Computer Review 22(1), 52-66.

EC, 2013. Citizen Science for Europe: Towards a Society of Empowered Citizens and Enhanced Research. 1-54.

Edwards, C., 2009. Resilient Nation. London: Demos, 100 pp.

Eng, E., Parker, E., 1994. Measuring Community Competence in the Mississippi Delta: The Interface between Program Evaluation and Empowerment. Health Education & Behavior 21(2), 199-220.

French, S., Maule, J., Papamichail, N., 2009. Decision Behaviour, Analysis and Support. Cambridge University Press.

French, S., Niculae, C., 2005. Believe in the Model: Mishandle the Emergency. Journal of Homeland Security and Emergency Management (2:1), 1-16.

Gao, H., Barbier, G., Goolsby, R., 2011. Harnessing the Crowdsourcing Power of Social Media for Disaster Relief. IEEE Intelligent Systems 26(3), 10-14.

Global Parliament of Mayors, n.d. http://www.globalparliamentofmayors.org/, [accessed 27 April, 2017].

Guttieri, K., Wallace, M. D., Suedfeld, P., 1995. The Integrative Complexity of American Decision Makers in the Cuban Missile Crisis. Journal of Conflict Resolution 39(4), 595-621.

Haasnoot, M., Middelkoop, H., van Beek, E., van Deursen, W. P. A., 2011. A Method to Develop Sustainable Water Management Strategies for an Uncertain Future. Sustainable Development 19(6), 369-381.

Hall, P. M., 1997. Meta-Power, Social Organization, and the Shaping of Social Action. Symbolic Interaction 20(4), 397-418.

Hart, P., 1993. Symbols, Rituals and Power: The Lost Dimensions of Crisis Management. Journal of contingencies and crisis management 1(1), 36-50.

IFRC, 2005. Data or Dialogue? The Role of Information in Disasters. International Federation of Red Cross and Red Crescent Societies, Geneva.

IFRC, 2013. World Disaster Report. Technology and the Future of Humanitarian Action. Geneva.

Jacobsen, K. L., 2015. Experimentation in Humanitarian Locations: Unhcr and Biometric Registration of Afghan Refugees. Security Dialogue 46(2), 144-164.

Kok, K., Patel, M., Rothman, D. S., Quaranta, G., 2006. Multi-Scale Narratives from an Ia Perspective: Part Ii. Participatory Local Scenario Development. Futures 38(3), 285-311.

Landgren, J., 2015. Insights from an Ethnographic Study of a Foreign Response Team During the Ebola Outbreak in Liberia. Kristiansand, 114-119.

Lindblom, C. E., 1959. The Science of 'Muddling Through'. Public Administration Review, 19(2), 79-88.

Makridakis, S., Taleb, N. 2009. Living in a World of Low Levels of Predictability. International journal of forecasting 25(4), 840-844.

McDonald, S. M. 2016., Ebola: A Big Data Disaster. Privacy, Property, and the Law of Disaster Experimentation. Bengaluru and Delhi.

Meier, P., 2014. Next Generation Humanitarian Computing. New York: ACM Press, 1573-1573.

Monaghan, A., Lycett, M., 2013. Big Data and Humanitarian Supply Networks: Can Big Data Give Voice to the Voiceless? IEEE, 432-437.

Montibeller, G., von Winterfeldt, D., 2015. Cognitive and Motivational Biases in Decision and Risk Analysis. Risk Analysis 35(7), 1230-1251.

Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F., Pfefferbaum, R. L., 2008. Community Resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness. American Journal of Community Psychology 41(1-2), 127-150.

Noveck, B., 2015. Smart Citizens, Smarter State. Cambridge, MA: Harvard University Press.

OCHA, 2010. Humanitarian Principles. https://docs.unocha.org/sites/dms/Documents/OOM_HumPrinciple_English.pdf, [Accessed 12 April 2017].

OCHA, 2012. Humanitarianism in the Network Age. UN OCHA, New York.

Palen, L., Anderson, K. M., Mark, G., Martin, J., Sicker, D., Palmer, M., Grunwald, D., 2010. A Vision for Technology-Mediated Support for Public Participation & Assistance in Mass Emergencies & Disasters. British Informatics Society Ltd, 12 pp.

Pan, S. L., Pan, G., and Leidner, D., 2012. Crisis Response Information Networks. Journal of the Association for Information Systems 13(1), Article 1.

Prus, R. C., 1995. Envisioning Power as Intersubjective Accomplishment: Acknowledging the Human Enterprise Entailed in Tactician-Target Interchanges. In: Society for the Study of Symbolic Interaction meetings. Washington, DC.

Prus, R. C., 1999. Beyond the Power Mystique: Power as Intersubjective Accomplishment. Suny Press, 338 pp.

Pruyt, E., Kwakkel, J. H., 2014. Radicalization under Deep Uncertainty: A Multi-Model Exploration of Activism, Extremism, and Terrorism. System Dynamics Review 30(1-2), 1-28.

Renn, O., 2008. Global Risk Governance: Coping with Uncertainty in a Complex World. Governance. London: Earthscan Publications.

Rizza, C., Büscher, M., Watson, H., 2017. Working with data: ethical legal and social considerations surrounding the use of crisis data and information sharing during a crisis. Journal of Contingencies and Crisis Management 25(1), 2-6.

Rizza, C., Curvelo, P., Crespo, I., Chiaramello, M., Ghezzi, A., Pereira, Â. G., 2011. Interrogating privacy in the digital society: media narratives after 2 cases, International Journal of Information Ethics 16, 6-17.

Rizza, C., Pereira, Â. G., Curvelo, P., 2014. 'Do-it-yourself justice': considerations of social media use in a crisis situation: the case of the 2011 Vancouver riots. International Journal of Information Systems for Crisis Response and Management (IJISCRAM) 6(4), 42-59.

Sandvik, K. B., 2013. The Risks of Technological Innovation. Geneva: IFRC, 134-161.

Sandvik, K. B., Gabrielsen, M., Karlsrud, J., Kaufmann, M., 2014. Humanitarian Technology: A Critical Research Agenda. International Review of the Red Cross 96(893), 219-242.

Smart, C., Vertinsky, I., 1977. Designs for Crisis Decision Units. Administrative Science Quarterly 22(4), 640-657.

Taleb, N. N., 2007. Black Swan: The Impact of the Highly Improbable. Random House.

Talhouk, R., Mesmar, S., Thieme, A., Balaam, M., Olivier, P., Akik, C., Ghattas, H., 2016. Syrian Refugees and Digital Health in Lebanon: Opportunities for Improving Antenatal Health. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16). ACM, New York, NY, USA, 331-342.

Turoff, M., Chumer, M., Van de Walle, B. A., Yao, X., 2004. The Design of a Dynamic Emergency Response Management Information System. Journal of Information Technology Theory and Applications 5(4), 1-36.

Vervoort, J. M., Kok, K., van Lammeren, R., Veldkamp, T., 2010. Stepping into Futures: Exploring the Potential of Interactive Media for Participatory Scenarios on Social-Ecological Systems. Futures 42(6), 604-616.

Von Schomberg, R., 2013. A vision of Responsible Research and Innovation. In: Owen, R., Bessant, J., Heintz, M., (Eds.), 2013. Responsible Innovation. London: Wiley, 51-74.

Waddell, K., 2016. How Big Data Harms Poor Communities. In: The Atlantic, http://www.theatlantic.com/technology/archive/2016/04/how-big-data-harms-poor-communities/477423/, [accessed 12 April 2017]

Watson, H., Finn, R. L., 2014. Ethical and Privacy Implications of the use of Social Media during the Eyjafjallajokull Eruption Crisis. International Journal of Information Systems for Crisis Response and Management (IJISCRAM) 6(4), 29-41.

Wehn, U., Rusca, M., Evers, J., Lanfranchi, V., 2015. Participation in Flood Risk Management and the Potential of Citizen Observatories: A Governance Analysis. Environmental Science & Policy 48, 225-236.

Westrope, C., Banick, R., Levine, M., 2014. Groundtruthing Openstreetmap Building Damage Assessment. Procedia Engineering 78, 29-39.

Whipkey, K., Verity, A., 2015. Guidance for Incorporating Big Data into Humanitarian Operations. Geneva, 42 pp.

Wright, G., Goodwin, P., 2009. Decision Making and Planning under Low Levels of Predictability: Enhancing the Scenario Method. International Journal of Forecasting 25(4), 813-825.

Wybo, J.-L., Lonka, H., 2003. Emergency Management and the Information Society: How to Improve the Synergy. International Journal of Emergency Management 1(1), 183-190.

4.3 Last mile communication

Adger, N., 2000. Social and ecological resilience: are they related? Progress in Human Geography 4(3), 347–64.

Ahmed, A.K., 2015. Changing landscape of early warning systems. Management Asian Disaster News 2, 5-9.

Alexander, D., 2014. Social Media in Disaster Risk Reduction and Crisis Management. In: Science and Engineering Ethics 20, 717–733.

Balana, C.D., 2012. Social media: Major tool in disaster response. Inquirer Technology, available at https://technology.inquirer.net/12167/social-media-major-tool-in-disaster-response, [Accessed 12 April 2017].

Basher, R., 2005. Global early warning systems for natural hazards — systematic and people-centred. Royal Society Discussion Meeting on Extreme Natural Hazards, London, 26-27 October 2005, available at http://www.preventionweb.net/files/8153_8153Basherpaper1704061.pdf, [Accessed 12 April 2017].

BBC London Local Radio Phone-in, 2003. Drive Time programme 1700 — 1900 Thursday August 28th.

Boggs, B.C., Edwards, M.L., 2010. Does what happens on Facebook stay on Facebook? Discovery, admissibility, ethics, and social media. Illinois Bar Journal 98(7), 1–4.

Carver, L., Turoff, M., 2007. Human-Computer Interaction: The Human and Computer as a Team in Emergency Management Information Systems, Communications of the ACM 50(3), 33-38.

Civil Contingencies Act DVD, 2005. Published by UK Government Civil Contingencies Secretariat — produced by Ian Cameron BBC and Rosanna Briggs, Emergency Planning Officer Essex County Council.

Collins, M.L., Kapucu, N., 2008. Early Warning Systems and Disaster Preparedness and Response in Local Government. Disaster Prevention and Management 17(5), 587–600.

Cutter, S.L., Emrich, C.T., Adams, B.J., Huyck, C.K., Eguchi, R.T., 2007. New Information Technologies in Emergency Management. In: Waugh Jr, W.L., Tierney, K., (Eds.) 2007. Emergency Management: Principles and Practice for Local Government. 2nd ed., Washington DC: ICMA Press.

Dufty, N., 2012. Using social media to build community resilience. Australian Journal of Emergency Management 27(1), 40.

Giroux, J., Roth, F., Herzog, M., 2013. 3RG, Special Report, Using ICT & Social Media in Disasters: Opportunities & Risks for Government. Center for Security Studies (CSS), Zurich.

Google Crisis Response, available at https://www.google.org/crisisresponse/about/, [Accessed 12 April 2017].

Grasso, V., 2012. Early Warning Systems: State-of-Art Analysis and Future Directions. Report United Nations Environment Programme (UNEP), available at http://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article_id=89, [Accessed 12 April 2017].

Heipke, C., 2010. Crowdsourcing Geospatial Data. Journal of Photogrammetry and Remote Sensing 65(6), 550–557.

Holden, M., 2006. Urban indicators and the integrative ideals of cities. Cities 23(3), 170–183.

Horita, F.E.A., deAlbuquerque J.P., Marchezini, V., Mendiondo, E.M., 2016. A qualitative analysis of the early warning process in disaster management, Short Paper — Community Engagement and Practitioner Studies, Proceedings of the ISCRAM 2016 Conference — Rio de Janeiro, Brazil, May 2016.

Hu, Q., Kapucu, N., 2014. Information Communication Technology Utilization for Effective Emergency Management Networks, Public Management Review 18(3), 323-348.

Hughes, A.L., Palen L., Peterson, S., 2009. Social media and emergency management. In: Trainor, J.E., Subbio, T., (Eds.), 2009. Critical Issues in Disaster Science and Management. https://training.fema.gov/hiedu/docs/critical-issues-in-disaster-science-and-management.pdf, [Accessed 12 April 2017].

Iannella, R.,Henricksen, K., 2007. Managing Information in the Disaster Coordination Centre: Lessons and Opportunities. In: van de Walle, B., Burghardt, P., Nieuwenhuis, C., (Eds.), 2007. Proceedings of the 4th International ISCRAM Conference. Delft: VUB Press, 1–11.

Implementation Plan, available at http://www.wmo.int/pages/prog/amp/pwsp/documents/WMO-SSD-1129_en.pdf, [Accessed 12 April 2017].

International Federation of Red Cross and Red Crescent Societies, 2012. Community early warning systems: guiding principles. Geneva 2012.

Ireson, N., 2009. Local Community Situational Awareness during an Emergency. In: Proceedings of the 3rd IEEE International Conference on Digital Ecosystems and Technologies (DEST 2009), 49 –54.

Jensen, S.J., Jensen, S.F., Johnston, D.M., Brown N.A., 2015. The Emergence of a Globalized System for Disaster Risk Management and Challenges for Appropriate Governance. International Journal of Disaster Risk Science 6, 87-94.

Kar, B., 2016. Citizen science in risk communication in the era of ICT, Concurrency and Computation. Practice and Experience 28, 2005–2013.

Klafft M., Reinhardt, N., 2016. Information and interaction needs of vulnerable groupos with regard to disaster alert apps. In: Weyers, B., Dittmar, A. (Eds.), 2016. Mensch und Computer 2016 — Workshopband. Aachen: Gesellschaft für Informatik e.V.

Lindell, M.K., Perry, R.W., 2004. Communicating Environmental Risk in Multi-ethnic Communities. Thousand Oaks, CA: Sage.

LIRNE Asia, 2008, Regional Dissemination of Findings from the Last-Mile Hazard Information Dissemination Pilot Project, HazInfo Supplemental Report, available at http://lirneasia.net/projects/2006-07/evaluating-last-mile-hazard-information-dissemination-hazinfo/, [Accessed 12 April 2017].

NRC (National Research Council), 2007. Improving Disaster Management: The Role of IT in Mitigation, Preparedness, Response, and Recovery. Washington, DC: The National Academies Press.

Preston, J., 2013. Game Theory and Adaptive Networks for Smart Evacuations, University of East London, available at http://www.csap.cam.ac.uk/media/uploads/files/1/dfuse-smart-evacuation-public-report.pdf, [Accessed 12 April 2017].

Reuter, C., Spielhofer, T., 2016. Towards social resilience: A quantitative and qualitative survey on citizens' perception of social media in emergencies in Europe, Technological Forecasting & Social Change, available at http://www.wiwi.unisiegen.de/wirtschaftsinformatik/paper/2016/2016_reuterspielhoefer_towardssocialresilience-citizensurvey_tfsc.pdf, [Accessed 12 April 2017].

Rojas-Caldenas, R.I., Corona Zambrano, E.A., 2008, Urban observatories opportunities for environmental monitoring: solid wastes. Waste Management 28, 40–44.

Sellnow, D.D., Lane D., Littlefield R.S., Sellnow T.L., Wilson B., Beauchamp K., Venette, S., 2015, A receiver-based approach to effective instructional crisis communication, Journal of Contingencies and Crisis Management 23(3), 149-159.

Singh Bedi, G., 2006. Strengthening multi-hazard early warning systems — the last mile. Asian Disaster Management News 12(4), 7–8.

Thomalla, F., Larsen, R.K., 2010. Resilience in the context of tsunami early warning systems and community disaster preparedness in the Indian Ocean Region. Environmental Hazard 9, 249-265.

UK Cabinet Office, 2005. Emergency preparedness: guidance on part1 of the Civil Contingencies Act 2004, its associated regulations and non-statutory arrangements (Chapter 1, 1.1 page 3) HM Government UK, available at https://www.gov.uk/government/publications/emergency-preparedness, [Accessed 12 April 2017].

UN/ISDR, 2005. The Hyogo Framework for Action 2005– 2015: Building the Resilience of Nations and Communities to Disasters. United Nations International Strategy for Disaster Reduction, available at http://www.unisdr.org/we/inform/publications/1037, [Accessed 12 April 2017].

United Nations (UN), 2006. United Nations Platform for Space based Information for Disaster Management and Emergency Response (UN-SPIDER), available at http://www.unoosa.org/pdf/publications/IAM2005E.pdf, [Accessed 12 April 2017].

United Nations (UN), 2015. Sendai Framework for Disaster Risk Reduction, 2015-2030, vailable at http://goo.gl/E6lM74, [Accessed 12 April 2017].

United Nations Office for Disaster Risk Reduction (UNISDR), 2004. Terminology: basic terms of disaster risk reduction. International Strategy for Disaster Reduction Secretariat, Geneva, available at http://goo.gl/UT0P5W, [Accessed 12 April 2017].

Vivacqua, A. S., Borges, M. R. S., 2010. Collective Intelligence for the Design of Emergency Response. In: Proceedings from the 2010 International Conference on Computer Supported Cooperative Work in Design (CSCWD), 623–628.

Wang, J., 2010. Beyond Information: The Sociocultural Role of the Internet in the 2008 Sichuan Earthquake. The Journal of Comparative Asian Development 9(2), 243– 292.

When, V., Rusca, M., Evers, J., Lafranchi, V., 2015. Participation in flood risk management and the potential of citizen observatories: A governance analysis. Environmental Science and Policy 48, 225-236.

World Meteorological Organization, 2014. The WMO Strategy for Service Delivery and It's.

4.4 Good practices and innovation in risk communication

Alexander, D., 2014. Social Media in Disaster Risk Reduction and Crisis Management. Sci. Eng. and Ethics 20, 717–733.

Allen, D. K., Karanasios, S., Norman, A., 2014. Information sharing and interoperability: the case of major incident management. European Journal of Information Systems 23(4), 418–432.

Árvai, J., 2014. The end of risk communication as we know it. Journal of Risk Research 17(10), 1245–1249.

Austin, L., Fisher Liu, B., Jin, Y., 2012. How Audiences Seek Out Crisis Information: Exploring the Social-Mediated Crisis Communication Model. Journal of Applied Communication Research 40(2), 188–207.

Bird, D., Ling, M., Haynes, K., 2012. Flooding Facebook — the use of social media during the Queensland and Victorian floods. The Australian Journal of Emergency Management 27(1), 27-33.

Bruns, A., Burgess, J., 2014. Crisis communication in natural disasters: The Queensland floods and Christchurch earthquakes. Twitter and society 89, 373-384.

BurgerNet app., n.d. www.burgernet.nl, [accessed 27 April, 2017].

Coleman, A., 2013. Managing a crisis in the era of social communication: how Greater Manchester Police is developing community engagement and communication. Journal of Brand Strategy 2.2, 128–133.

Cool, C. T., Claravall, M. C., Hall, J. L., Taketani, K., Zepeda, J. P., Gehner, M., Lawe-Davies, O., 2015. Social Media as a communication tool following Typhoon Haiyan. Western Pacific Surveillance and Response Journal 6(1), 86–90.

Coombs, W. T., Holladay, S. J., 2014. How publics react to crisis communication efforts: Comparing crisis response reactions across sub-arenas. Journal of Communication Management 18(1), 40–57.

Cuevas, H. M., Jones, R. E. T., Mossey, M. E., 2011. Team and Shared Situation Awareness in Disaster Action Teams. In: The Proceedings of the Human Factors and Ergonomics Society Annual Meeting September 2011, 55(1), 365–369.

De Vries, H., Bekkers, V., Tummers, L., 2015. Innovation in the public sector: A systematic review and future research agenda. Public Administration 94(1), 146–166.

Denef, S., Bayerl, P., Kaptein, N., 2013. Social Media and the Police — Tweeting Practices of British Police Forces during the August 2011 Riots. In: CHI '13 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 3471–3480.

Duffy, N., 2012. Using social media to build community disaster resilience. The Australian Journal of Emergency Management

27(1), 40-45.

Dutta-Bergman, M. J., 2006. Community participation and Internet use after September 11: Complementarity in channel consumption. Journal of Computer-Mediated Communication 11(2), 469–484.

Flizikowski, A., Hołubowicz, W., Stachowicz, A., Hokkanen, L., Kurki, T., Päivinen, N., Delavallade, T., 2014. Social media in crisis management — the iSAR+ project survey. In: Proceedings of the international ISCRAM Conference. http://iscramlive.org/IS-CRAM2014/papers/p68.pdf, [Accessed 12 April 2017].

Fruth, J., Nett, E., 2014. Uniform approach of risk communication in distributed IT environments combining safety and security aspects. In: International Conference on Computer Safety, Reliability, and Security, 289–300. Springer International Publishing.

Gibson, H., Akhgar, B., Domdouzis, K., 2015. Using Social Media for Crisis Response: The ATHENA System. In: Mesquita, A., Peres, P. (Eds) Proceedings ECSM 2015 2nd European Conference on Social Media Porto, Portugal. Academic Conferences and Publishing International Limited. 183–192.

Greater Manchester Police app., n.d. www.gmp.police.uk, [accessed 27 April, 2017].

Gupta, A., Lamba, H., Kumaraguru, P., 2013. $1.00 per RT #BostonMarathon #PrayForBoston: Analyzing Fake Content on Twitter. Eighth IEEE APWG eCrime Researcher Summit (eCRS), IEEE, 1–12.

Heath, R. L., 2006. Best Practices in Crisis Communication: Evolution of Practice through Research. Journal of Applied Communication Research 34(3), 245-248.

HM Government Office of Science, 2014. Innovation: Managing Risk, Not Avoiding It. Evidence and Case Studies. Annual Report of the Government Chief Scientific Adviser, HM Government, London.

Holderness, T., Turpin, E., 2015. Assessing the Role of Social Media for Civic Co-Management During Monsoon Flooding in Jakarta, Indonesia. White Paper: PetaJakarta.org. https://petajakarta.org/banjir/en/ accessed on 27/09/2016, [Accessed 12 April 2017].

Holderness, T., Turpin, E., 2016. From Social Media to GeoSocial Intelligence: Crowdsourcing Civic Co-Management for Flood Response in Jakarta, Indonesia. In: Social Media for Government Services, Springer (preprint version).

Höppner, C., Whittle, R., Bründl, M., Buchecker, M. 2012. Linking social capacities and risk communication in Europe: a gap between theory and practice?. Natural Hazards 64(2), 1753–1778.

Houston, J. B., Hawthorne, J., Perreault, M. F., Park, E. H., Goldstein Hode, M., Halliwell, M. R., Turner McGowen, S. E., Davis, R., Vaid, S., McElderry, J. A., Griffith, S. A., 2015. Social media and disasters: a functional framework for social media use in disaster planning, response, and research. Disasters 39(1, 2), 1–22.

Jäntti, M., Kurki, T., Hokkanen, L., 2016. Identifying requirements for a social media-based emergency management system. In: proceedings of the eleventh international conference on systems ICONS 2016, 32–37.

Jong, W., Dückers, M. L., 2016. Self-correcting mechanisms and echo-effects in social media: An analysis of the 'gunman in the newsroom' crisis. Computers in Human Behavior 59, 334-341.

Kasperson, R., 2014. Four questions for risk communication. Journal of Risk Research 17(10), 1233–1239.

Lachlan, K., Spence, P., Burke, J., 2007. The Role of Medium Choice in Perceptions of Crisis Message Adequacy and Responses during Hurricane Katrina. Paper presented at the annual meeting of the NCA 93rd Annual Convention, TBA, Chicago, IL, Nov 14, 2007.

Liegl, M., Boden, A., Buscher, M., Oliphant, R., Kerasidou, X., 2016. Designing for ethical innovation: A case study on ELSI co-design in emergency. International Journal of Human-Computer Studies 95, 80–95.

Liu, S. B., 2014. Crisis crowdsourcing framework: Designing strategic configurations of crowdsourcing for the emergency management domain. Computer Supported Cooperative Work (CSCW) 23(4–6), 389–443.

Manso, M., Guerra, B., Carjan, C., Jigman, A., Amditis, A., Sdongos, E., Donaldson, D., 2016. The Application of Telematics and Smart Devices in Emergencies: Use Cases in Next Generation Emergency Services. In: IEEE First International Conference on Internet-of-Things Design and Implementation (IoTDI) IEEE. April. 2016. 289–292.

Manso, M., Manso, B., 2012. The Role of Social Media in Crisis: A European holistic approach to the adoption of online and mobile communications in crisis response and search and rescue efforts. In: Proceedings of the 17th International Command & Control Research & Technology Symposium. Fairfax VA, June 19–21. http://isar.i112.eu/downloads/files/2012Role_of_Social_Media.pdf, [Accessed 12 April 2017].

OECD, 2012. The use of social media in risk and crisis communication. Report of the High Level Risk Forum. OECD Conference Centre, Paris, December 13.–14.

Palen, L., Vieweg, S., Sutton, J., Liu, S. B., Hughes, A. L., 2007. Crisis informatics: Studying crisis in a networked world. In; Proceedings of the Third International Conference on E-Social Science. Michigan, October 7–9, 2007.

Pidgeon, N., 2014. Complexity, uncertainty and future risks. Journal of Risk Research 17(10), 1269–1271.

Posetti, J., 2012. The Twitterisation of ABC's Emergency and Disaster Communications. The Australian Journal of Emergency Management 27(1), 34–39.

Renn, O., 2014. Four questions for risk communication: a response to Roger Kasperson. Journal of Risk Research 17(10), 1277–1281.

Reuter, C., Spielhofer, T., 2016. Towards social resilience: A quantitative and qualitative survey on citizens' perception of social media in emergencies in Europe. Technological Forecasting and Social Change, 13 pp.

Schiavo, R., 2016. Making the Case for Community and Citizen Engagement in Risk Communication. In: 22nd IUPHE World Conference on Health Promotion, 2016 May 25, Curitiba, Brazil.

Scolobig, A, Prior, T., Schröter, D., Jörin, J., Patt, A., 2015. Towards people-centred approaches for effective disaster risk management: Balancing rhetoric with reality. International. Journal of Disaster Risk Reduction 12, 202–212.

Seeger, M. W., 2006. Best Practices in Crisis Communication: An Expert Panel Process. Journal of Applied Communication Research 34(3), 232-244

Stephens, K. K., Malone, P., 2009. New media for crisis communication: Opportunities for technical translation, dialogue, and stakeholder responses. In: Coombs, W. T., Holladay, S. J., (Eds.), 2009. The Handbook of Crisis Communication Wiley-Blackwell. 381–395.

Tanenbaum, A. S., Van Steen, M., 2007. Distributed Systems: Principles and Paradigms. 2nd revised edition. Pearson Education Limited.

Tirkkonen, P., Luoma-Aho,V., 2011. Online authority communication during an epidemic: A Finnish example. Public Relations Review 37, 172–174.

Trumbo, C. W., McComas, K. A., 2008. Institutional Trust, Information Processing and Perception of Environmental Cancer Risk. International Journal of Global Environmental Issues 8(1/2), 61–76.

Van De Ven, J., van Rijk, R., Essens, P., Frinking E., 2008. Network Centric Operations in Crisis Management. In: Fiedrich, F.,Van de Walle, B., (Eds.), Proceedings of the 5th International ISCRAM Conference — Washington, DC, USA, May 2008.

Vihalem, T., Kiisel, M., Harro-Loit, H., 2012. Citizen's Response Patterns to Warning Messages. Journal of Contingencies and Crisis Management 20(1), 13–25.

WhereAREU app., n.d. where.areu.lombardia.it, [accessed 27 April, 2017].

Wolbers, J., Boersma, K., 2013. The common operational picture as collective sensemaking. Journal of Contingencies and Crisis Management 21(4), 186-199.

Xylomenos, G., Ververidis, C. N., Siris, V. A., Fotiou, N., Tsilopoulos, C., Vasilakos, X., Katsaros, K. V., Polyzos, G. C., 2014. A survey of information-centric networking research. IEEE Communications Surveys & Tutorials 16(2), 1024–1049.

Yasuda, M., Yi, C. J., Nouchi, R., Suppasri, A., Imamura, F., 2016. A Practical Application Of A Children's Disaster Prevention Education Program In The Philippines. WIT Transactions on the built environment. At: SUSI 2016. May 2016 Crete, Greece.