Technological Forecasting & Social Change 148 (2019) 119724

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

The impact of risk cultures: Citizens' perception of social media use in emergencies across Europe

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Usage of social media during emergencies and respective perceptions vary across countries. Our representative survey of 7071 citizens in Europe (Germany, Italy, the Netherlands and the United Kingdom) shows differences of current use of social media in emergencies, expectations towards authorities monitoring social media, intensity of perceiving barriers regarding the use as well as variances concerning the (likelihood of future) use of mobile apps. While German and British participants' frequency of use of social media is medium and low, respectively, Italian and Dutch respondents use them relatively frequently. Our comparison of the four countries allows for an interpretation of divergent behavior across countries with respect to risk cultures as well as expanding the respective model to social media contexts. At the same time, our findings stress that across the four European countries participants assessed similar advantages like dissemination of information and barriers like false rumors with respect to use social media during emergencies. Distributed equally across nations, age and gender showed significant relationships with social media usage which, among other findings, suggests being helpful for effective implementation of management structures using new technologies.

Keywords

Citizens' perception
Social media
Mobile apps
Emergencies
Risk cultures
Representative survey

1. Introduction

Social media are used across the world. Facebook counts 2.04 billion active users per month, followed by YouTube with 1.5 billion and WhatsApp and Facebook Messenger with 1.2 billion (We Are Social, 2016). Use of these media differs across several factors such as age but also across nation states. Comparing general social media use in the United Kingdom (UK), Germany (GER), the Netherlands (NL) and Italy (IT), the latter makes the least use of them, with 40% (37 million) of the Italian population active. The UK (59%, 39 m), Germany (55%, 45 m) and the Netherlands (57%, 9.74 m) are almost equal (Statista, 2017). Based on the fact that mobile devices are very often used to communicate via social media, not least because they are always ready to hand, it is not surprising that social media are also used in emergencies (Reuter et al., 2018). However, there is a lack of robust quantitative and comparative findings on citizens' perceptions of social media use in emergencies across different countries. Focusing on four European countries, we present and compare representative survey results with the aim of grasping similarities and differences in social media use during emergencies. Referring to situations of disaster, previous research indicated varying risk cultures in European countries to shape populations' behavior (Dressel, 2015; Dressel and Pfeil, 2017).

Research into emergencies has become more common in Human Computer Interaction (HCI) (Ludwig et al., 2017; Reuter et al., 2018). It is important to gain a deep understanding of social media use in emergencies as it poses various advantages which are yet to be fully exploited. Social media offers a more effective way of knowledge management, bringing together important information by various actors, contributes to situational awareness in crises, and allows for crowdsourcing (Vieweg et al., 2010; Gao et al., 2011; Hughes and Palen, 2009; Lim et al., 2011; Yates and Paquette, 2011). As a vast body of literature has shown, we can assume risk perception not to be independent from individuals' various contexts (Coppola, 2006; Dressel and Pfeil, 2017; Renn and Rohrmann, 2000). Thus, a cross-cultural comparison allows to focus on culture-specific encounters of risks and actual situations of emergencies, offering useful insights for the application of emergency management procedures (Coppola, 2006; Renn and Rohrmann, 2000; Viklund, 2003). Therefore, it seems worthwhile examining cultural differences in terms of use of social media in emergencies, proposing an explanation of individuals' behavior. Referring to models of risk culture, we contribute to the respective discourse by shedding light on attitudes and behavior towards and within

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https://doi.org/10.1016/j.techfore.2019.119724
Received 23 December 2018; Received in revised form 14 June 2019; Accepted 20 August 2019

social media channels. Our comparison proposes varying degrees of social media usage and openness towards its current and future use during emergencies, pointing out to the importance of individuals' willingness to use social media and its collaborative value (Chang et al., 2015).

Our paper introduces findings on the perception of social media use in emergencies in four European countries: Italy, Germany, the Netherlands and the UK by presenting a representative survey of 7071 participants and offering a respective analysis of its results. Our research questions are as follows: (R1) How do citizens of Italy, Germany, the Netherlands and the UK use social media during emergencies? (R2) What are their expectations towards emergency services, (R3) what are perceived barriers, and (R4) what is their attitude towards mobile emergency apps?

Presenting answers to our first question (R1), we focus on current use and participants' reasonings behind it. Findings regarding the following three questions (R2-R4) help to complement our task pointing out to important aspects of citizens' perception and use of social media during emergencies. Our work proves valuable not only with respect of providing scientific input based on a large, representative and comparative sample but also yields relevant findings regarding future practice of disaster and emergency management, implying implementation of social media channels.

In answering these questions, similarities and differences across the four countries become apparent. Our findings show that 45% of the citizens have already used social media during emergencies, social media are used more to search for information than to share. Citizens expect emergency services to monitor social media (most in Germany) and to respond within an hour (most in Italy); rumors and unreliable information are considered as important barriers – while barriers are most seen in Germany, less in UK and Italy and least Netherlands. Especially Italian participants suggest being open for social media use during emergencies while showing high expectations with regards to authorities' performance. Contrasting in use and attitude towards managing emergencies via social media, the British case points out to perceiving future crisis management and communication via social media to be unnecessary.

The paper is structured as follows: First, we shed light on findings of related work and our theoretical framing (Section 2). In the following, we present method (Section 3) and quantitative as well as qualitative results of the surveys (Section 4). Discussing our findings, we propose an interpretation of main results and indicate limitations and outlook (Section 5).

2. Related work and theoretical framing

Since 2001, the use of social media in emergencies, such as natural hazards (e.g., tsunamis, hurricanes, earthquakes, floods) and human-induced disasters (e.g., accidents, shootings, terror attacks, political uprisings) (Reuter et al., 2017), has increased considerably, and a number of trends have been identified. This seems to be the case regardless of the scale of the emergency (Reuter et al., 2018). Accordingly, crisis informatics (Palen et al., 2007) research examines opportunities and challenges of social media in emergencies by both authorities, such as emergency services (Reuter et al., 2016; Kaufhold et al., 2019), and citizens (Pipek et al., 2014). Published studies have tended to focus on the examination of social media data in the English language, often on Twitter (Hughes et al., 2016), and the study of US-based events, complemented by a recent trend of non-US case studies (Gaspar et al., 2014). Mark et al. focus on continually disruptive environments and technologies as a resource, examining the cases of Iraq and Israel (Mark and Semaan, 2008) while various studies concentrate on incidents in China and other Asian countries (Acar and Muraki, 2011; Chen Huang et al., 2011; Huang et al., 2010) as well as dedicating special attention on events of the Arab spring (Kavanaugh et al., 2011). Al-Saggaf et al. as well as Papagiannidis and Bourlakis (Al-Saggaf and Simmons, 2015; Papagiannidis and Bourlakis, 2015) examine social media use and its potentials in times of natural disasters in Saudi-Arabia. Reuter et al. study emergency services' attitudes towards the use of social media, thereby focusing on another relevant group of actors in emergency-related contexts (Reuter et al., 2016). To further support emergency management, Kaufhold et al. compare and evaluate guidelines for social media in order to prevent its chaotic use before, during and after emergencies (Kaufhold et al., 2019). Generally, we follow the definition of social media by Kaplan et al. (Kaplan and Haenlein, 2010); yet, with respect to citizens' attitudes towards emergency apps, we assumed participants' to not differentiate greatly between social network sites, instant messengers and mobile apps created for (local) communication, finding and sharing of information.

Contrasting prior work focusing on bigger disasters (Federal Emergency Management Agency, 2018; UN Office for Disaster Risk Reduction, 2016; Western Cape Government, 2015; Whittaker et al., 2015; World Health Organization, 2002), we choose a broad definition (Haddow et al., 2007; Tierney, 2001) of emergencies, referring not only to academically conceptualized emergencies and disasters (UN Office for Disaster Risk Reduction, 2016) but also emergency situations in which only a few individuals may be affected and call upon emergency services' standard procedures for help (e.g., burglary). Communication via social media may prove effective in each scenario. Aware that individual incidents differ in scope and individuals may pursue actions via social media differently, citizens may want to contact emergency services or have high expectations towards authorities independent from the type of emergency. Assuming a broad understanding of an emergency takes into consideration that various participants define emergency based on their experiences and conventional usage of the term; the common understanding forming the basis of individual action and defining circumstances at which social media may aim.

In contrast to other studies focusing, e.g., only on perceptions of directly involved individuals, we defined individuals to use social media during emergencies even when they were not directly involved as primary sources of information as this may prove interesting results as well.

2.1. Quantitative studies on citizens' perception of social media use in emergencies

Several studies have tried to understand how citizens perceive social media communications in emergencies. The American Red Cross (American Red Cross, 2012) investigated citizens' usage of social media during emergencies with 1017 online and 1018 telephone survey respondents. According to this study, users like to share safety reassurances, weather information, eyewitness information, their location, and their feelings with respect to an emergency. The most trusted sources include family, friends, local emergency officials, and news media (or reporters). In a iSAR+ project study, 317 citizens and 130 emergency services were interviewed concerning the possibilities and challenges of social media integration into crisis response management (Flizikowski et al., 2014). In general, the respondents were positively inclined towards the use of social media. In a comparative study with over 1000 participants, the Canadian Red Cross identified Canadian citizens' expectations of emergency services regarding current and future performance as well as the extent to which they use social media and mobile devices in crisis communication (Canadian Red Cross, 2012). Social media were perceived as useful additions to existing channels, yet not considered to replace traditional media. Monitoring and the provision of situational information constitute benefits of using social media during emergencies, reassuring citizens of appropriate management. Furthermore, Reuter and Spielhofer analyzed an EmerGent project survey of 1034 citizens across Europe (Reuter and Spielhofer, 2017). It examined citizens' attitudes towards the use of social media for private purposes and in emergencies. The results show that citizens use social media rather to search (43%) than share information (27%), anticipate

receiving emergency information faster via social media than traditional channels (77%) and expect emergency services to monitor social media (69%). Although two quantitative studies examined cross-cultural samples, cultural differences affecting social media use during emergencies were not investigated rigorously. To address this issue, the notion of risk cultures offers an interesting theoretical framing, proposing an alternative to individualistic models of risk perception (Lee et al., 2013).

2.2. Risk cultures as a theoretical framing of social media use in emergencies

As each society may deal differently with risks and our article focuses on behavior of populations during emergencies including respective attitudes, theoretical work regarding so-called risk cultures proves helpful in interpreting our survey results (Cornia et al., 2016; Gierlach et al., 2010; Hewitt, 2012; Marris et al., 1998). Choosing this relational approach allows for an analysis based on already conceptualized types (Cornia et al., 2016), at the same time testing the potential of the respective theoretical framework. Alternatively, one may assume socioeconomic or demographic factors to impact social media use in emergencies. Even though GDP per capita varies across the four European countries, survey results did not implicate any related causality, while neither income nor distribution of age groups did vary heavily (while social media usage did) (index mundi, 2019; Trading Economics, 2019). Additionally, our cases suggested everyday internet or social media use being relatively constant across our cases (Internet World Stats, 2019). Thus, we followed the framework of risk cultures, which poses a plausible starting point for an analysis of perception, which is influenced by a community's use of language and non-verbal behavior. While the risk culture approach concentrates on individuals' behavior in and attitudes towards emergency situations, including populations' perception of traditional media, it does not take “new” social media into account. The work of Cornia et al. (Cornia et al., 2016), proposing a conceptualization of risk cultures and an analysis of seven European countries, forms our point of reference in interpreting perceptions regarding and actions within social media channels, this focus being disregarded in the prior risk culture debate. Referring to the work of Douglas and Wildavsky (Douglas and Wildavsky, 1983), they follow a traditional understanding of risk cultures (Cornia et al., 2016; Dressel, 2015). The three types identified as well as the respective classification of cases, along the criteria of *framing* incidents, *trust* towards authorities, and target of *blaming*, prove useful here. Thus, risk culture grasps the ways in which collectives perceive a disruptive event, show trust towards involved authorities, and ascribe responsibility of (consequences of) the event. We follow the conceptualization of Germany as a state-oriented risk culture, the Netherlands as an individualistic one and Italy as a fatalistic risk culture (Cornia et al., 2016) as it matches satisfactorily our analysis, even though Italy suggests change towards an individualistic risk culture. We include the UK in our study, constituting a first analysis of this case from the chosen risk culture perspective. In light of our findings, we classify it as a fatalistic risk culture, although our results suggest a higher level of trust than its fatalistic ideal type indicates.

In *state-oriented risk cultures* people assume that prevention of disasters is generally possible, often framing disasters as events which are not solely in nature's hand but also determined by human-environment. Trust in state authorities is high and they are expected to prevent and manage emergencies. Generally, one can identify high trust in mass media and high compliance with authorities' instructions while citizens show little knowledge and awareness of coping mechanisms and low confidence of their respective individual capabilities (Cornia et al., 2016). *Individualistic risk cultures* assume similarly that disaster risk prevention is possible while negative consequences can be minimized as well; thus, disaster is framed as an incident humankind can generally manage and control. While trust towards authorities is not particularly low, citizens still feel that they individually share responsibilities of being informed, prepared, aware with respect to risks, showing relatively high knowledge of coping mechanisms (Cornia et al., 2016). Roughly, risk cultures have been characterized on a continuum of individualism and collectivism (Gierlach et al., 2010; Zheng, 2017). A *fatalistic risk culture* perceives hazards as “unpredictable and unavoidable”, implying nature's or a godly power over human population (Cornia et al., 2016). Trust in authorities is low due to prior inefficacy as is trust towards mass media which is often perceived as subjective and clientelistic. Furthermore, individuals have low confidence in their respective problem-solving potentials. Disillusioned, they still generally expect the state to act during emergencies while not taking state communications (e.g., warnings) seriously (Cornia et al., 2016). Defining risk culture as a configuration of the variables *framing, trust*, and *blaming*, our study allowed for an operationalization of risk cultures with respect to social media (see Table 1).

Following Cornia et al. (Cornia et al., 2016) we consider citizens' perception of efficacy of management structures to stabilize or change risk cultures with a fatalistic risk culture evolving when authorities' actions are considered inefficient and strengthening state-oriented risk cultures when society perceives management structures to be successful. Additionally, we suggest frequency of emergencies, also with respect to certain types of incidents (small- vs. large-scale events), to count as relevant factors strengthening perceptions of (lacking) efficiency of management structures, thus, determining citizens' perception regarding necessity of change.

2.3. Research gaps

Much research on social media in emergencies focused on the Anglo-Saxon discourse, US-based events and Twitter. There are some studies on national differences of social media use although not focusing on emergencies. Furthermore, there are not many studies on citizens' perceptions of social media use in emergencies providing any comparison across countries (first gap). Moreover, opportunity-based samples largely form the basis of most studies. The number of participants might be high, but they do not ensure representativeness in relation to age, education, income, gender, and region. From a methodological perspective this restricts, to some extent, the reliability of these studies regarding generalizable statements (second gap). These gaps point out to the necessity of quantitative work, which may enable to triangulate against more qualitative studies. Regarding explanatory factors of divergent behavior with respect to social media use during emergencies our work poses a first attempt to transfer models of risk culture to the sphere of social media, allowing for an interpretation of usage patterns (third gap).

3. Method

We decided to commission representative online surveys to collect more robust data and up-to-date information on citizens' attitudes towards the use of social media in emergency situations in Europe. We chose to compare countries that (a) differ in risk cultures and (b) in the general use of social media (Dressel, 2015; Dressel and Pfeil, 2017). We conducted four representative studies in Germany, Italy, the Netherlands and the UK.

3.1. Case selection

Our study constitutes the first cross-country comparison focusing on Europe. To account for differences in outcome, i.e., diverging behavior of and attitudes towards social media use during emergencies, deriving from variation of risk cultures, we chose four countries which are relative similar with respect to demographic factors as well as internet access and service conditions (OECD, 2018a, 2018b, 2018c). The latter, paired with socialization of social media use through similar products

(e.g., Facebook, iPhone) across these countries, may account for similar outcomes. At the same time, all four democratic countries are part of the European Union, thus, following same supranational regulations of disaster management and the Internet while sharing membership of the European organization since its offspring. Diverging with respect to risk culture, implying concrete formations of state-society relations and self-evaluations of subjects embedded in respective social and cultural contexts, the cases allow for approaching the independent variable's effect on social media use during emergencies. Each country represents a certain configuration of the variables *framing, trust*, and *blaming*, defining the respective risk culture regarding social media (see Table 1).

3.2. Survey questions

The survey consisted of nine questions, with the first eight in closed-ended form using five-point Likert rating scales (Q4, Q5 and Q8) and multiple-choice items (Q1, Q2, Q3, Q6 and Q7). The end-points of the three rating scales were 'Strongly agree' and 'Strongly disagree', 'This would definitely put me off' and 'Would definitely not put me off' as well as 'Very likely' and 'Not at all likely' (see Appendix: Survey questions). First, participants were asked about frequency of use of social media (Q1), their previous usage of social media in emergencies (Q2) and, if applicable, the kinds of information shared (Q3). Regarding the latter, participants could choose more than one option among the most typical types of information shared on social media (Reuter and Kaufhold, 2018), including various kinds of social media usage patterns applicable to various situations of different degrees of involvement. Then, we requested the expected responsiveness of emergency services to messages posted via social media (Q4) and regarded opinions about discouraging factors for using social media in emergencies (Q5). We also considered previously downloaded apps for emergencies (Q6) and specifications concerning the types of emergency-related apps the participants had already downloaded (Q7). We also wanted to know about future usage of apps in emergencies for exemplified purposes (Q8). Finally, the last question was open-ended and covered experiences with social media in emergencies (Q9). The questions were derived from our interest in answering the research questions (R1-R4). Asking for usage patterns regarding social media channels and smartphone applications made it possible to approach the countries' respective risk cultures reflected by social media behavior and attitude (e.g., relative high interest towards use). At the same time, it became also clear which activities cannot be easily traced back to a specific type of risk culture. Referring to participants' expectations towards authorities' responsiveness allowed us to reflect on citizens' targets of potential blaming depending on the type of risk culture. Focusing on discouraging factors also allowed us to focus on individualistic, state-oriented, and fatalistic risk cultures' related attitudes indicating levels of trust.

3.3. Data collection

The surveys in Italy, the Netherlands and the UK were conducted by Opinium (http://opinium.co.uk), also co-working with London School of Economics.[1] The survey in Germany was carried out by the ISO-certified[2] market and social research agency GapFish (https://gapfish.com/). All participants of the online surveys were paid a small amount of money, with the sample selected from a pool of volunteers. A study solely based on the German sample has already been published (Reuter et al., 2017). All surveys were conducted between October 2016 and March 2017. Both research agencies offered robust samples, allowing for generalization. The surveys in Italy, Netherlands and UK were weighted to be in line with population statistics. The German survey was stratified according to gender and age to achieve representative responses from citizens and therefore did not need to be weighted for these variables. Furthermore, we ensured a wide spread of the survey sample in terms of income, education, and region. Attempts at weighting it regarding the income of survey participants were not possible due to lack of access to nationally representative data for this variable. The Dutch survey was weighted regarding gender, age, household income, working status, and region. National statistics were used from the Dutch Central Bureau of Statistic (https://www.cbs.nl/en-gb). The UK survey was weighted to be in line with population statistics regarding gender, age, region, working status and social grade. Population statistics were derived from the Office for National Statistics (https://www.ons.gov.uk). Italy has a much lower proportion of internet users, 66% compared to around 90% in the other three countries (http://data.un.org). Thus, in addition to gender, age, region, working status and household income, the data of the Italian survey was also weighted by Facebook and smartphone use as there was a risk of bias towards internet users. National information about demographic statistics was used from the Italian National Institute of Statistics (http://www.istat.it/en), and information of Facebook and smartphone use was taken from a recent *We Are Social* survey on internet and social media use across the world (Kemp, 2017).

3.4. Data analysis

The quantitative analysis of all surveys was carried out using IBM SPSS Statistics 23. Tables and figures were created in Microsoft Excel. The analysis involved calculation of frequencies regarding all questions. To test for differences between the countries, various significance tests were used depending on the level of measurement. Chi-Square tests were used for categorical variables and Kruskal-Wallis tests for ordinal variables. Kruskal-Wallis test is a non-parametric test for independent samples with more than two groups. Because of the multiple-comparison problem the Bonferroni correction ($\alpha' = 1 - (1-\alpha)1/k$) was used to control for the increased type I errors. The original significance level of 0.05 was reduced to 0.0015. Figures are used to display results across countries. In order to present results comprehensible, figures simplify responses to the three rating scale questions. The combined results consider that sample size is much lower in Germany (1069) than in Italy, Netherlands and UK (2001, 2001, and 2000, respectively) so each country's results were determined in equal measure. Additionally, gender (categories: female, male) and age (categories: 18–24, 25–34, 35–44, 45–54, 55–64, 65 +) were used to perform subgroup analysis.

Our open question "Please provide any additional details of your experience of using social media in emergencies or what might encourage you to do so in future" (Q9) provided several interesting results. We used open coding (Strauss and Corbin, 1998) by developing codes abductively, performing a qualitative data analysis (Hickey and Kipping, 1996). Codes were derived from thorough reading of answers to open-ended questions as well as from code categories grasping our research interest. Throughout the coding process, codes were jointly defined and checked. Each open-ended response was then assigned to one or multiple categories to achieve an overview of the relevant topics. For each country, the code categories *experience, perceived barriers*, and *assessed advantages* were used, the two latter aggregating any codes connotating social media characteristics combined with negatively and positively associated signifiers, respectively, while the former term includes usage-related phrases with respect to frequency and diversity of use; thus, all of the three categories constitute end results of an open process, aiming at offering insights with respect to our research questions. While regarding the Netherlands, the UK and Italy, conditions of use, reflecting perceived barriers, could be made out, German participants did not formulate demands for improvements but still presented skeptic attitudes. The three code categories were derived from 21 codes in total (see Table 2). Codes of both the category of *perceived barriers* as well as *advantages* constitute indicators for the independent variables

[1] https://www.opinium.co.uk/case_study/london-school-of-economics/
[2] https://gapfish.com/gapfish-is-again-iso-certified/

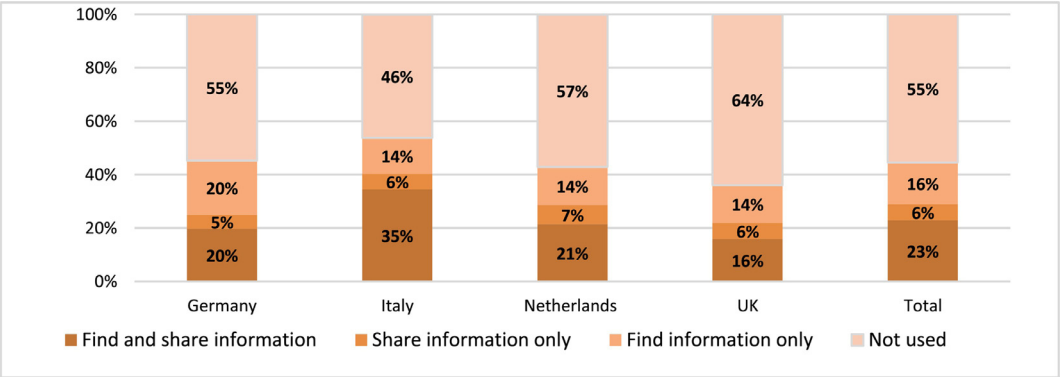

Fig. 1. Use of social media during an emergency (Q2) (note: $N = 6723$ (excluding 348 participants choosing 'Don't know/Can't remember').

trust and *framing*, respectively. *Experience* as a code category serves as an indicator for the dependent variable of social media use in emergencies (see Table 1). In all surveys, a few responses were unusable or incomprehensible. The previously acquired knowledge from the literature review and quantitative analysis was used to increase analytical sensitivity. Each quotation is referenced with the participants' response identifier.

4. Results

This section reports the quantitative and qualitative findings from four representative online surveys, exploring citizens' attitudes towards and use of social media in emergencies, conducted in four European countries ($N = 7071$): Germany, Italy, the Netherlands and the UK.

4.1. Finding/sharing information on social media during emergencies

Analysis of the survey showed that almost half (45%) of citizens across the four countries have used social media during an emergency. However, as can be seen in Fig. 1, there are significant differences in the level of use across the four countries.[3] Italy represents the country with the highest proportion of citizens that have used social media during an emergency. More than half of the Italian population (54%) had used social media during emergencies; 41% used it to share information. Qualitative analysis revealed that not only Italian but participants from all four countries assessed independent of their cultural background the flow of information as advantageous. Further, improved communication, and up-to-date and immediate transfer of news were rated as positive features of social media use, traditional media being a point of reference. German and Dutch participants pointed out to social media as an alternative in comparison to overloaded phone networks while the latter group also thought of preventing such a situation. German participants raised awareness regarding the prevention of panics by emergency services' monitoring via social media; Italian participants named prevention as advantageous as well. Only British participants did not refer to prevention. Furthermore, the lowest usage is reported in the UK, where only 36% of citizens had used it in the past to share and/or to find out information about an emergency. This is backed by qualitative analysis of answers of the open-ended question. UK participants revealed to be most inexperienced regarding social media use in emergencies (54%) followed by Germany (46%) while the Netherlands (22%) and Italy (12%) have considerably less respondents who do not use social media, do not have a smartphone or have never experienced an emergency. UK respondents' answers did not suggest any explicit interest or opinion with respect to (future) use of social media during emergencies. Some Italian participants pointed out that the thought of using social media during an emergency had just not occurred, not necessarily indicating that they were generally reluctant to use it.

4.2. Types of information shared

Across all countries, citizens are most likely to share weather conditions or warnings via social media in emergencies (Fig. 2). This is especially the case in Germany, where nearly two-thirds (63%) chose to do so. In contrast, only 33% of citizens in the Netherlands have shared this type of information. The second most likely information to share is feelings or emotions. Nearly half of German participants (46%) have shared feelings or emotions and 31% of British citizens have shared this type of information. Another noticeable finding is that the proportion of Italians who have shared photos or videos (40% and 38%) is considerably higher than for citizens across the four countries overall. Significant differences between the four countries were found for all types of information.[4]

4.3. Barriers to use social media during emergencies

The majority of citizens across countries had not shared information during an emergency but either only used social media to find information or not been active on them at all. They might had done this deliberately or they may not have had the possibility or need to use social media during an emergency. Therefore, it may prove substantial to track down barriers keeping people from using social media during emergencies. Fig. 3 displays the main reasons why citizens would rather not use social media during an emergency.

Reasons include concerns about credibility of social media content (such as false rumors or that information on social media are not reliable), technical concerns (that social media might not work in an emergency), as well as data privacy concerns, low confidence regarding one's own ability to use social media, and the opinion that it is better to make an emergency phone call than to use social media. Across all

[3] ($\chi^2(9, N = 6723) = 239.57$, $p < 0.001$, Cramer's V = 0.11)

[4] weather conditions or warnings: $\chi^2(3, N = 1983) = 70.07$, $p < 0.001$, Cramer's V = 0.188; Road and traffic conditions: $\chi^2(3, N = 1982) = 97.91$, $p < 0.001$, Cramer's V = 0.222; Your feelings or emotions about what was happening: $\chi^2(3, N = 1982) = 21.43$, $p < 0.001$, Cramer's V = 0.104; What actions you were taking to stay safe: $\chi^2(3, N = 1981) = 20.72$, $p < 0.001$, Cramer's V = 0.102; An eyewitness description of something you experienced: $\chi^2(3, N = 1981) = 32.13$, $p < 0.001$, Cramer's V = 0.127; An eyewitness photo: $\chi^2(3, N = 1983) = 183.84$, $p < 0.001$, Cramer's V = 0.304; A video: $\chi^2(3, N = 1983) = 76.01$, $p < 0.001$, Cramer's V = 0.196; Other: $\chi^2(3, N = 1983) = 22.41$, $p < 0.001$, Cramer's V = 0.106), besides 'Reassurance that you are safe' ($\chi^2(3, N = 1982) = 7.01$, $p = 0.072$, Cramer's V = 0.059), 'Your location' ($\chi^2(3, N = 1981) = 10.71$, $p = 0.013$, Cramer's V = 0.074) and 'Advice about what actions others should take to stay safe' ($\chi^2(3, N = 1983) = 4.23$, $p = 0.237$, Cramer's V = 0.046).

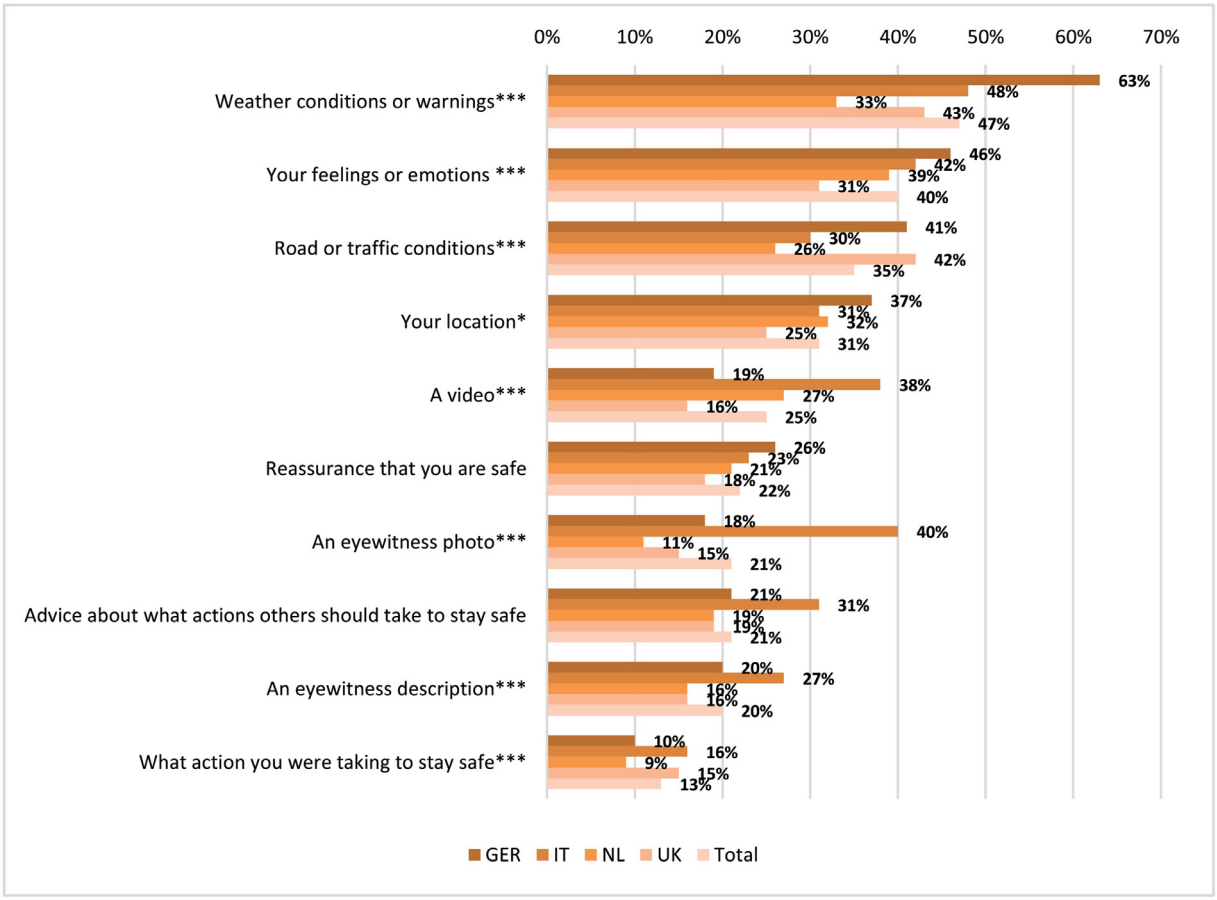

Fig. 2. Types of information shared (Q3) (note. $N = 1983$, *** indicates $p < 0.001$, ** $p < 0.01$ and * $p < 0.05$.)

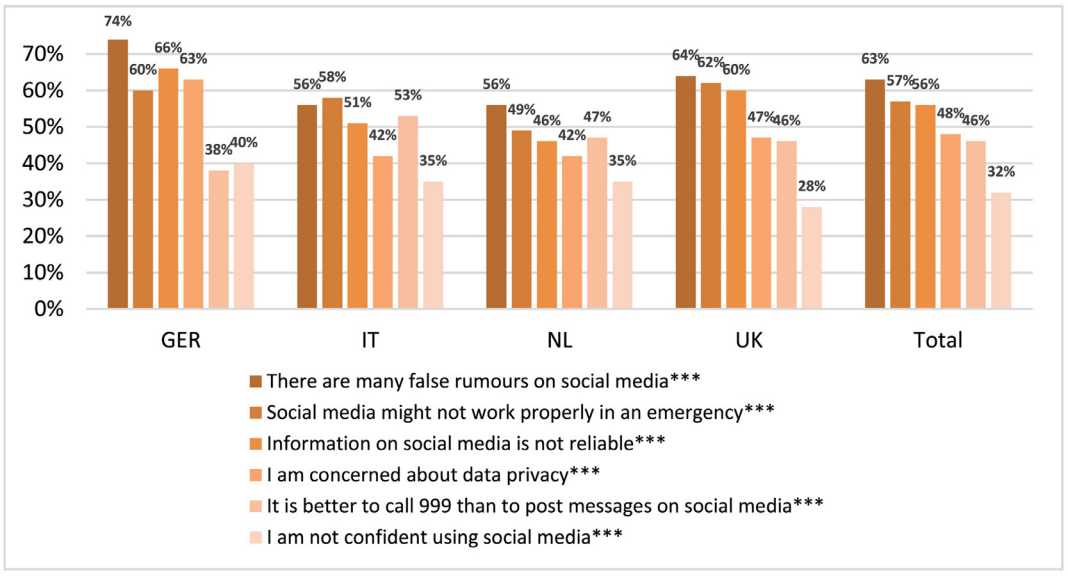

Fig. 3. Reasons for not using social media during an emergency (Q5; this would [definitely] put me off). Note. $N = 7071$, *** indicates $p < 0.001$.

countries, the biggest concern of citizens is that there are many false rumors on social media (63%). This fear is not unjustified as in the aftermath of the May 2017 Manchester suicide bombing photos of supposedly missing people were posted on social media (Prospect Magazine, 2017) or regarding the 2016 Brussels bombing where photos of another attack were shared. This is particularly a concern for German citizens, with 74% indicating that false rumors might put them off using social media during an emergency.[5] The second biggest concern (57% of citizens overall) related to technical issues of using social media in emergencies. Only Dutch citizens seem to be less worried with 49% expressing doubt of functionality as a reason for not using social media

[5] ($\chi^2(3) = 156.62$, $p < 0.001$)

in an emergency.[6] Answers to the open-ended questions were mostly supportive of statistical distributions. British, Dutch and Italian participants often stated that they would use social media in emergencies but only under certain conditions. Many Italians (20%) mentioned several conditions making the use of social media more likely. Dutch people (12%) do not generally reject usage of social media in emergencies but still have some concerns, e.g., with respect to data security, reliability, and the flood of information. If these aspects were improved, they would consider using social media in emergency situations. British participants perceived social media use during time-critical situations only to be necessary "if it was quicker than 999" or "if it was the only way to contact […]" (#630). Several Dutch respondents (16%) reject the use of social media in dangerous situations as they prefer traditional media or do not trust social networks regarding efficiency. German (11%), British (9%) and Italian (8%) respondents also expressed various doubts about social media use but less than the Dutch.

4.4. Expected responsiveness of emergency services

Considering the importance of citizens' willingness to cooperate with authorities during emergencies, it is reasonable to ask whether there are specific expectations towards emergency services with respect to potential use of communicated data or responses to any requests. The survey showed that there is considerable variation between citizens' attitudes in the four countries (Fig. 4). More than two-thirds of German citizens expect their emergency services to regularly monitor social media while in the UK only 37% of citizens share this expectation.[7] Similarly, while 60% of Italian citizens think that emergency services should reply to any request for help sent via social media within an hour, in the UK the proportion was only 30%.[8] This, combined with findings reported above, indicates that at the time of the survey most citizens in UK did not expect emergency services to access information shared with them or others during an emergency, contrasting with the other countries' respective results.

4.5. Downloading and using emergency apps

The survey shows that the use of relevant apps during emergencies is still in its infancy in most European countries – except for the Netherlands where 28% of citizens had downloaded such an app (Q6). In contrast, only 7% of citizens in the UK, and 16% in Germany and Italy had done so.[9] There are several types of apps that could be helpful during an emergency, e.g., weather, warning, first aid and emergency call apps. Across all countries, weather apps (52%) were the most popular apps citizens had downloaded. This proportion was especially high in Germany (69%) and lowest in UK with 44%.[10] In the Netherlands warning apps were most common with 53% having downloaded such an app, with an average across all four countries of 42%.[11] Downloading of emergency calls apps was more common in Italy (33%) and the UK (28%) than in the Netherlands (18%) and Germany (16%).[12] Only the proportion of citizens that had downloaded a First Aid app did not vary significantly between the countries.[13]

There is a significant relationship between downloading an app and gender (towards male participants[14]), and age (towards younger participants[15]). Only 8% of the oldest age group (65 +) had downloaded an app while 23% of those younger than 25 had done so.

Although most citizens across the four countries had not downloaded an emergency app, a larger proportion of respondents indicated that they were likely to use such an app in the future. Citizens of all countries thought that they would most likely use such an app in the future to receive emergency warnings. As can be seen in Fig. 5, around 60% of citizens in Germany, Italy and the Netherlands stated that they would use an emergency app for this purpose in the future, whereas in the UK the proportion was considerably lower (39%).[16] Differences between the countries were also found for all other reasons.[17] The least popular reason for using an app in the future is to contact an emergency service. In the UK, only 21% would use an app for this purpose while in Italy 50% said they would do so.

5. Discussion and conclusion

Our surveys with 7071 participants from Germany, Italy, the Netherlands and the UK showed that almost half (45%) of citizens across the four countries have used social media during an emergency. We visualized the results of the statistical analysis (see Appendix: overview of survey results). The main results are interpreted and discussed referring to the framework of risk cultures. Table 1 gives an overview of the four countries in comparison, presenting configurations of risk culture and variations in use of social media in emergencies.

5.1. Interpretation of main results

The interpretation of main results is structured by our research questions. Here, it is not only possible to present relevant findings but also to reflect upon limitations of the theoretical framework, thereby pointing out to potentials of future research.

5.1.1. How do citizens use social media during emergencies (R1)?

Twenty-three percent in total use social media both to find out and share information, with Italy (35%) having the largest proportion in comparison and the UK (16%) presenting the smallest share. Italy, being the forerunner of social media use during emergencies but usually depicted as a fatalistic risk culture indicating little individual action (Cornia et al., 2016), seems to undertake a social change towards an individualistic risk culture, pushed by relatively frequent occurrences of emergencies, which may affect communities collectively (Benessia and De Marchi, 2017; Mysiak et al., 2013; Schelfaut et al., 2011).

Regarding the types of shared information, weather conditions or warnings are most likely to be shared as well as feelings or emotions across the four countries, with the Netherlands and the UK sharing less often respective information while Germany (regarding weather-related content) and especially Italy were more active. Note that behavior of German respondents may be explained by occurrences of a specific kind of emergency happening (e.g., thunderstorms) and otherwise low incentives of state-oriented participants. Again, Italy may have experienced more large-scale emergencies (e.g., floods, earthquakes and avalanches) preceding the timing of this survey, making inefficiency of conventional management structures obvious (Schelfaut et al., 2011). There is no coherent explanation based on the risk culture approach when it comes to the low percentages of Dutch participants sharing videos or eyewitness pictures. Yet, it might be worth to consider that in the light of already effective conventional disaster management

[6] ($\chi^2(3) = 111.15$, $p < 0.001$)
[7] ($\chi^2(3) = 462.21$, $p < 0.001$)
[8] ($\chi^2(3) = 391.49$, $p < 0.001$)
[9] ($\chi^2(6, N = 7071) = 406.11$, $p < 0.001$, Cramer's V = 0.17)
[10] ($\chi^2(3, N = 1065) = 29.38$, $p < 0.001$, Cramer's V = 0.159)
[11] ($\chi^2(3, N = 1067) = 23.63$, $p < 0.001$, Cramer's V = 0.142)
[12] ($\chi^2(3, N = 1066) = 30.29$, $p < 0.001$, Cramer's V = 0.161)
[13] ($\chi^2(3, N = 1065) = 6.84$, $p = 0.077$, Cramer's V = 0.077)
[14] ($\chi^2(2, N = 7071) = 23.95$, $p < 0.001$, Cramer's V = 0.058)
[15] ($\chi^2(10, N = 7070) = 272.64$, $p < 0.001$, Cramer's V = 0.14)
[16] ($\chi^2(3) = 514.44$, $p < 0.001$)
[17] ('find out information about the emergency': $\chi^2(3) = 381.54$, $p < 0.001$; 'receive tips about how to stay safe': $\chi^2(3) = 367.37$, $p < 0.001$; 'connect with other citizens to help others affected by the emergency': $\chi^2(3) = 447.00$, $p < 0.001$; 'contact an emergency service instead of making a 999 call': $\chi^2(3) = 417.40$, $p < 0.001$; 'share information about the emergency with an emergency service': $\chi^2(3) = 345.83$, $p < 0.001$)

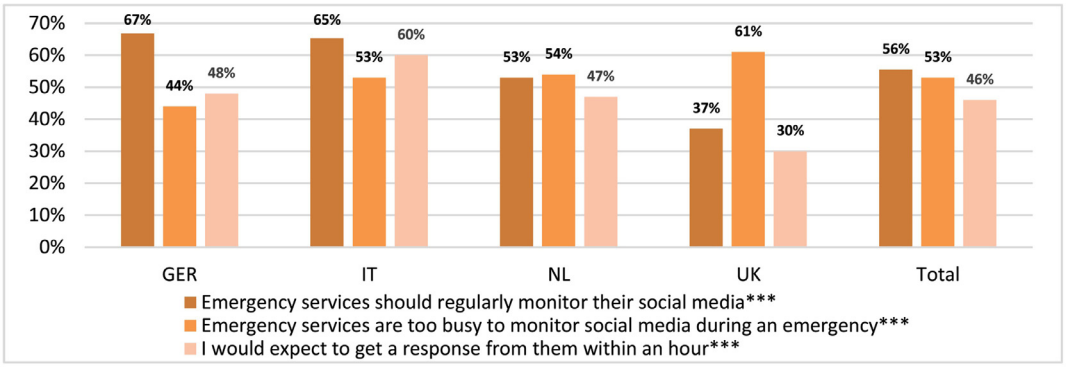

Fig. 4. Expected responsiveness of emergency services to messages posted via social media (Q4; strongly agree, agree) note. $N = 7071$, *** indicates $p < 0.001$.

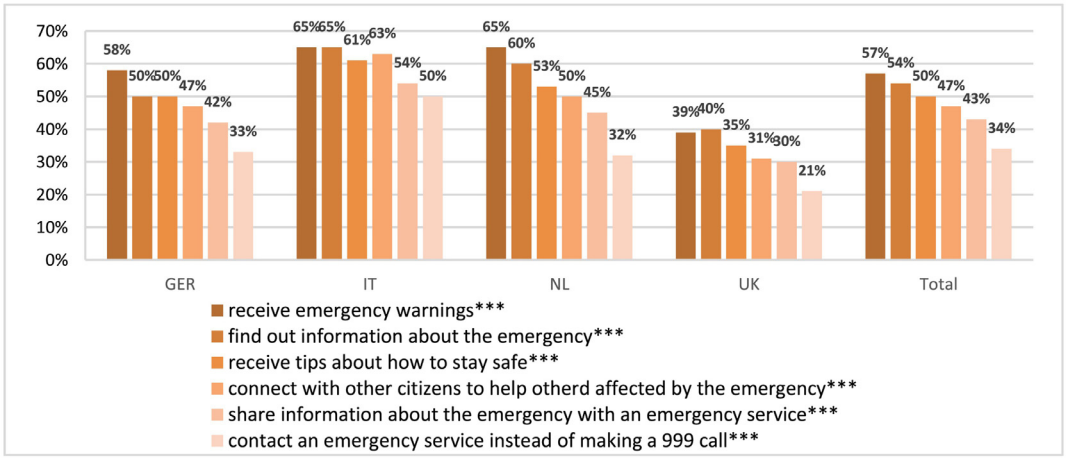

Fig. 5. Likelihood of using an app in the future for different purposes (Q8; very likely, quite likely) note. $N = 7071$, *** indicates $p < 0.001$, ** $p < 0.01$ and * $p < 0.05$.

structures, Dutch citizens do not perceive expanded usage of social media to be necessary (Wachinger et al., 2013; Kievik and Gutteling, 2011). When reflecting on (overall) UK results, it is suggested that self-reliant activity via social media are blocked by a similar, yet rather pessimistic perception. This is backed by qualitative results regarding the open-ended question with British participants pointing out to non-confidence and social media communication being unnecessary.

In sum, there are significant relationships with age[18] and gender[19] regarding attitudes and behavior, independent from national and cultural context. Across all countries and respective risk cultures, younger people were more likely to have used social media during an emergency. Only 28% of the youngest age group (below 25) have not used social media during an emergency whereas 77% of those aged 65 or older have not used it. Similarly, women are significantly more likely to have used social media in an emergency (47%) than men (42%), independent from their home location. As age and gender is distributed equally across the four countries, these factors apply for similar cross-national behavior.

5.1.2. What are citizens' expectations towards emergency services (R2)?

On the one hand, emergency services are clearly expected to monitor social media by 56%, which is mostly expected by Germans (67%) and Italians (66%). Moreover, they are expected to respond within an hour by 46% in total and in a high proportion by Italians (60%). These two points correlate significantly. On the other hand, they are perceived as too busy to monitor social media by 54% in total, especially by British respondents (62%).

Low expectations of the British may be explained by ranking social media communication of emergency services low on their list of priorities, i.e., by evolving disinterest or fatalism. At the same time, low percentages regarding the need of social media monitoring by emergency services may point out to a more individualistic risk culture with less accounting responsibilities to state actors (Cornia et al., 2016). Grand expectations of German emergency services match the state-oriented risk culture as well as Italy's strong focus on state responsibilities despite mistrust towards authorities (Cornia et al., 2016). The latter is stressed by Italian respondents referring to the state's responsibility to control communication via social media according to privacy rights, reliability and validity when answering the open-ended question. The Netherlands pose again a coherent example for an individualistic, self-reliant risk culture with comparatively lower expectations towards authorities (Cornia et al., 2016).

5.1.3. What are citizens' perceived main barriers of social media during emergencies (R3)?

Main barriers of using social media mentioned are false rumors by 63% in total, with Germans (74%) and British (64%) being most skeptical; unreliable information by 56% in total, representing a similar distribution of skepticism by Germans (66%) and British (60%); data privacy by 48% in total, largely by Germans (62%); and the possibility that social media might not work properly in an emergency by 57% whereby Dutch (49%) indicated the least skepticism.

Germany's trust in state authorities as well as towards traditional mass media is reflected by the highest distrust regarding information spread via social media, comparing among the countries and the

[18] ($\chi^2(15, N = 6724) = 967.32$, $p < 0.001$, Cramer's V = 0.22)
[19] ($\chi^2(3, N = 6724) = 18.88$, $p < 0.001$, Cramer's V = 0.053)

respective risk cultures. As the state is regarded to be the central actor (Cornia et al., 2016), it is persuasive that in the light of social media being dominated by non-state actors and a relatively great number of sources which are not credited or used as references by state actors, including private individuals spreading information, Germans perceive social media to be unreliable in a strong way. This also points out to the UK having similarly high trust issues (i.e., false rumors or data privacy). The UK results surprise, having in mind the country's neoliberal turn as well as diverse use of smartphones in the British population's everyday lives (Fortunati and Taipale, 2014). The Netherlands, with an individualistic understanding of risk management and lower expectations towards state actors are more likely to trust corporate and individual sources. The numbers again suggest a change of Italy's risk culture from fatalistic to individualistic.

However, two results are striking. Aware of Italy's comparatively disappointing management structures (Alpaslan and Gianni, 2012; Mysiak et al., 2013) which led to the establishment of a fatalistic risk culture, having mistrust towards state institutions, blaming them in cases of mismanagement while feeling individually powerless (Cornia et al., 2016), it is interesting that Italian participants rated highest regarding the statement of rather calling emergency phone numbers than communicating via social media. The respective number was lower across all other countries, with Germany showing the lowest percentage. Second, it should be noted that privacy concerns are high regardless of risk culture; thus, further elaboration and analysis of populations' attitudes towards social media (companies) may be useful. Regarding responses to the open-ended question which were qualitatively analyzed, perceived barriers like privacy issues, usability, as well as assessed benefits like effective information flow, immediate communication, were named across all four countries, independent from risk culture or disruptive incidents. This suggests factors like human-computer interaction, habits, and perception of media (social vs. traditional) to be helpful in explaining the choice of similar parameters of evaluation when it comes to social media use during emergencies.

5.1.4. What are citizens' attitudes towards mobile emergency apps (R4)?

They are only used by 17% in total, but in larger proportions in the Netherlands (28%), with a significant relationship with gender towards male participants, and age towards younger participants. The most downloaded apps are weather apps by 42% in total, mostly by Germans (69%), and warning or alert apps by 42% in total with a visibly higher proportion in the Netherlands (33%). For future use, the most likely opportunities mentioned (for details see (Reuter and Spielhofer, 2017)) were receiving emergency warnings by 57% in total, UK (39%) having the least expectations, and tips about how to stay safe by 50% in total, whereby Italians (61%) expressed the highest expectations. Finally, finding out information about the emergency was mentioned by 54% in total.

The individualistic nature of the Dutch risk culture can explain the proactive measure of downloading emergency apps. Further analysis of decisive factors regarding the choice of specific app categories needs to be done as it is not sure whether the types of emergencies have influenced the choices of app categories, with German participants having downloaded weather apps significantly more than British respondents. Referring to their individualistic risk culture, Dutch behavior can only partly be explained, noting that the frequency of downloading warning apps was considerably higher than of emergency call apps when comparing.

Across countries, rankings for reasons to use respective apps in the future were nearly identical. Still, Italy's comparatively high ranking of justifying future use with reference to social connections which might prove helpful to others contrasts with the other countries' results. The latter may be due to their relative collectivist nature (Bontempo et al., 1997; Gierlach et al., 2010; Statman, 2008). A collectivist nature, compared to the Netherlands and the UK (Statman, 2008), became also prevalent regarding German participants' relatively higher interest in sharing information, as answers to the open-ended question suggested. Greater willingness among Italians of using emergency apps prospectively does not surprise keeping in mind changing attitudes towards more individual engagement. Still having a strong sense of blaming state authorities, 50% of Italian participants potentially prefer contacting services via emergency apps over phone calls, contradicted by highest results when it comes to favoring calling emergencies via telephone instead of using social media (cf. main barriers). This suggests that participants may have divergent attitudes towards social media and emergency apps.

5.2. Relevant characteristics and implications

An analysis of the four European countries revealed several interesting findings which may prove fruitful not only for the scientific debate but also regarding the implementation of emergency management structures via social media. Especially with respect to citizens' expectations towards authorities' monitoring (R2) and attitudes towards the use of mobile emergency apps (R4) our findings match with prior research referring to risk cultures (Cornia et al., 2016; Dressel and Pfeil, 2017). Furthermore, intensity of perceived barriers (R3) varies according to risk culture, with German participants being more skeptical about (citizen-generated) social media content (Reuter and Spielhofer, 2017). Yet, current risk culture approaches exclude frequency and types of emergencies as contextual factors even though both variables may have an impact on citizens' perception of the respective efficacy of management structures (R1).

Our findings suggest Italian citizens to rely relatively strongly on social media which may be due to frequency of disruptive events affecting a larger proportion of the collective (e.g., natural disasters). Departing from a rather fatalistic risk culture, as framed in prior work (Dressel, 2015; Dressel and Pfeil, 2017), thus, showing signs of readiness regarding individual action, Italian participants seem to be open towards an improvement of authorities' monitoring of emergencies via social media. This implies that in practice social media use in emergencies should be especially useful to populations potentially relying on it due to strongly perceived need of improving management structures.

Contrasting answers were given by British respondents who had used social media less frequent in emergencies, were above-average skeptical towards it and perceived (future) use rather unnecessary. As the UK has not been classified as a specific model of risk culture, our findings may contribute to this process by pointing out to an evolving fatalistic attitude towards disruptive events.

Regarding more specific actions of social media use, a small part of it could be interpreted to be of either collectivistic or individualistic nature, following the traditional division of such approaches (OECD., 2018a; Reuter et al., 2016). Yet, our analysis made clear that common assumptions of risk cultures fail to incorporate for example concrete content-sharing behavior into their theories.

Age was shown to be strongly correlated with the use of social media during emergencies[20] and the availability of an emergency app[21] as indicated by large effect sizes. Apart from age, gender correlated with some of the answers. These categories are distributed equally across the four countries, thus, applying for similar attitudes and behavior. Especially habitual use of social media by younger people should be taken into consideration when managing emergencies as well as less frequent use by older generations by aiming for addressing them sufficiently through “multimodal warnings” and tighter linkages between public authorities, press, and social media, keeping in mind growing ageing populations (Righi et al., 2017; Wendling et al., 2013).

Focusing on risk culture-specific use of social media yields relevant consequences. It sheds light on the importance to factor cultural

[20] (Q2, $\chi^2(15, N = 6724) = 967.32$, $p < 0.001$, Cramer's V = 0.22)
[21] (Q6, $\chi^2(10, N = 7070) = 272.64$, $p < 0.001$, Cramer's V = 0.14)

embeddedness into an understanding of risk perception, individuals' actions as well as emergency and disaster management procedures. Our work suggests this context, created through specific ways of framing, trust, and blaming, not to be restricted to the offline world. Crisis informatics focuses on the potential of interactive systems in times of disruptive events; this paper tries to grasp individuals' perceptions and behaviors, both influencing cooperation efforts. As other scholars insist (Alexander, 2014; Lo and Chan, 2017; White, 2011), incorporating social media into emergency management implies various advantages with respect to collaborative work. At the same time, it is necessary in times of frequent use of social media, especially when expectations towards authorities are high and fatalism in risk perception is evolving (Lo and Chan, 2017; Wendling et al., 2013). Additionally, examining risk cultures, respective perceptions and behavior during emergencies may prove useful in light of disaster management in countries facing rather more than less climate change enhanced hazards in the nearest future (Lo and Chan, 2017).

Our work allows for deriving policy implications focusing on crisis communication. Generally, we follow Dressel et al. (Dressel and Pfeil, 2017) by supporting the view of the need to center individuals' attention in state-oriented risk cultures on potentially helpful proactiveness while individuals embedded in individualistic risk cultures should be assured of state authorities' responsiveness to avoid fatalistic tendencies. Crisis communication in fatalistic risk cultures should work in both directions while a framing of emergencies as un-manageable incidents and failure of foresight at its initial stage may be omitted or counteracted, respectively (Constantinides, 2013). Our focus on social media behavior opens further possibilities, pointing out to the necessity of authorities to present themselves to be approachable and efficient via social media. Our findings on perceived barriers stress the importance of transparency, reduction of rumors, and privacy in risk and crisis communication, supporting other research (Wendling et al., 2013). One may also keep in mind that certain kinds of emergency apps may be more helpful in some contexts than in others. Crisis communication agendas may also include optimizing communication to the population about reliability of social media correspondence, enhancing trust regarding cooperation between citizens and authorities and offering information which may prove necessary.

5.3. Limitations and outlook

Of course, this study has limitations. The online survey's results might be biased due to possible self-selection of volunteering individuals. Our findings are based on individuals' answers and not observation of actual behavior. However, citizens' perceptions were our focus and, as such, the study provides valuable results, not at least with respect to potential further implementation of management structures via social media, a process relying on the respective addressees' attitudes. Depending on the type of smartphone used, it may have been perceived necessary to download weather apps for general use and the multiple-choice questionnaire might have pre-limited the choice of answers of the open-ended question. We restricted our study to four cases, controlling various variables while focusing on risk culture induced divergences. Future research may complement our work by including other (European) countries. The validity of the findings' interpretation is limited due to rough and non-examination of actual frequency of (certain types of) emergencies as well as conventional and digital implemented risk management structures, respectively. Nevertheless, taking frequency and types of emergencies as influencing factors into account poses a starting point for future research. Our choice to restrict cultural spaces along national borders may be complemented by regional, sub-national studies, which may, for example, represent earthquake-prone communities, locations close to the sea or metropolitan areas with a higher risk of human-induced emergencies. Such comparisons of different emergency contexts may reveal a respective effect regarding behavior. Analysis on state-level may still prove inadequate, as a comparison between respondents from Bavaria and North Rhine-Westphalia reveals no significant results.[22] As we proposed British passive behavior towards social media use in emergencies and skepticism towards authorities' performance, it is certainly interesting to examine the UK populations' culture of dealing with risks more accurately. Adapting the framework of risk cultures to social media and offering an interpretation of variances of use of social media in situations of emergency, we proposed an argument regarding the frequency of use, and implicitly the diversity of usage patterns. Future research may engage with findings of the media sciences and psychology regarding human-computer interaction, perceptions of social (vs. traditional) media and habits, thereby grasping cross-cultural similarities of behavior and attitudes as well as diverging behavior when it comes to specific actions taken via social media. We offer first insights into social media use during emergencies from a risk culture perspective; in future work, it may prove valuable, especially with respect to the design of emergency apps, to focus on specific settings of emergencies. Further, as we chose to dichotomize originally Likert-scaled answers to simplify the interpretation, it may prove fruitful to have a more nuanced look at participants who opted for “extreme” answers, their risk culture as well as other potential factors.

Regarding the risk culture framework, future research could examine in which way ICT, such as social media and mobile emergency apps, potentially support citizens from two perspectives. Firstly, since it is a desirable condition that both authorities and citizens are prepared for emergencies, ICT might assist in (1) *complementing the weaknesses* of specific risk cultures. Thus, state-oriented risk cultures should be supported in terms of individual proactive behavior and individual-oriented risk cultures assured of their authorities' capabilities and responsibilities, while fatalistic risk cultures potentially benefit from both approaches. Secondly, ICT might support in (2) *utilizing the strengths* of specific risk cultures. Since trust in authorities is high in state-oriented risk cultures, citizens expect authorities to communicate, or *push*, emergency-relevant information, i.e., by disseminating accurate and relevant information across different channels. On the other hand, individual-oriented risk cultures, which emphasize citizens' responsibilities, should be provided with information resources that they can use, or *pull*, on demand, i.e., by providing relevant information on how to behave before, during and after emergencies via emergency crisis apps. Although both ways cannot be considered as strengths of a fatalistic risk culture, our results on Italians' use and intended future use of social media and mobile emergency apps suggest a change from fatalistic to individual-oriented risk culture, making it worthwhile to examine the transformative potential of ICT on risk culture in future studies.

Acknowledgements

This research project ‘EmerGent’ was funded by a grant of the European Union (FP7 No. 608352). A study solely based on the German sample has already been accepted for publication (Reuter et al., 2017) as well as a study of authorities' attitudes regarding the subject matter (Reuter et al., 2016), focusing on another important group of actors. The former case study (a) uses a much smaller dataset (1,069 instead of 7,071), (b) is not of comparative nature, (c) does not apply the risk

[22] There was no statistically significant difference of the use (i.e., share/find info) of social media during emergencies between respondents living in Bavaria and respondents living in NRW ($\chi 2$ (4, N = 257) = 3.361, $p > 0.05$). Only with respect to expectations towards emergencies, the test revealed significant correlations between answers and state ($p > 0.05$). Yet, the differences between the two states are very small. Bavaria was assumed to pose a more provincial state and NRW, as a highly densely populated area, a metropolitan region with potentially rather small-scale emergencies (in contrast to foregrounding natural disasters). Yet, the results indicate that observation on the state-level is still not accurate enough.

culture framework for analysis, and has, based on the pure consideration of one country, (d) a smaller possibility of generalization of the results.

Declaration of competing interest

None.

Appendix A. Overview of survey results

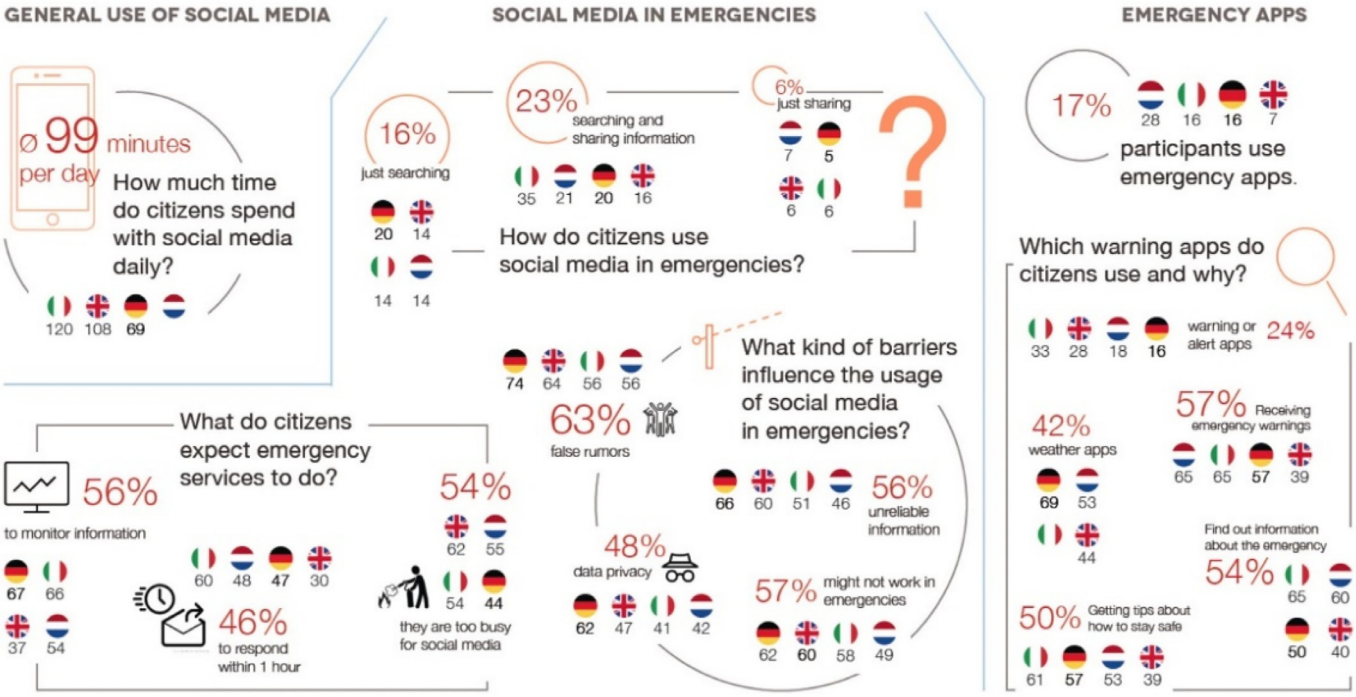

Fig. 6. Visualization of statistical results of European survey.

Appendix B. Configurations of risk culture and variations in use of social media

Table 1
Overview of the four countries in comparison (risk culture configuration and behavior).

	Risk culture			
	Configuration of variables	Indicators		
Germany (state-oriented risk culture)	*Framing*: generally manageable	Lack of confidence of using SM	40%	Highest
		Interest in future use		
		- To receive warnings	58%	Medium
		- Find out info	50%	Medium
		- Receive tips	50%	Medium
		- Connect	47%	Medium
		- Share info	42%	Medium
		Assessed advantages (cf. free answers): prevention		
	Trust: high	Skepticism of SM		
		- False rumors	74%	Strongest
		- Reliability	66%	Strongest
		- Data privacy	63%	Strongest
		- SM potentially not work	60%	Strong
		Criticism (free responses)	11%	Medium
		Authorities' time management		
		Too busy to monitor SM	44%	High
		To response within 1 h	48%	Medium
	Blaming: state	Authority expectations		
		Should monitor SM	67%	Highest
		Interest in future use		
		- To receive warnings	58%	Medium
		- Find out info	50%	Medium
		- Receive tips	50%	Medium
		- Connect	47%	Medium
		- Share info	42%	Medium

(*continued on next page*)

Table 1 (*continued*)

	Risk culture			
	Configuration of variables	Indicators		
Italy (individualistic, former fatalistic risk culture)	*Framing*: manageable with additional individual support	Lack of confidence of using SM	35%	Medium
		Interest in future use		
		- To receive warnings		
		- Find out info	65%	Highest
		- Receive tips	65%	Highest
		- Connect	61%	Highest
		- Share info, named explicitly in free answers	63%	Highest
		Assessed advantages (cf. free answers): prevention	54%	Highest
	Trust: low	Skepticism of SM		
		- False rumors	54%	Weakest
		- Reliability	51%	Weak
		- Data privacy	42%	Weakest
		- SM potentially not work	58%	Strong
		Criticism (free responses)	8%	Weakest
		Authorities' time management		
		Too busy to monitor SM	53%	Low
		To response within 1 h	60%	Highest
	Blaming: state, oneself & other individuals	Authority expectations		
		Should monitor SM	65%	High
		Interest in future use		
		- To receive warnings	65%	Highest
		- Find out info	65%	Highest
		- Receive tips	61%	Highest
		- Connect	63%	Highest
		- Share info, named explicitly in free answers	54%	Highest
The Netherlands (individualistic risk culture)	*Framing*: manageable with additional individual support	Lack of confidence of using SM	35%	Medium
		Interest in future use		
		- To receive warnings	65%	Highest
		- Find out info	60%	High
		- Receive tips	53%	Medium
		- Connect	53%	Medium
		- Share info	45%	Medium
		Assessed advantages (cf. free answers): prevention		
	Trust: medium	Skepticism of SM		
		- False rumors	54%	Weakest
		- Reliability	46%	Weakest
		- Data privacy	42%	Weakest
		- SM potentially not work	49%	Weakest
		Criticism (free responses)	16%	Strongest
		Authorities' time management		
		Too busy to monitor SM	54%	Low
		To response within 1 h	47%	Medium
	Blaming: state, oneself & other individuals	Authority expectations		
		Should monitor SM	53%	Medium
		Interest in future use		
		- To receive warnings	65%	Highest
		- Find out info	60%	High
		- Receive tips	53%	Medium
		- Connect	53%	Medium
		- Share info	45%	Medium

(*continued on next page*)

Table 1 (*continued*)

	Risk culture			
	Configuration of variables	Indicators		
United Kingdom (fatalistic risk culture)	*Framing*: potentially manageable, independent from individual actions	Lack of confidence of using SM	28%	Lowest
		Interest in future use		
		- To receive warnings	39%	Lowest
		- Find out info	40%	Lowest
		- Receive tips	35%	Lowest
		- Connect	31%	Lowest
		- Share info, not indicated in free answers	30%	Lowest
		Assessed advantages (cf. free answers): not naming prevention		
	Trust: medium	Skepticism of SM		
		- False rumors	64%	Strong
		- Reliability	60%	Strong
		- Data privacy	40%	Weakest
		- SM potentially not work	62%	Strong
		Criticism (free responses)	9%	Weak
		Authorities' time management		
		Too busy to monitor SM	61%	Lowest
		To response within 1 h	30%	Lowest
	Blaming: neither directly the state, oneself nor others	Authority expectations		
		Should monitor SM	37%	Lowest
		Interest in future use		
		- To receive warnings	39%	Lowest
		- Find out info	40%	Lowest
		- Receive tips	35%	Lowest
		- Connect	31%	Lowest
		- Share info, not indicated in free answers	30%	Lowest

	Social media (SM) use in emergencies			
	Var.	Indicators		
Germany (state-oriented risk culture)	Frequency: medium	Overall use	45%	Medium
		Inexperience (cf. free answers)	46%	High
		Find and share information	20%	Medium
		Share information only	5%	Medium
		Find information only	20%	Highest
		Download of emergency apps	16%	Medium
		Download of warning apps	42%	Medium
		Download of weather apps	69%	Highest
		Download of emerg. call apps	16%	Lowest
		Types of info shared:		
		- Weather cond.	63%	Highest
		- Feelings	46%	Highest
		- Location	37%	Highest
		- Reassurance of being safe	26%	Highest
		- Road/traffic cond.	41%	High
		- Advice	21%	Medium
		- Eyewitness description	20%	Medium
		- Video	19%	Low
		- Eyewitness photo	18%	Low
		- Actions taken to stay safe	10%	Low
Italy (individualistic, former fatalistic risk culture)	*Frequency*: high	Overall use	54%	Highest
		Inexperience (cf. free answers)	12%	Lowest
		Find and share information	35%	Highest
		Share information only	6%	Medium
		Find information only	14%	Low
		Download of emergency apps	16%	Medium
		Download of warning apps	39%	Medium
		Download of weather apps	50%	Medium
		Download of emerg. call apps	33%	Highest
		Types of info shared:		
		- Weather cond.	48%	Medium
		- Feelings	42%	Medium
		- Location	31%	Medium
		- Reassurance of being safe	23%	Medium
		- Road/traffic cond.	30%	Medium
		- Advice	31%	Highest
		- Eyewitness description	27%	Highest
		-Video	38%	Highest
		- Eyewitness photo	40%	Highest
		- Actions taken to stay safe	16%	Highest
The Netherlands (individualistic risk culture)	*Frequency*: medium	Overall use	43%	Medium

(*continued on next page*)

Table 1 (*continued*)

	Social media (SM) use in emergencies			
	Var.	Indicators		
		Inexperience (cf. free answers)	22%	Low
		Find and share information	21%	Medium
		Share information only	7%	Medium
		Find information only	14%	Low
		Download of emergency apps	28%	Highest
		Download of warning apps	53%	Highest
		Download of weather apps	46%	Medium
		Download of emerg. call apps	18%	Low
		Types of info shared:		
		- Weather cond.	33%	Lowest
		- Feelings	39%	Medium
		- Location	32%	Medium
		- Reassurance of being safe	21%	Medium
		- Road/traffic cond.	26%	Lowest
		- Advice	19%	Lowest
		- Eyewitness description	16%	Lowest
		-Video	27%	Medium
		- Eyewitness photo	11%	Lowest
		- Actions taken to stay safe	9%	Lowest
United Kingdom (fatalistic risk culture)	*Frequency*: low	Overall use	36%	Lowest
		Inexperience (cf. free answers)	54%	Highest
		Find and share information	16%	Lowest
		Share information only	6%	Medium
		Find information only	14%	Low
		Download of emergency apps	7%	Lowest
		Download of warning apps	36%	Lowest
		Download of weather apps	44%	Lowest
		Download of emerg. call apps	28%	High
		Types of info shared:		
		- Weather cond.	43%	Medium
		- Feelings	31%	Lowest
		- Location	25%	Lowest
		- Reassurance of being safe	18%	Lowest
		- Road/traffic cond.	42%	Highest
		- Advice	19%	Lowest
		- Eyewitness description	16%	Lowest
		-Video	16%	Lowest
		- Eyewitness photo	15%	Low
		- Actions taken to stay safe	15%	High

Appendix C. Code categories, codes and code examples

Table 2
Overview of the code categories, codes, and code examples (sub-codes are indicated by hierarchy).

Code category	Codes	Code examples
(1) Experience	(1.1) Frequency of general SM use	"none, I do not use social media"
	(1.2) Possession of smartphone	"I do not have a smartphone, and I will not get one. For this reason, I do not need social media, which I overall regard as superfluous as they only have very limitedly use for social development […]"
	(1.3) Experience of emergencies	"Not really needed to contact emergency services"
	(1.4) Specific applications	"I have shared a stolen bike alert which was found because of Facebook"
	(1.5) Ranges of application	"Social media is a great medium for snow reports."
(2) Perceived barriers	(2.1) Skepticism in general towards SM	"I am not interested in social media"
	(2.1.1) Rumors	"can amplify rumors and misinformation."
	(2.1.2) Unnecessary panic	"I always find the scale of a problem seems to be heightened by social media. People often get themselves in hysterics over something that may not bother them usually"
	(2.2) Skepticism especially towards SM use in emergencies	"I can't imagine using social media for an emergency"
	(2.2.1) Slowness	"I would be afraid that if I would share news myself, this does not spread quickly enough, even if it is really important."
	(2.2.1) Reliability	"I do not see it as a very reliable method especially in the event of a power failure."
	(2.2.1.1) Information flow	"Yes, perhaps in a situation where you need to know important information then I might look at social media but would not always trust it."
	(2.2.1.2) Data security	"I sometimes find social media unreliable. I often get hacked."
	(2.3) Conditions of use	"What would encourage me is if I knew the response rate would be adequate"
(3) Assessed advantages	(3.1) Immediacy	"Having information on where an emergency is going on helped me to deal with it promptly. The transition to social news is quicker and more immediate."
	(3.2) Productivity	"social media have greater reach and responsiveness than traditional media."
	(3.3) Improved communication	"On a local level you can act more intensely than via radio or TV […]. In case you're the one in danger, you may spread information, give an all-clear signal or delegate tasks via an app."
	(3.4) Panic prevention	"To prevent people coming into a dangerous situation"

(*continued on next page*)

Table 2 (*continued*)

Code category	Codes	Code examples
	(3.5) Information flow	"Having information on where an emergency is going on helped me to deal with it promptly."
	(3.6) Up-to-date	"social media shows multiple sides of an emergency situation, and comments and posts are posted almost every minute so you're always up-to-date."
	(3.7) No overload of phone network	"Sharing information is important to prevent overload from, for example, call centers."

Appendix D. Survey questions

Q1: Please indicate how often, on average, you do the following things (Hourly, Daily, At least once a week but less than daily, Less than once a week, Never): Use a smartphone (e.g., Android, iPhone or Windows)| Use Facebook| Use Twitter|Use some other types of social media (e.g., Instagram, YouTube, etc.)|Post messages on social media.

Q2: Have you ever used social media such as Facebook, Twitter, Instagram etc. to find out or share information in an emergency such as an accident, power cut, severe weather, flood or earthquake close to you? Yes, I have used it to find out and share information | Yes, I have used it just to share some information |Yes, I have used it just to find out some information|No, I have not used it in this way|Don't know/Can't remember.

Q3: What types of information did you share? (Select as many as apply) Weather conditions or warnings|Road or traffic conditions|Reassurance that you are safe | Your feelings or emotions about what was happening|Your location|What actions you were taking to stay safe | An eyewitness description of something you experienced|Advice about what actions others should take to stay safe|An eyewitness photo|A video|Other (please specify).

Q4: Imagine that you posted an urgent request for help or information on a social media site of a local emergency service, such as your local police, coastguard, fire or medical emergency service. To what extent do you agree with the following statements (Strongly agree, Agree, Neutral, Disagree, Strongly disagree) Emergency services should regularly monitor their social media|I would expect to get a response from them within an hour|Emergency services are too busy to monitor social media during an emergency.

Q5: What might put you off using social media during an emergency? (This would definitely put me off; Might put me off; Neutral; Would probably not put me off; Would definitely not put me off) Information on social media is not reliable|There are many false rumors on social media | I am concerned about data privacy|It is better to call 112 than to post messages on social media |I am not confident using social media|Social media might not work properly in an emergency.

Q6: Have you ever downloaded a smartphone app that could help in a disaster or emergency? (Yes; No; Do not know/Not sure).

Q7: What type of app did you download? A weather app | A warning app |A First Aid app |An emergency call app|An-other type of app (please specify).

Q8: Please indicate how likely you are in future to use a smartphone app for each of the following purposes as a result of an emergency? (Very likely, Quite likely, Neutral, Not very likely, Not at all likely). To receive emergency warnings| To receive tips about how to stay safe| To contact an emergency service instead of making a 112 call| To share information about the emergency with an emergency service| To find out information about the emergency|To connect with other citizens to help others affected by the emergency.

Q9: Please provide any additional details of your experience of using social media in emergencies or what might encourage you to do so in future.

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