

Social Media in Emergencies: A Representative Study on Citizens' Perception in Germany

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The value of social media in crises, disasters, and emergencies across different events (e.g. floods, storms, terroristic attacks), countries, and for heterogeneous participants (e.g. citizens, emergency services) is now well-attested. Existing work has examined the potentials and weaknesses of its use during specific events. Fewer studies, however, have focused on citizens' perceptions of social media in emergencies, and none have deployed a representative sample to examine this. We present the results of the first representative study on citizens' perception of social media in emergencies that we have conducted in Germany. Our study highlights, for example, that around half (45%) of people have used social media during an emergency to share and / or look for information. In contrast, false rumours on social media (74%) are perceived as a threat. Moreover, only a minority of people have downloaded a smartphone app for emergencies (16%), with the most popular ones' weather and first aid apps.

CCS Concepts: • **Human-centered Computing** → **Collaborative and Social Computing** → Empirical studies in collaborative and social computing

KEYWORDS

Social Media, Crisis, Emergency, Perception, Quantitative, Qualitative

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1. INTRODUCTION

Research into crisis management in Computer Supported Cooperative Work (CSCW) and Human Computer Interaction (HCI) has become more common as it has become evident that the work of professional bodies, volunteers and other organizations is increasingly mediated by computer technology and, more specifically, by the use of social media. A series of disasters and other crisis events have been examined in the light of this fact (e.g. [19,31,35,37]). Such events are of an eclectic, and to a degree unforeseeable, character. For example, the attack at the Christmas market in Berlin in December 2016, the shootings in and around the Olympia shopping mall in Munich in July 2016 or the attacks at the Champs-Élysées in France and in London in June 2017 were both shocking and largely unanticipated. However, also small occasions, such as a car accident, or a fire are emergencies that are considered in this context. The United Nations Department of Humanitarian Affairs define emergencies like those mentioned above as “[a] sudden and usually

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unforeseen event that calls for immediate measures to minimize its adverse consequences” [49]. Likewise, we will consider emergencies such as an accident, power cut, severe weather, flood or earthquake in this paper.

For our purposes, the use of social media in critical situations is especially interesting: Already after the 9/11 events in 2001, citizens were creating wikis to collect information about missing people [32], and FEMA and the Red Cross used web-based technologies to inform the public and to provide status reports internally and externally [17]. This burgeoning research field, sometimes summarised under the term *crisis informatics*, has revealed interesting and important real-world uses for the social media. Coined by Hagar [16], crisis informatics is “a multidisciplinary field combining computing and social science knowledge of disasters; its central tenet is that people use personal information and communication technology to respond to disasters in creative ways to cope with uncertainty” [31].

The so-called Web 2.0 [28] was initially defined, in fact, as an architecture for supporting new possibilities for social interaction. Over the years, this interaction has been increasingly defined in terms of social media as a “group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allows the creation and exchange of user-generated content” [22]. In this context, user-generated content refers to “the various forms of media content that are publicly available and created by end-users” [22]. Currently [in August 2017], the most common types include Facebook with about 2.0 billion active users monthly, WhatsApp (1.2 billion), YouTube (1 billion), Instagram (700 million), Twitter (328 million), and LinkedIn (106 million)¹.

Current research, e.g. during the last 5 years, in CSCW focuses on how (mobile) applications and technologies are capable of supporting authorities’ [2] and citizens’ [14] collaborative efforts before, during, and after crises or emergencies. In terms of social media, many available studies focus on the concrete use of social media during a specific emergency, such as the 2011 London riots [12], the 2012 hurricane Sandy [19], the 2013 European floods [37], or the 2014 Oso landslide [11]. These studies demonstrate the specific ways in which social media have responded to various crises. Across various studies of emergencies and disaster events, numerous positive and negative aspects of social media have been identified [3], and different groups of users’ contextually specific attitudes and behaviour have been studied [41]. Such qualitative studies provide for an in-depth approach to the practices of various parties in relation to specific events. The very fact of the eclectic nature of these events, however, means that generalisation about overall attitudes to social media use is difficult. Here, we provide data of a quantitative kind in order to complement the important qualitative work that has already been done, so as to provide a more general understanding of attitudinal tendencies with respect to how much social media are used, and for what purposes.

To this end, our study aims to research citizens’ perception of social media in emergencies with a view to some more generalised conclusions. The sample we engage with concentrates on the situation in Germany, and subsequently compares selected findings with a further survey in the UK. This paper contributes findings on the perception of social media use in the German population with a representative survey of 1,069 participants. Our findings show that social media is used in emergencies more to search for than to share; emergency services are clearly expected to monitor social media and to respond within an hour as well; the main barriers to use social media are rumours and unreliable information.

2. PERCEPTION OF THE USE OF SOCIAL MEDIA IN EMERGENCIES

During the last few years, several studies in HCI, CSCW, and other disciplines on social media use in emergencies have emerged [35]. The qualitative research we refer to, almost by definition, has focused on local practices and rather less on general attitudinal matters. In this paper, then, we explicitly focus on the findings of quantitative studies of perceptions of the use of social media in emergencies of which, hitherto, there have been relatively few.

¹ <https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/>

2.1 Citizens' Perception of Social Media

In particular, four quantitative studies examining attitudes and perceptions are worth mentioning. Firstly, a comparative study with over 1,000 participants was conducted by the Canadian Red Cross in 2012 [8]. This aimed to identify the extent to which Canadian citizens use social media and mobile devices in crisis communication and what they expect from the emergency services, both currently and in the future. Secondly, the American Red Cross [4] studied citizens' use of social media during emergencies, with 1,017 online and 1,018 telephone survey respondents in 2012. In the third study worth mentioning, Flizikowski et al. [15] presented a survey within Europe in 2014, conducted among citizens (n=317) and emergency services (n=130), which identified the opportunities and challenges of social media integration into crisis response management. Finally, Reuter and Spielhofer [41] analysed the findings of a survey of 1,034 citizens across Europe conducted in 2015 to explore citizens' attitudes towards the use of social media for private purposes and in emergency situations.

Flizikowski et al. [15] identified issues such as lack of knowledge, non-uniform terms of use, personnel issues, credibility of citizen-generated content, and accessibility from both citizens' and emergency services' points of view. Personnel issues and credibility issues were also identified in the study of the Canadian Red Cross [8]. According to the American Red Cross [4], 22% of high school graduates and 12% of general citizens stated that they had already used social media sites during emergencies to get information about damage caused, information on how other people were coping, weather, and traffic or to share personal feelings, safety reassurances, or eyewitness information.

In principle, participants' attitudes towards the use of social media were positive overall [15]. Benefits of using social media during emergencies can be seen in reassurance for citizens, providing situational information, and monitoring [8]. Accordingly, social media is seen as a support for, adjunct to, existing channels [8]. Friends, family, news media (or reporters), and local emergency officials especially are seen as the most trusted sources [4]. Therefore, the Canadian Red Cross employs "trusted volunteers" to support the official response via social media [8]. Moreover, citizens' use social media to search (43%) rather than to share information (27%) [41]. Users are most likely to seek information about weather, traffic, damage caused, and information on how other people were coping [4]. If they do provide information, users not only share weather information, safety reassurances, and their feelings about the emergency, but also their location and eyewitness information [4]. Even if the attitude towards social media is positive, only a few people have used it to share or obtain information during emergencies and disasters or in severe weather conditions [14].

In conclusion, the difference between the apparently positive attitude manifested and the actual usage suggests that there are barriers to the use of social media. Indeed, within all studies, challenges in the use of social media were identified. Both, citizens and emergency services identify the same challenges, especially concerns about the credibility of citizen-generated content [8,15,41], a lack of knowledge and personnel issues [8,15], lack of uniform terms of use [15], and difficult accessibility for older generations [15]. Regarding trustworthiness, unknown people in the general vicinity of the emergency are the least trusted [4]. It follows that, from the point of view of the emergency services, the monitoring of social media is expected and anticipated [41].

In addition to citizen's perception of social media, some research focuses on the perceptions of the authorities. For example, Reuter et al. [38] published the findings of a survey in 2016 conducted with 761 emergency service staff across Europe about current attitudes influencing the use of social media in emergencies.

2.2 Research Gap

These studies we have cited have been conducted in different countries, largely based on opportunity-based samples. This means that the number of answers might be high, however it is not guaranteed that they cover the population in terms of gender, age, region, education and income in an appropriate form (e.g. 51% female, 49% male). From a methodological perspective, it seems that none of the existing studies was based

on a representative sample that guarantees this and thus we have little information about how often and with what regularity social media are used. It is not obvious whether those samples are representative of a cross-section of the population. This of course limits the reliability of these studies in terms of generalizable statements to some extent, and provides an opportunity for a representative and therefore more robust and reliable study.

Of course, representativeness can only be assessed in relation to a target population. We focus on a representative sample in Germany. Given the fact of existing work in the US, Canada, and Europe, it was interesting from our point of view to conduct a study in Germany to verify or disconfirm existing findings, thus providing a basis for comparability. The transferability of our results to other countries obviously is uncertain but for those with similar statistics on social media use, socio-economic wealth, technical development, and infrastructure, our study design might be applicable.

According to our *definition of emergency*, based on the United Nations Department of Humanitarian Affairs [49], it comprises everything such as an accident, power cut, severe weather, flood, or earthquake. This was mentioned in Q2 for the participants as a basic interpretation of that term.

3. METHODOLOGY

3.1 Survey Design

The survey conducted consisted of nine questions, most of them in closed answer format except for the last question, which was open format (see appendix for the questions). First, participants were asked about the frequency of their social media (Q1) and their previous usage of social media in emergencies (Q2). For participants who answered with the options “Yes, I have used it to find out and share information” or “Yes, I have used it just to share some information”, the kinds of information shared was collected (Q3). Then, for all participants, we requested participants to assess the responsiveness of emergency services to messages posted via social media (Q4) and elicited opinions about factors which might discourage social media use in emergencies (Q5). We also considered previously downloaded apps for emergencies (Q6) and specifications concerning the kinds of emergency-related apps the participants had already downloaded (Q7). We also wanted to know, regarding all participants, what possible future usage of apps in emergencies for exemplified purposes were anticipated (Q8). Finally, the last question was open format and covered further details about experiences with social media in emergencies (Q9).

3.2 Characteristics of Survey Participants

3.2.1 Gender, Age, Region, Education, Income

The survey was conducted using a panel of GapFish (Berlin) in October 2016. GapFish is an ISO-certificated panel provider. They guarantee panel quality, data quality and security as well as survey quality through various (segmentation) measurements for each survey within their panel of 180,000 active participants.

We conducted a representative survey of the adult German population stratified for **gender** and **age**, meaning that gender and age of the sample matched the population as a whole. There were no significant differences between the population statistics and the survey statistics in relation to gender and age ($\chi^2(1, N = 1,069) = .000, p = .994$ and $\chi^2(5, N = 1,069) = .426, p = .995$, respectively).

In addition, we ensured a wide spread of the survey sample in terms of **region**, **education**, and **income**. Significant differences were found between population statistics and the survey statistics for region and income ($\chi^2(3, N = 1,069) = 175.92$ and $\chi^2(3, n = 802) = 225.36, p < .001$, respectively). Some respondents did not provide information about their income ($n = 802$). Several categories for each variable were combined in order to perform the chi-squared tests. States in Germany were combined to the regions 'North', 'South', 'East', and 'City States' and income categories were combined to 'Less than 1,500', '1,500-2,500', '2,500-4,500', and 'Over 4,500'. It was not possible to test for significant differences for the variable 'highest education' between the survey and the population as there were no national statistics available that matched the categories used in the survey.

The **gender** distribution of our sample (N=1,069) with 50.9% female and 49.1% male participants was representative in relation to Germany (51% female, 49% male) [7].

All participants were older than 18 years and the majority (60%) were older than 45 years, which corresponds to the age distribution in Germany (57.2% over 40 years) [46]. Our sample consists of participants from all states in Germany, whereby the majority was of North Rhine-Westphalia (14.1%), the state with the highest population in Germany [7]. About 34% of the survey respondents stated that they completed 'A-Levels' as their highest education (combines the responses 'A-Levels' and 'university-degree'). In Germany as a whole, the proportion is slightly lower with 29% [13]. 22.7% of Germans had a secondary school certificate in 2015, whereas in our sample 33.2% stated this as their highest educational qualification. Nevertheless, our sample comprises participants of all educational levels. About 21.9% of our participants stated that they earn about 2,500€ to 3,500€ per month after tax deductions, which corresponds to the income distribution in Germany [7]. Again, our sample consists of participants with income from under 1,000€ to over 4,500€ per month to ensure a wide spread of household income.

3.2.2 Smartphone and Social Media Use

Our first question concerned the frequency of smartphone and social media use, whereby 50% of our German participants use a smartphone daily, and 29% even use it hourly (Figure 1). However, there are also nearly 8 million² German citizens (13%) who never use a smartphone and therefore have limited access to their social media accounts. Looking at this 13% group in detail, they are appreciably more likely to be aged 65 and over. Of all respondents, aged 65 and over, 28% have never used a smartphone; in comparison, all respondents aged between 18 and 24 years old use a smartphone. This equates to a significant relationship between age and frequency of smartphone use, $\chi^2(20, N = 1,069) = 363.59, p < 0.001$. Those numbers correspond with the representative ARD/ZDF study [23]. 49% of participants overall use a smartphone daily to get access to the internet, whereas that figure is 86% of under thirty-year-olds [21].

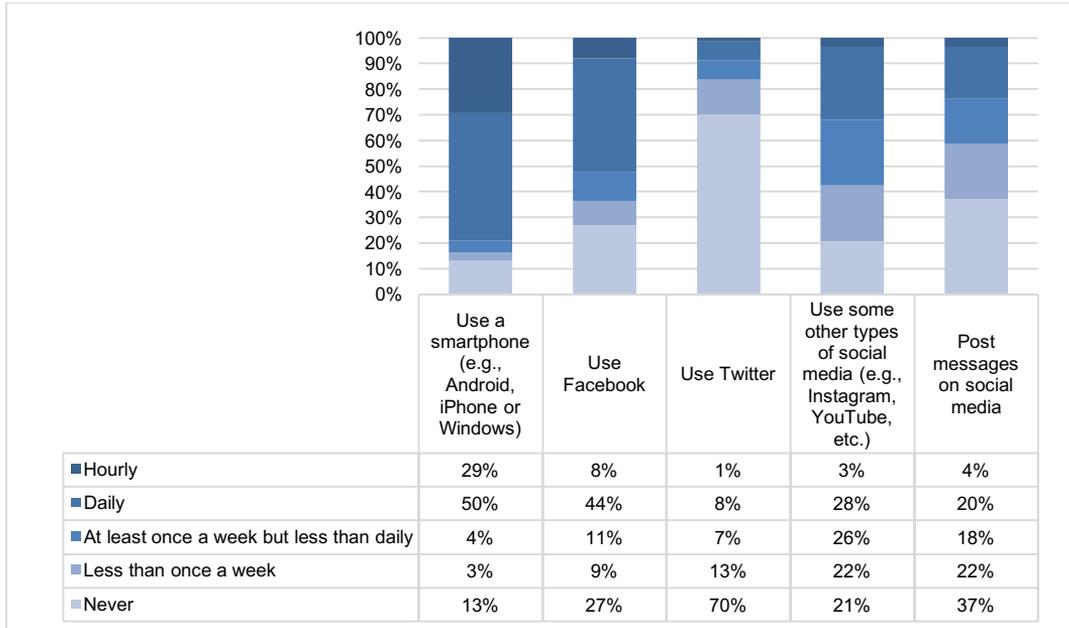


Figure 1. Please indicate how often, on average, you do the following things (Q1)

² According to OECD the population of Germany over the age of 18 is 64,160,544 in 2013 (<http://stats.oecd.org/>)

Overall, 44% indicated use of Facebook and 20% indicated use of Twitter daily, whereas 28% used other types of social media daily. These results are consistent with another German study on social media use— even though the questioning differed a little between both surveys. Among the 589 participants in that study, 51.1% used social media several times a day [47]. Daily usage of Facebook has increased from 23% in 2015 to 26% in 2016 [23]. In 2016, 2% of the participants used Twitter daily. Hourly usage was indicated for Facebook by 8% and for Twitter by 4%.

- The proportion of people who use Facebook at least daily declines with age, starting with 76% in the youngest age group down to 33% in the oldest age group, $\chi^2(20, N = 1,069) = 175.45, p < 0.001$.
- Apart from age, gender was shown to have a significant relationship with the frequency of Facebook use, $\chi^2(4, N = 1,069) = 13.19, p = 0.01$. More than half (57%) of women use it at least daily compared with 47% of men.
- Similar to Facebook use, younger citizens are more likely to use Twitter than older citizens. The relationship between age and frequency of Twitter use was significant, $\chi^2(20, N = 1,069) = 38.25, p = 0.008$. In particular, while 13% of 18 to 44-year-olds use it at least daily, only 6% of those aged 45 or older do so.
- Furthermore, the frequency of Twitter use differed significantly between men and women, $\chi^2(4, N = 1,069) = 11.02, p = 0.026$. Of all men, 10% use Twitter at least daily whereas it is only 8% for women. Nevertheless, 70% stated that they never post messages on social media. [21].

3.3 Quantitative Analysis

For the quantitative analysis, the survey data was extracted and analysed using IBM SPSS Statistics 23, a software package for analysing quantitative data [20]. Microsoft Excel was used for qualitative coding and for the design of the displayed figures. The analysis consisted of three key steps: (1) *Preparing* the data including assignment of missing values and data values, and combination of categories of demographic background variables. (2) *Exploring basic frequencies* for each question. (3) *Using cross-tabulations* with chi-squared tests to explore any significant differences across different types of respondents in relation to gender, age, region, income, and highest education level. Unless otherwise stated response categories from the questions (e.g., Q1: hourly, daily, at least once a week but less than daily, less than once a week, never) were utilized for tests of significance. For the variable age the following categories were used: 18-24, 25-34, 35-44, 45-54, 55-64, 65+. In general, significant differences were only found for age and gender whereas region, education, and income did not show any significant differences in social media use nor attitudes towards the social media (Q1-Q8). Kendalls' Tau was used to determine correlations between ordinal items.

3.4 Qualitative Analysis

The analysis of our free-text survey question was based on the inductive approach of *grounded theory* [48]. We used *open coding* associated with grounded theory to derive categories from the more qualitative free-text answers by carefully reading and aggregating categories. Categories were jointly checked and agreed. Each open-ended response was then assigned to one or multiple categories to achieve a quick overview of the interesting and relevant topics. The previously acquired knowledge from the literature review and quantitative analysis was used to increase theoretical sensitivity. Each quotation is referenced with the participants' response identifier.

4. EMPIRICAL RESULTS

4.1 Use of Social Media in Emergencies (Q2+Q3): More Searching, Less Sharing

Nearly half of the survey sample (44%) indicated that they had used some form of social media during an emergency (Figure 2). For this purpose, 19% have used social media to find out and share information and at least 20% have already used it merely to gather information about emergencies. Only 5% of the participants have used social media channels specifically to share information in emergencies. Of the 1,040 citizens that

made a clear statement, in relation to gender, women are more likely to find and share information (23%) as well as find information (22%) than men (17% and 19%, respectively), $\chi^2(3, n = 1,040) = 8.05, p = .045$. In relation to age, there was a significant relationship between the use of social media in emergencies and age, $\chi^2(15, n = 1,040) = 142.62, p < 0.001$. The frequency for all forms of use decreases with age. While 27% of 18 to 24-year-olds reported having looked for and shared information on social media during an emergency, only 10% of the respondents in the age group 65+ said they had done so.

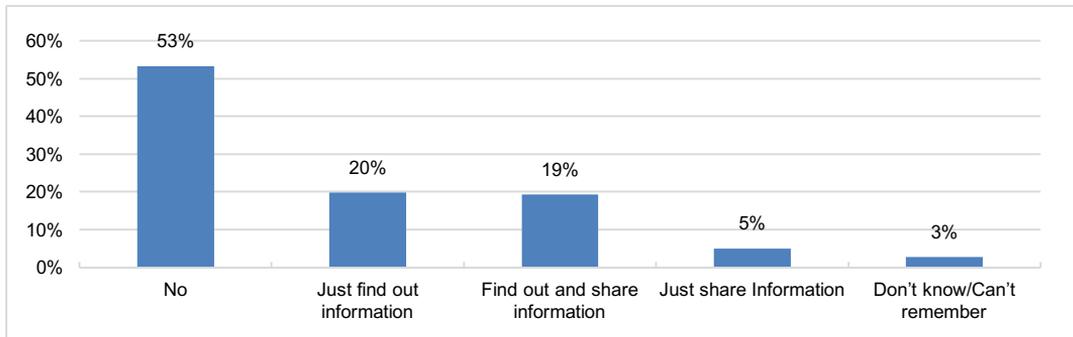


Figure 2. Have you ever used social media (such as Facebook, Twitter, Instagram) to find out or share information in an emergency such as an accident, power cut, severe weather, flood, or earthquake close to you? (Q2)

For those who shared information on social media (n=259), the most shared information is weather conditions or warnings (63%), road or traffic conditions (59%), feelings or emotions about what was happening (46%) and one's own location (37%) (Figure 3). However, some significant differences were revealed depending on the age and gender of citizens. Female respondents (52%) were more likely to share emotions or feelings than male respondents (39%; $\chi^2(1, N = 259) = 4.80, p < .028$), while men (15%) were more likely to share what they were doing in order to stay safe than women (6%; $\chi^2(1, N = 259) = 6.03, p < .014$). Moreover, the older age groups, 45-54 (60%), 55-64 (56%), and 65+ (58%) are more likely to have shared emotions and feelings via social media during emergencies than the younger age groups, 18-24 (29%), 25-34 (39%), and 35-44 (45%), $\chi^2(5, N = 259) = 11.50, p < .042$.

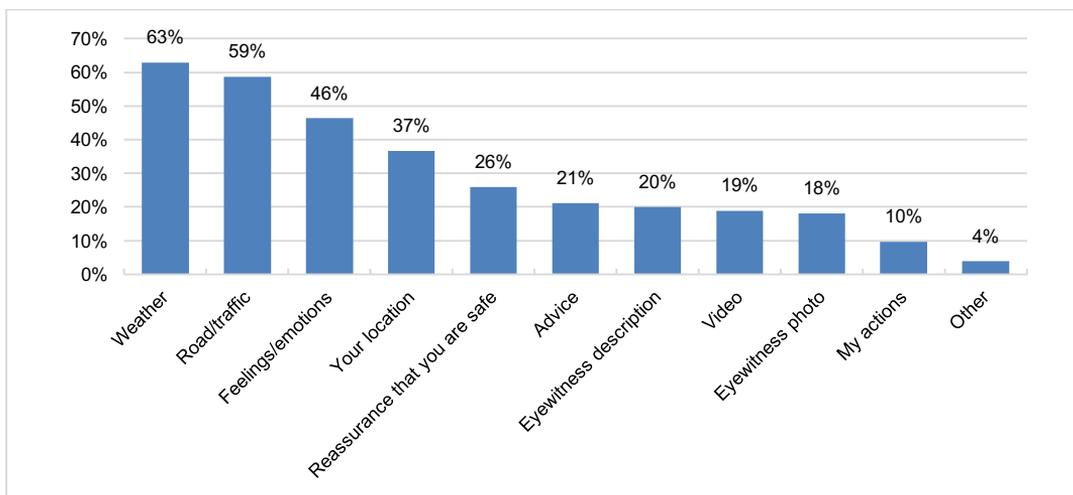


Figure 3. What types of information did you share? (Select as many as apply) (Q3)

4.2 Expectations (Q4): Emergency Services should monitor Social Media

The most stated expectation when posing an urgent request for help or information on a social media site was that emergency services should regularly monitor their social media use (31% strongly agree; 36% agreed) (Figure 4). Second, 47% expect a response from emergency services within an hour (17% strongly agree; 30% agree). In contrast, 43% think that emergency services are too busy to monitor social media during an emergency (17% strongly agree; 26% agree). Interestingly, only the statement ‘emergency services should regularly monitor SM’ and the statement ‘expect a response from emergency services within an hour’ are correlated ($r_{\tau}=.527, p<.001$) whereas neither of these are correlated with the statement ‘emergency services are too busy to monitor SM during an emergency’ ($r_{\tau}=-.01, p=.7$ and $r_{\tau}=-.003, p=.911$, respectively). This indicates, perhaps unsurprisingly, that respondents who expect emergency services to monitor social media also expect them to respond within an hour.

Looking at the differences, it was shown that the three younger age groups, 18-24 (57%), 25-34 (53%), and 35-44 (53%) are more likely to agree to the statement that emergency services are too busy to monitor social media during an emergency than the group of respondents aged 45-54 (37%) and 65+ (31%), $F(5, 1,063) = 8.65, p < .001$.

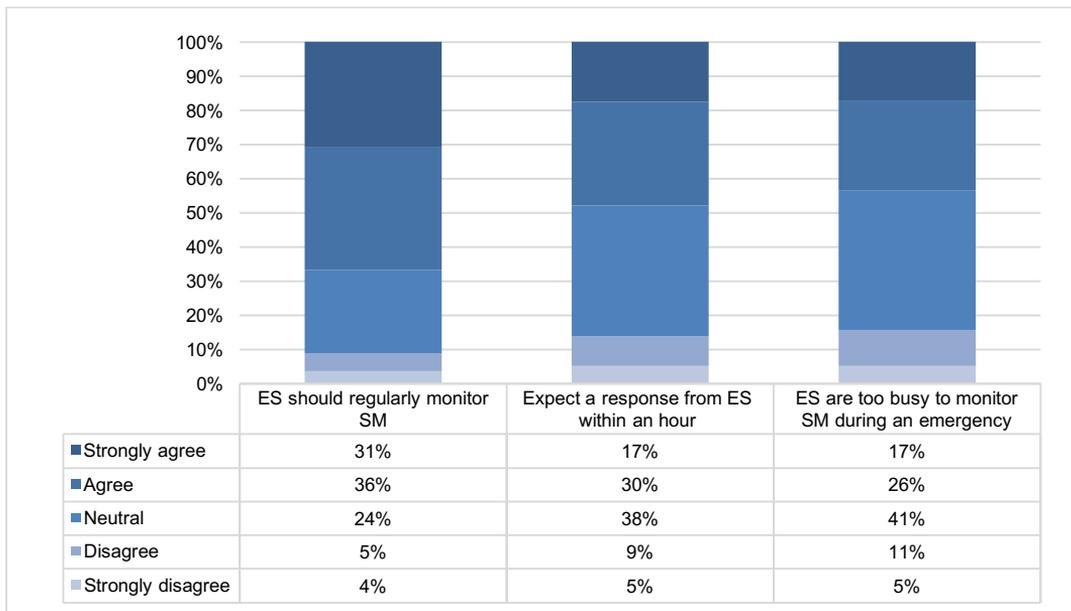


Figure 4. Imagine that you posted an urgent request for help or information on a social media site of a local emergency service, such as your local police, coastguard, fire, or medical emergency service. To what extent do you agree with the following statements (Q4)

4.3 Barriers (Q5): False Rumours

Despite all the positive aspects of social media usage for emergencies, barriers to its use remain (Figure 5). The many false rumours on social media (definitely) put off participants the most (34% were definitely put off; 40% were put off). 43% suggested that unreliable information on social media tended to put them off and 22% were ‘definitely’ put off. Additionally, 62% were concerned about data privacy such that this would (definitely) prevent them from using social media in emergencies. The chance that social media might not work properly in an emergency would also prevent 33% (additional 27% definitely) from using it. For 22%, it was definitely better to call 112 than to post messages on social media and 14% stated that they were definitely not confident using social media for such purposes.

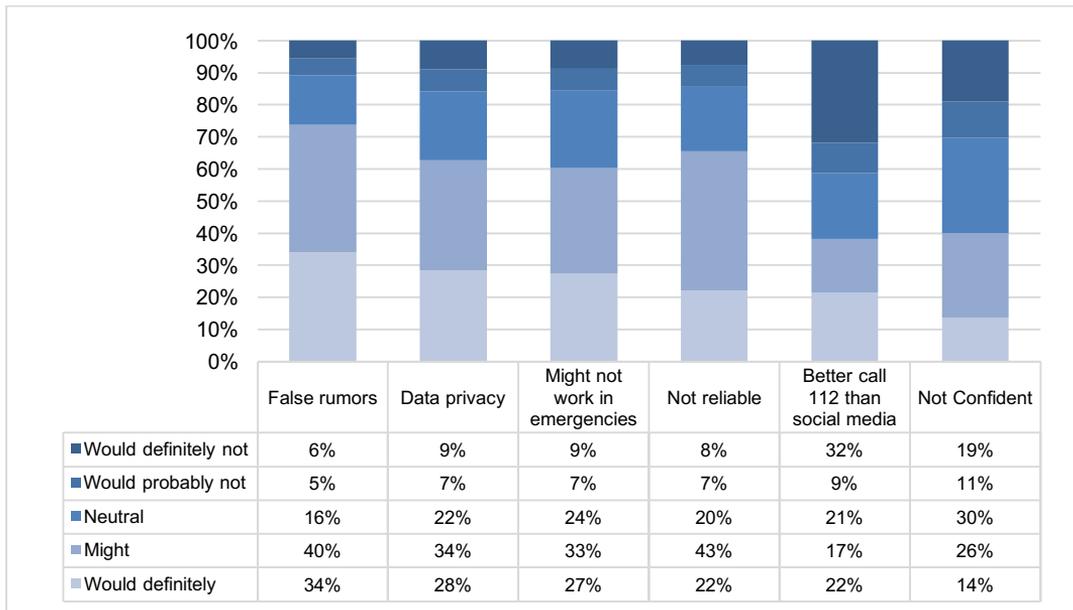


Figure 5. What might put you off using social media during an emergency? (Q5)

4.4 Emergency Apps (Q6-8): Used by One out of Six

Findings on the use of emergency apps have already been partially reported [36]: Among 1,069 German participants, only 16% have already downloaded a smartphone app that could help in a disaster or emergency (Figure 6). People who typically download an emergency app are more likely to be male (60%) than female (40%) and to be aged between 25 and 54 years (65%). This equates to a significant relationship between downloading an app and gender, $\chi^2(3, n = 1,012) = 9.67, p = 0.002$ and between downloading an app and age, $\chi^2(5, n = 1,012) = 42.88, p < 0.001$. Respondents that were not sure whether that have downloaded an app were excluded from this analysis.

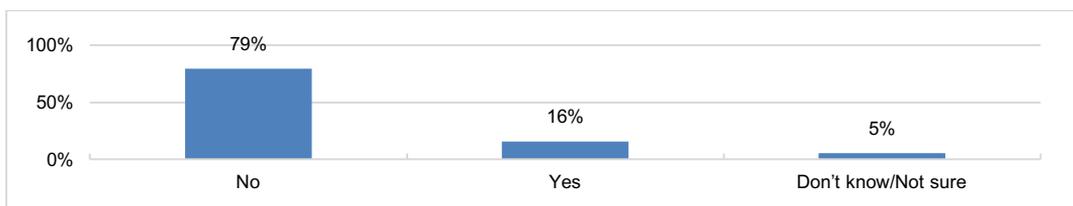


Figure 6. Have you ever downloaded a smartphone app that could help in a disaster or emergency? (Q6)

Of all citizens that have downloaded an app (n=166), the most downloaded app was a weather app (69%; 11% in total), followed by a warning or alert app (42%, 6% in total) (Figure 7). The app KATWARN was downloaded by 37% (6% in total) and the app NINA was downloaded by 25% (4% in total) of the participants who have downloaded an app³.

³ KATWARN warns against catastrophes by knowing the user's GPS coordinates or selected areas by the user [36]. NINA is an app of the German Federal Office for Civil Protection and Emergency Aid (BKK) for warnings against catastrophes and recommendations for action as well as tips [6]. Affected people can inform contact points about their state of affectedness.

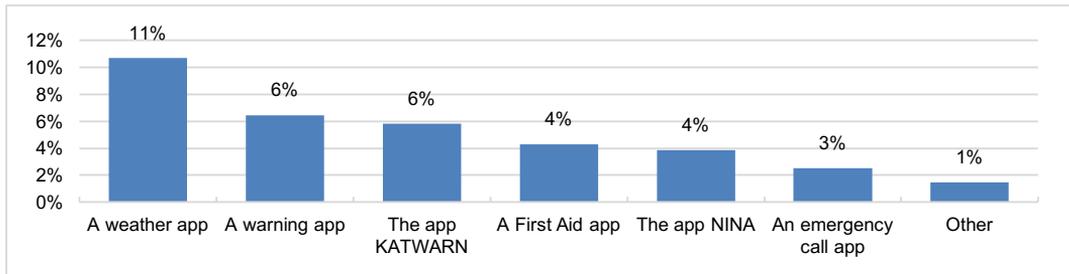


Figure 7. What type of app did you download? (Q7)

While the proportion of people that have downloaded an emergency app is currently quite low (16%), a significantly higher percentage of citizens indicated that they were likely to use apps for such purposes in the future. Receiving emergency warnings is the most likely stated future usage purpose of such smartphone apps in an emergency (57%) (Figure 8). About 51% stated that they are quite/very likely to receive tips about how to stay safe or find out information about the emergency in this way. Connecting with other citizens to help others affected by the emergency was indicated by 46% as at least quite likely and another 42% might share information about the emergency with an emergency service. To contact an emergency service instead of making a 112 call is the least likely usage purpose as 32% agreed and 42% stated this as not very likely and not likely at all.

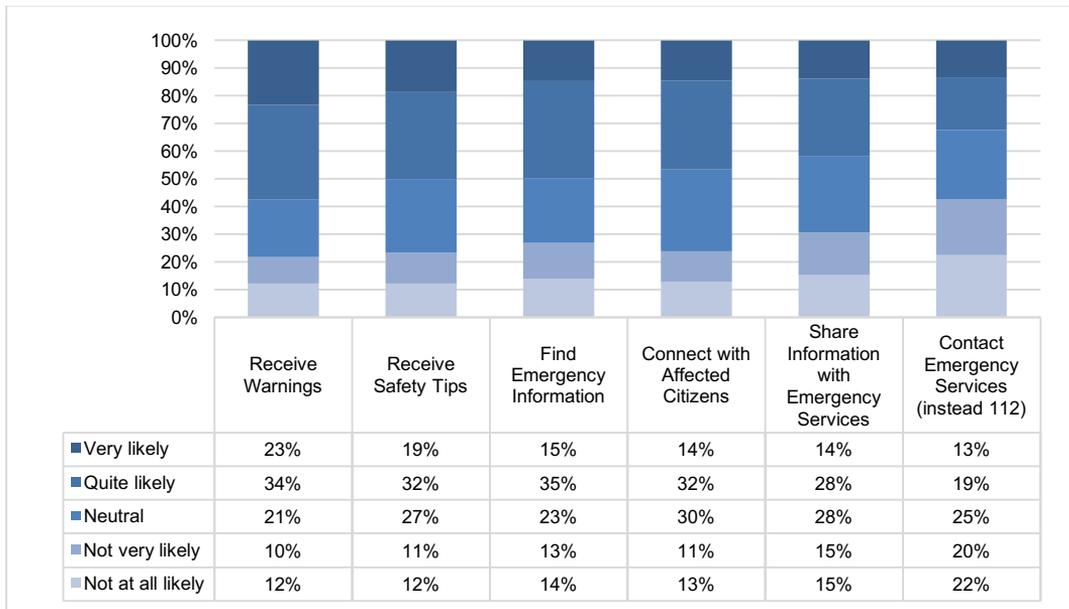


Figure 8. Please indicate how likely you are in future to use a smartphone app for each of the following purposes as a result of an emergency? (Q8)

4.5 Open Comments (Q9): Benefits, Information Flow, Applications Fields, Inexperience, Scepticism

The open question asked for “as many additional details as possible about your experience with social media in emergency situations, or what would encourage you to use them in the future”. It was also analysed with the help of open coding. We created five meta-codes, which were coded for 890 usable answers (not empty)

of the participants: *benefits, information flow, ranges of application, scepticism, and inexperience*. Each answer could be coded with a maximum of two meta-codes.

4.5.1 Benefits: Faster than other Channels

With respect to the meta-code *benefits* (n=151), it became apparent that several people rate social media as useful or quick to use, for instance, and support, at least to some extent, the use of social media in emergency situations. Moreover, some people find it particularly useful to *get and spread information* with the help of social media (n=135). On the other hand, many participants are not familiar with social media in emergencies or do not use them so that their answers can be classified into the meta-code *inexperience* (n=487). Further, a few participants were *sceptical* about the use of social media in emergencies due to rumours, alternatives, or data security, for example (n=114). For the fifth meta-code, *ranges of application* (n=50), the participants named cases as e.g. natural disasters, fight against terrorism, or the safety-checks.

Several participants use social media in emergency situations as they think they are more immediate than other media and reach many people (n=45): *"Social Media are more current and faster than other news channels in such situations"* (#943). Additionally, it is assumed that help can be better organised at short notice (#86).

Concerning the usefulness of social media in emergencies, few participants (n=32) believe that social media are particularly practical for all purposes: *"At a local flood in my city, the help was organised via Facebook. That was very helpful and productive – during the coup in Turkey, I could contact friends and make sure that they are okay. I would like official warnings via Twitter or Facebook, for example. These would be seen directly in the timeline. All this, however, should only be an addition to normal communication in case of an emergency (radio, TV, etc.)"* (#333).

According to some participants, the authorities could also use social media in case of a catastrophe to prevent panic. One participant points to the 2016 Munich shooting, as an example as there was a very professional spokesperson (#1210). Another sub-code of the meta-code productivity is connectivity (n=27). That means that some participants assume that social media encourages the exchange of information as social media makes it easy to communicate with each other. In emergencies, people can contact each other more readily and are therefore better connected. One participant sees even more advantages in terms of emotional processing: *"You can exchange with several people at the same time; You can hear more opinions and thus act/ behave better; You can see what others do; You are not "alone" or do not feel lonely"* (#788).

4.5.2 Information Flow: Spreading and Obtaining up-to-date Information

In this context, information flow is also one significant advantage of social media for some participants. Because of the degree of connectivity, people have more opportunities to spread and obtain information. Several people (n=89) use social media for this purpose, based on the enormous capacity for information dissemination and therefore users always feel well informed. They perceive social media to be always up-to-date, especially in unusual situations: *"Social media are useful to gather information about events. In the meantime, the technology has advanced so much that information is contemporary. The example of Halloween: With the help of Facebook we could see where horror clowns were spotted and knew what places we had to avoid"* (#739).

This example shows that many people use social media to obtain information as they think that social media usually provides the latest news and are quicker and more up-to-date than traditional media. For instance, one participant mentions that the police can publish recommendations in emergencies in social media as in the case in Munich, where the police warned people via Facebook not to leave the house (#716).

Further, Facebook, for example, offers features such as the 'Safety-Check'. In the case of an emergency, the telephone network is often overloaded so that you cannot reach your relatives or friends directly. With the given feature, people can confirm that they are okay if they stay near a catastrophe. In this context, one participant cited the Munich shooting again because in this case, he obtained information about status with the help of social media since he thought that traditional media were not that quick (#955). Additionally,

social media are used for warnings (n=23) and the dissemination of information (n=23), which also counts for the meta-code information flow.

4.5.3 Ranges of Application: Natural Disasters, Safety Checks

If people use social media in emergencies, they have different areas of application (n=50). The most frequently mentioned instances where people used social media were natural disasters (n=15). In the case of a natural disaster, which cannot be influenced by humans, many people may be in danger. In this occasion, it is felt that social media may be helpful to obtain information about the status or the extent of the catastrophe. Further, people may be warned, or help can be organised. One participant used social media in an emergency and found it very useful: *“Example of a flood: By shared postings and information I could estimate whether the region where I live or the residences of relatives are at risk or rather warn others, who do not have access to social media (e.g. elder generations)”* (288).

The above-named feature ‘Safety-Check’ was also used by a few other participants (n=12). They were very thankful for this feature as social media had a calming effect. One participant sees even more advantages: *“I like the possibility of stating ‘safe’ (on Facebook) in a natural disaster or the like. At various floods in Germany, emergency appeals on Facebook could be posted in a group which gave me, as a volunteer, possibilities to help systematically”* (#382).

Another participant used Facebook during the shooting in Munich: *“[...] I found it very helpful and reassuring to see on Facebook that friends on-site are safe (with the help of the quite new ‘I am safe’-function)”* (#208). Another tool, which was named at least three times, was Katwarn (n=3) (see Q6-8). Further, people use social media for the search for a missing person (n=7).

4.5.4 Scepticism: General Sceptics and Rumours

Several participants, even so, take a sceptical view towards the use of social media in emergencies, thus their answers are classified into the meta-code scepticism (n=114). As a reminder, Q5 (N=1,069) asked about barriers, highlighting rumours (74%), data privacy (62%), or that it is simply not working (60%) or not reliable (65%). From these 114 sceptical participants, some (n=48) are sceptical in general and therefore do not want to trust social media in dangerous situations. One reason is the spreading of rumours, which unsettles a few respondents: *“I am sceptical. It is not reliable; there is too much misinformation, users share news, search calls, etc. without checking their truthfulness”* (#277). Information flow may, therefore, lead to unnecessary panic (#639).

Moreover, some sceptical participants do not completely reject the use of social media but prefer alternatives (n=30). In everyday life, they use social media, but in emergencies, they still switch to traditional media as they find it difficult to rely on the internet. As one participant states: *“I would rather rely on a phone call; afterwards you can look and read on social media. We find it difficult to rely on the internet completely”* (#156). Another respondent suggested he does not totally trust social media and therefore used other media in emergencies: *“In emergencies, the news channels would run day and night. (On that basis that there is electricity, if not, an app would also be useless at some point due to empty battery). Since there was too much mischief on Facebook and co, I would probably not totally rely on it [...]; news channels are more competent [...]”* (#988).

4.5.5 Inexperience

Of course, several participants do not use social media at all and mentioned this in the comments (n=88), or are not familiar with the use of social media in general and especially not in emergencies (n=339) and therefore belong to the meta-code inexperience. On the one hand, they do not use social media since they think it is unnecessary as one participant confirms: *“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 [...]”* (#323).

On the other hand, they still prefer other media, for example, if they are at an advanced age: *“I belong to the elder generation, and I do not know about technologies. I rely on traditional news”* (#631). Others are

inexperienced but would not exclude the use of social media in emergencies: *“No experience with social media in case of an emergency. Still, I would be encouraged if particular information disseminates quicker”* (#402).

5. DISCUSSION AND CONCLUSION

Social media may be used in crises, disasters, and emergencies across different types of events, countries, and continents as well as there being various types of participant involvement. It is important to examine the attitudes of involved participants to understand the appropriation of social media, to identify existing barriers, and to develop solutions, for instance via mobile applications that promote an efficient use before, during, and after safety-critical events. A number of existing studies have already researched the citizens' [4,8,15,41] and emergency services' attitudes towards social media [21,33,38,42]. Focusing on the citizens' perspective, however, few of the above studies involved a large scale and statistically reliable sample.

SOCIAL MEDIA IN EMERGENCIES: A REPRESENTATIVE STUDY ON CITIZENS' PERCEPTION IN GERMANY

We researched the perception of social media use in the German population with a representative survey of 1,069 participants.

Our findings show that social media is used in emergencies more to search for than to share; emergency services are clearly expected to monitor social media and to respond within an hour as well; the main barriers to use social media are rumours and unreliable information.

Source: Christian Reuter, Marc-André Kaufhofer, Thomas Spielhofer, & Anna Sophie Hehne (2017). Social Media in Emergencies: A Representative Study on Citizens' Perception in Germany. Proceedings of the ACM: Human Computer Interaction (PACM): Computer-Supported Cooperative Work and Social Computing, 1(1), ACM-Press.

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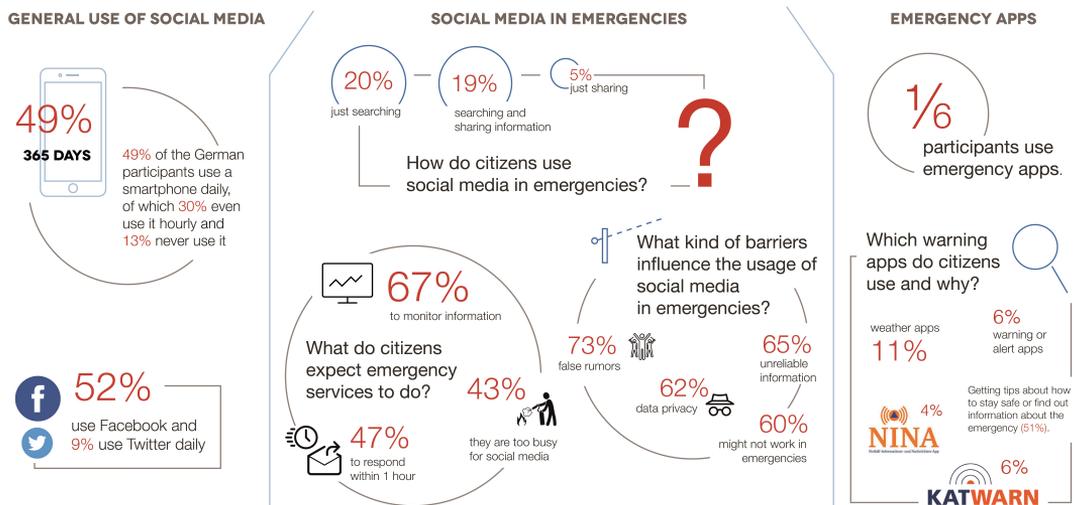


Figure 9: Infographic on Citizens' Perception of Social Media in Emergencies in Germany (2017)

5.1 The Perception of Social Media in Emergencies by Citizens' in Germany

This paper makes a contribution in the following two ways to crisis informatics, both of which we consider to be important: (a) providing data which is agnostic to a particular disaster, and (b) examining a large population of people who have both used and not used social media in an emergency. In order to understand our findings appropriately, the results are to be interpreted along our broadly chosen definition of emergency in section 1.

Our study revealed that 79% of the adult German population use a smartphone daily, while 13% never use a smartphone; half of those are 65 years old or over. More than half of the population use Facebook daily with younger citizens using it more often but also a third of those aged 65 or older use it daily. Twitter is less frequently used with 70% of the population never using it (Q1).

The main results of our study are listed below:

- 1) **Current Use:** Social media is used in emergencies more to **search for** (20%) than to **share** (5%) information and with the 19% who use it both to find out and share information, there are significant relationships with gender (as well as content-related) and with age.
- 2) **Expectations:** On the one hand, emergency services are clearly expected to **monitor social media** (67% (strongly) agree) and to **respond within an hour** (47%), and these two points correlate significantly. On the other hand, they are perceived as **too busy to monitor social media** (43%), with a significant bias towards younger participants.
- 3) **Main barriers** of using social media are false rumours (73% were (definitely) put off), unreliable information (65%), data privacy (62%), and the possibility that social media might not work properly in an emergency (60%).
- 4) **Emergency apps** are only used by one out of six (16%), with a significant relationship with gender towards male participants, and age towards younger (25-54 years) participants. The most downloaded apps are weather apps (69%) and warning or alert apps (42%). For future use, receiving emergency warnings (57%) and tips about how to stay safe or find out information about the emergency (50%) are the most likely perceived opportunities (see [36] for details).

Focusing on the open question (Q9), the following results can be summarised in five meta-codes:

- 1) **Benefits** (n=151): Social media are perceived as faster than other channels (n=45), practical for all purposes (n=32) and connectivity (n=27).
- 2) **Information flow** (n=135): Spreading and obtaining up-to-date information (n=89), receiving warnings (n=23) and disseminating information (n=23) are appreciated within the social media usage.
- 3) **Ranges of application** (n=50): In case of natural disasters (n=15) and for safety checks (n=12), social media is used the most.
- 4) **Scepticism** (n=114): General scepticism (n=48) due to rumours and the preference of alternatives (n=30), especially for older generations, could be identified.
- 5) **Inexperience** (n=487): People that do not use social media at all (n=88) and that are not familiar with the use, especially in emergencies (n=339), could be found in our study.

Moreover, our study revealed that some characteristics of citizens are more important than others to predict their attitudes towards and actual use of social media in emergencies:

- Especially **age** was shown to be strongly correlated with the general use of social media (Q1, e.g., Facebook ($p < .001$), Twitter ($p < .01$)), the use during emergencies (Q2, $p < .001$) and the availability of an emergency app (Q6, $p < .001$).
- Apart from age, **gender** was correlated with some of the questions but we did not find any significant effects for income and location.
- However, as **income** is correlated with most of the background variables it is worth to continue including it in further surveys.
- We found numerous correlations with **education** level, although in most cases there was no clear direction. One exception is the item 'Emergency services are too busy to monitor social media' (Q4) – younger ($p < .001$) and more educated people ($p < .05$) were more likely to agree with this statement. The influence of education level on the attitudes towards use of social media in emergencies should be therefore explored in further studies, potentially alongside working status and social grade, which were not included in this study but in surveys that we conducted in other European countries.

5.2 Directions for Future Research

The results indicate implications for further research:

- 1) Firstly, the propagation of emergency-related apps needs to be promoted. As users tend to use platforms that they are familiar with, the augmentation of general apps or platforms with disaster capability, such as Facebook Safety check, seems a promising approach to improve social resilience during crises and emergencies. Also, work on the distribution of these apps with sharing and other collaborative functionality is needed [36].
- 2) Secondly, expectations towards emergency services lead to two conclusions: monitoring is needed, but monitoring should not cost time during emergencies. Obviously, small emergency services cannot handle this task manually, a problem which has also been identified in earlier research [38]. VOST teams are a possibility [9], however, further cost effective and convenient ways of monitoring [26] are needed, e.g. semi-automatic generation of alerts and notifications based on social media [34] that can also be transferred to control station systems. Another aspect concerns the perception of social media as entailing negative aspects such as rumour propagation, dissemination of false or misleading information, ethical dilemmas [3], and propaganda or social bots [40].
- 3) Moreover, although researchers consider citizens to act rationally during crises in western societies [18], participants reflected on the nature of panic. These problems have become even more apparent, especially in CSCW, dealing with uncertainty [45] and mechanisms of self-correction [5] related to false rumours that are hot topics in current research. However, more work is evidently needed.

5.3 Relationship with Prior Work

Our work contains similarities to existing studies, but also offers some distinctive conclusions. Compared to the study of the Canadian Red Cross [8], more people in our study used social media to either get or share information (25% vs. 12%), which might be due to the fact that the Canadian study was published in 2012. Meanwhile the overall social media usage in general has developed [25]. In comparison to Reuter and Spielhofer [41], the percentages for receiving (39% vs. 43%) and sharing (24% vs. 27%) information during crises are slightly lower (Q2). In both studies, the sharing of weather conditions and warnings, road or traffic conditions, as well as feelings and emotions about what was happening were most prominent (Q3). However, there is a big difference in sharing eyewitness photos (18% vs. 59%). According to our study, slightly fewer people expect emergency services to monitor social media (67% vs. 69%), and fewer expect emergency services to be too busy (43% vs. 56%) and thus more people demand a response within one hour (47% vs. 41%) (Q4). However, it must be noted that we are comparing studies which have different degrees of representativeness, were conducted in different timeframes, and have either a single- or multi-country focus. Regardless, the fact of these variations suggests there is a need for a systematic and large-scale approach to studies of attitudinal work, which can be used to supplement the more site-specific studies that constitute the main body of work in this area.

Besides, qualitative studies offered insights into citizens' activities, phenomena and types of information in social media during emergencies. A body of case studies examined the dissemination of situational updates [50], the expression of solidarity [44] or emotional support [51], reassurance of safety [1], sharing of eyewitness information [11] or general advice [43]. To draw conclusions on a broader scope, [30] investigated several crises in a systematic manner showing the average prevalence of different information types in Twitter, such as 32% other useful information (incl. weather and road conditions), 20% sympathy and emotional support, 20% affected people, and 10% caution and advice. Similarly, our findings reflect situational updates, such as information on weather (63%) or roads/traffic (59%), to be the largest category, followed by emotional content (46%) and affection-based information, such as own location (37%) or reassurance of own safety (26%), but much less general advice (21%) (Q3). In contrast, plenty of qualitative and mixed method studies identified misinformation [39], unreliable information [37] and rumours [29,52] as barriers of social media use; our study confirms false rumours (74%) followed by the reliability of

information (65%), enriched by 114 open-ended responses expressing a sceptical view on social media use during emergencies (Q9), as the strongest barriers (Q5).

This study revealed that only 21% of the participants downloaded a smartphone app that could help in a disaster and emergency (Q6); a qualitative study with 22 interviewees suggests that there is a weak motivation due to the low probability of (natural) disasters in Germany, and identifies warning messages, recommendations for action, sending warnings and all-clears, chat and organisation and tailorable behaviour as desired functionality of emergency apps [36]. The wider distribution of weather apps (11%) over warning (6%), first aid (4%) or emergency call apps (3%) could be related to a higher relevance in daily life (Q7). On the other hand, participants indicate that they likely will use smartphone apps to receive warnings (57%) or safety tips (51%) in future (Q8), confirming the need for and potentials of providing instructing information [10] and orientation information [27] during emergencies. A mixed method approach could be applied to gather qualitative in-depth feedback about motivational and functional requirements, e.g. by considering a persuasive system design approach [24], of emergency apps and test findings qualitatively against a larger sample.

5.4 Limitations

Of course, this study has limitations. Firstly, we study many aspects that have already been studied in the past. However, they have not been studied in a representative way and not with regard to all the aspects we deal with. Secondly, the study was conducted using an online survey which still might provide representative results with regard to some factors, but just covers people how are willing to do online-surveys; therefore, they are most likely more familiar with internet and social media. Thirdly, we only study citizens' perceptions in Germany. This gives us the possibility to conduct a representative study on a wider basis. In future research, we want to conduct and analyse further representative studies in other countries in Europe (UK, Italy, and the Netherlands). The representative study in the UK has already been conducted and provides some interesting preliminary findings about existing differences: Accordingly, in the UK social media is less used during emergencies (not used by 53% in GER vs. 66% in UK; Q2). In the UK, emergency services are more often seen as being too busy to use social media in emergencies (62% UK vs. 43% GER, Q4) and citizens expect less that social media is monitored by emergency services (67% GER vs. 37% UK, Q4). In addition, the distribution of emergency related apps is much lower in the UK (7%) than in Germany (15.5%). These findings are very preliminary and at present non-parametric. Detailed comparisons and analysis about the reasons of those findings will be conducted in future work.

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APPENDIX: 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 rumours 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*

[By the term 'confident', we relate to people who are conscious about handling their social media tools, respectively by 'not confident' it is obvious that this refers mostly to people with few social media experiences.]

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 | The app KATWARN | The app NINA | Another 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.

We asked two additional questions that were not analysed in the scope of this paper.

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