

Crisis-Related Apps: Assistance for Critical and Emergency Situations

Inga Karl, Hamm-Lippstadt University of Applied Science, Lippstadt, Germany

Kristian Rother, Hamm-Lippstadt University of Applied Science, Lippstadt, Germany

Simon Nestler, Hamm-Lippstadt University of Applied Science, Lippstadt, Germany

ABSTRACT

In this paper the authors developed applications for apps in times of crises and critical situations. They analyzed how people act in these situations and how to mitigate their uncertainty and fears through situation-specific communication. Including these aspects as well as the general challenges of crisis communication, pros and cons of apps based on existing examples were discussed. The resulting requirements for an app for crises and dangerous situations should assist in designing a communication solution that strengthens the feeling of security of citizens in critical times, such as life-threatening situations. This solution is intended as an additional means of communication for emergency services to modernize crisis communication with affected people.

Keywords: Apps, Crisis Behavior, Crisis Communication, Critical Situation, Life-Threatening Situation

1. INTRODUCTION

In life-threatening situations, such as unexpected dangerous conditions, many people feel uncertain. In such cases, these people are looking for help and feel confused: What is happening? What is the correct course of action? What should I consider? Who can help? The less information is available, the higher the anxiety, panic reactions and incorrect behavior. If people experience helplessness, a loss of control and uncertainty with the feeling of being in mortal danger, they are petrified with fear (Herzog, 2014). [Renner and Gamp \(2014\)](#) demonstrated that contextual information could help affected people to assess the situation and make informed decisions. Accordingly, the timely communication of current issues can affect the loss of control, thus reducing the feeling of insecurity.

Mobile devices such as smartphones afford a rapid exchange of information. They are handy, practical, can be used anywhere and provide access to various forms of content and functions in

DOI: 10.4018/IJISCRAM.2015040102

real time. More and more people own smartphones (Statista, 2015) and use numerous apps that accompany them reliably in their everyday life (Rademacher, 2012). The smartphones serve as a “digital nanny” for users, which reminds them of appointments, predicts the weather or serves as a source of entertainment, thus they never get the feeling of being alone. Rademacher (2012) posited that the immediate availability of such information via apps creates a feeling of control because knowledge and the ability to influence ones living environment are available at any time, e.g. through communication with contacts and monitoring their status updates. This perceived control has a soothing effect on people (Rademacher, 2012).

Our research project deals with the design of communication networks that strength the sense of security of the citizens in crises situations. We aim to improve the communication between crisis actors and the affected so that important information can be exchanged at any time and for various conditions. In this context, the use of apps for crisis communication seems to be of great benefit. The technical possibilities, such as the immediate access to stored data or the mobile web and thus the access to current news, as well as the familiar handling of the technology and the associated confidence, can foster autonomous action and reduce perceived uncertainty among people. Considering these aspects, the following research question can be derived: Which factors are critical to design an efficient communication app for citizens in critical situations?

In order to design a concept for a successful solution, various aspects are considered in this paper. First, in the following chapter communication in critical situations is analyzed. There we consider the behavior of people during the different crisis phases in relation to the crisis communication of authorities and organizations with security tasks and examine the challenges of crisis communication. Then, various communication means are reflected in terms of their suitability for crisis and emergency scenarios. In the third chapter, we present different apps that have been developed for crisis situations in order to help people. We analyze the properties and functions of apps and discuss their advantages and disadvantages for critical scenarios. Based on the previous results, we derive requirements for an app that can be used for different critical situations and supports all user groups. In the conclusion we discuss this design concept and further steps of our research project.

2. COMMUNICATION IN CRISES AND EMERGENCY SITUATIONS

Insecurity and fear arise in situations that occur unexpectedly with unknown consequences. These include life-threatening events. To avoid panic, it is vital to provide citizens, particularly the affected, with relevant information. To reach people in crises there are different communication tools. Emergency services can use many different media, such as newspapers, websites, radio, flyers, local announcements and sirens to inform the citizens. Sometimes people do not know that this information is available. This often depends on the citizens themselves and the awareness of their own situation.

2.1. Crisis Phases and Human Behavior

As already pointed out, in crisis situations it is important to strengthen the sense of security of those affected so that they act properly. According to a theory by John Leach human behavior is not dependent on the type of a disaster, but on the perceived risk (Leach & Campling, 1994). Leach distinguishes three stages of a crisis and assigns each to a certain behavior. The crisis communication should be adjusted according to the appropriate behavior. The objectives of crisis communication can be assigned to the respective phases.

In the phase *before a crisis*, people are uninterested in potential crises and tend to ignore the facts and suggested precautions. Therefore, the crisis communication in this phase should include informing the population. Trust and credibility in the source are crucial (Federal Ministry of the Interior, 2008). To avoid that the communicated information is ignored, it is important to highlight the personal relevance and usefulness for those affected (Downs, 2011). With a higher perception of risk the likelihood to remember important information increases (Brewer, 2011).

In Leach's phase *during a crisis*, people show reflexive and schematic behavior. They have no control over their emotions and information processing is inhibited. At this stage crisis communication should comprise an accurate assessment of the situation (Renner & Gamp, 2014). The assessment should be prompt, transparent, objective and truthful, even if the information is still uncertain (Federal Ministry of the Interior, 2008). This knowledge and an accurate assessment of the situation help choosing appropriate behavior patterns and making informed decisions.

In the third phase, *after the crisis*, people are aware of the impact and damage, but act very emotional trying to suppress the reality. At this stage there is no specific need for communication with the population (Federal Ministry of the Interior, 2008). Here crisis management reflects about previous events in order to gain new insights and to prepare for future crises. However, it can be assumed that the citizens have to deal with the particular experiences and thus require corresponding feedback and support in this phase.

Considering these behavioral strategies, it seems to be important to align the crisis communication according to the needs of citizens. It should be noted at which time information is necessary for citizens and when they would consider it. As already indicated, not all of the crisis media are known by the citizens or they are not accessible to them. However, it is important to bring information to the affected quickly and without gaps. In this context, it makes sense to adapt the information media to the needs of citizens, because according to Leach's theory an adaptation of citizen's behavior in crises cannot be implemented (Vorst, 2010).

2.2. Challenges of Crisis and Emergency Communication

Successful crisis communication is also dependent on other factors besides the choice of suitable media. In this context, the communication source as well as the communicated content is important. Hagar (2010) demonstrated different information challenges in the context of information communication from the authorities to citizens (see Table 1). In that regard Hagar emphasized that it is relevant to understand the importance of information in the various stages of a crisis, to analyze complex information needs and information-seeking of the people and to get an understanding of the factors that impact the integration and coordination of information in a crisis.

Table 1. Information challenges in a crisis (Adopted from Hagar, 2010)

Information Challenges in a Crisis
<ul style="list-style-type: none"> • Information overload or, conversely, lack of information • Changing information needs at various stages of a crisis: preparedness, warning, impact, response, recovery and reconstruction • The many diverse actors and agencies involved who increase the amount of information produced • The connection of informal and formal channels of information creation and dissemination • Information uncertainty • Trustworthy sources of information • Conflicting information • Getting the right information to the right person at the right time

These challenges vary depending on the situation. The specific crisis scenario and the relevant addressees must be distinguished, because people can have different roles in the scenarios, e.g. victim, volunteer, relative or observer. These factors are decisive for the investigation of technologies and human-centered approaches that support communities in crises ([Hagar, 2010](#)). To account for the challenges, the communication should provide personalized information for all persons. Hence the challenge is to reach individuals to address the relevant information needs. In order to provide customized information, their specific situation must be known. In addition to the information about the general situation and situation assessment, there will be situations that require certain actions. People have to be instructed to behave properly, if they are not able to do so of their own accord. These include situations that affect the person's own concern (e.g. car accident).

In order to get adequate help, support and situation-related information in crises, the role of the persons concerned can be crucial. In relation to the various roles, different level of affection can be distinguished. Each level contains specific needs for information. On the other hand, people have a different perception of the situation on each level. In our view, four different roles or level of affection can be distinguished:

- **First Level of Affection:** Victims and people who can give first-hand information (e.g. how they feel), since they themselves are affected, and people who are affected themselves but cannot provide information. If they are able to act, they can search or call for help and they can help themselves.
- **Second Level of Affection:** Companions or direct helpers who are with or near victims and affected in critical situations. They can report second-hand information (e.g. reflect how others feel) and describe the situation in detail (e.g. what they see). They can search or call for help and they can help others.
- **Third Level of Affection:** Observers or indirect helpers who see or hear about critical situations but cannot report in detail. They could help others.
- **Fourth Level of Affection:** Messengers or public facilities who cannot see but tell that something has happened and where it is. They could help others.

In view of the challenges and the various forms of communication, the most vital requirement referring to [Hagar \(2010\)](#) is to get the right information to the right person at the right time.

2.3. Means of Communication

At first glance human-to-human communication appears to be the only option to receive personalized information. In this way, the own situation can be described and required information can be retrieved. Media such as radio, television, flyers or sirens are unsuitable, as an exchange between the communication parties is needed. Because direct communication from the authorities to citizens cannot detect the citizen's needs, if the backchannel to ascertain the needs is missing.

For a bi-directional exchange other communication methods seem to be more convenient. Probably the easiest way is a face-to-face conversation or a phone call. In this context, the set of acquaintances as well as appropriate experts (e.g. emergency personal) serve as sources of information and recommenders of actions or instructions ([Whalen & Zimmerman, 1990](#)). Possible limitations arise in this case if it is not possible to address or to call another person, for example, when the person got into a critical situation himself and is not able to make calls or speak due to the circumstances. Social media represent another means of bi-directional exchange. In contrast to mass communication through traditional media, for the most part the receiver knows who the

transmitter of information from social media is. These provide information on different areas in crises. First, the exchange between relevant persons can be carried out in real time and people can search for published news. In addition, various initiatives are launched through social networks in crises, e.g. to coordinate volunteer help and helping others to cope with the crisis (Kaufhold & Reuter, 2014). A big advantage of social media communication is the possibility to use it on the go anywhere. Among other things, a disadvantage is that the information in social media often does not come from authorized sources or security organizations.

Although the authorities provide many media for different situations, they must be taken to the citizens, because mostly they do not know that such media exist. According to Leach's theory (Leach & Campling, 1994), facing a crisis is difficult, because people do not deal with potential crises or dangerous situations before they occur. Accordingly, they must first identify the relevant information corresponding to the phase of the crisis and the person concerned. In crises people likely use the channels that they prefer to use otherwise (see schematic behavior *before crisis*). Social media offer access to content by various technologies that people already use a lot every day and on the go. Taking into account the mentioned aspects, mobile technologies offer a combination of different functions that can provide an attractive solution both in terms of the behavior of people in crises as well as the communication challenges.

2.4. Modern Crisis Communication via Social Media

The relevance of communication by the authorities to citizens through social media was highlighted in various works. In this context, studies focused on past crises to analyze the communicated content. St Denis, Palen, and Anderson (2014) found that authorities do not comply with the citizens communication needs and emphasized the potential of social media for crisis communication. Previous studies already stated the essentiality of mobile peer-to-peer communication in phases of crises (Palen, Vieweg, Liu, & Hughes, 2009). Ivarsson (2015) also emphasized the significance of the involvement of the public for crisis communication. Tapia and LaLone (2014) indicated the use of social media communication in the context of the Boston Marathon Bombing. Other studies emphasized a consideration of volunteers through social media, because in crises people tend to help each other and need to be coordinated (Condon & Robinson, 2014; Purohit et al., 2014; Van Gorp, 2014). Furthermore, Magnusson and Öberg (2015) stated that crisis training is a fundamental user need. Hence, this aspect should also be integrated into modern crisis communication.

In relation to the development of crisis-related social media, Hughes, St Denis, Palen, and Anderson (2014) identified design proposals for crisis communication analyzing past postings from social media. They propose to highlight important information related to a crisis so that it can be found quickly. This proposal can also be applied to the use of apps. In a crisis-specific app the attention to such information can be increased because of the crisis focus of the app. Relating to the thesis by Downs (2011) this would highlight the personal relevance and usefulness for affected people. Roos, van Buul-Besseling, Streefkerk, and Neef (2015) have derived success factors for crowdsourcing platforms. They describe motive alignment of the crowd as an important factor for the usage of such technologies. Choi, Choi, and Kim (2012) already considered motivational aspects of app usage and found a correlation between extrinsic motives and trust.

Research in the field of crisis context focuses increasingly on the use of apps to support the communication and interaction between victims and the helping actors (e.g. Bean et al., 2015; Cheng, Liang, & Leung, 2014; Reuter, 2014). Therefore, in the following, various apps are analyzed based on their features to outline their advantages and disadvantages for crisis communication.

3. USE OF APPS IN CRISIS AND EMERGENCY SITUATIONS

The numerous functions of smartphones including MTS, GPS, camera and data memory enable various application options. Location-based information can support people by promoting situational awareness. If MTS or GPS do not work people can still use preprogrammed instructions. Also people can participate and share vital information with others. Köllen (2015) described different crisis apps for weather or hazard warning (*KATWARN*¹), search for objects that were buried by avalanches (*Galileo-LawinenFon*²), first aid instructions (*Malteser Erste-Hilfe-App*³) or current investigations of wrong-way drivers (*ANIK*⁴). Moreover, there are apps to recruit and coordinate registered volunteers (*Hands2Help*⁵) whereas trained first aiders can register at *Mobile Retter*⁶ and be alarmed in an emergency situation in their immediate vicinity, to get there faster than the ambulance. Depending on the context of a crisis or disaster, there are different objectives of communication. The crisis communication can be supported by the use of apps, whereby the uncertainty of affected people can be reduced.

3.1. Characteristics of Crisis Apps

In the following, the mentioned apps (Köllen, 2015) and their functions will be presented to illustrate the possibilities for the use of apps in critical situations. To give a better overview, we present other apps that are similar to the already mentioned ones. These apps address different roles of affected people and their level of affection in various contexts. They promote an information gain, provide behavioral instructions, coordinate people in crises and provide useful support in other critical situations. It should be noted that the objective is not to investigate the apps to see if they are well designed or how popular they are. Furthermore, it should be noted that the featured apps exemplify an overview of the various areas of application for the discussed problems. There are many other areas for the use of apps for example in the context of security, such as location trackers for kinds or pets (*trax*⁷). The aforementioned apps can be considered in various operational scenarios.

3.1.1. Apps with Alarm for Situation Awareness

There are apps like *KATWARN* and *ubAlert*⁸ that send messages or alerts to the users of the apps and thus inform them of the situation or a disaster, such as storms, epidemics or fires. With *KATWARN* users are warned via push-notification by civil protection authorities, fire departments and by the German Weather Service (Fuchs-Kittowski & Faust, 2014). They can share the warnings and forwarding them via SMS. Similar to *KATWARN*, *ubAlert* allows users to indicate their residence to get location-specific information within a specified radius via email or SMS. However, users can also take action themselves by creating warnings and passing them on to the app (Ibrahim et al., 2013). Following a review of the relevance of the message by the operator, all registered users who are located within the warning area will be informed. The warnings are displayed graphically on a map and can be filtered by time, location, severity, credibility and category if required. There is also information about the state of the message (rumor vs. confirmed message). The app has a collaboration aspect as messages can be broadly shared and commented by users.

As another example of warnings via apps, the student project *ANIK* from the University of Clausthal can be cited. Drivers on a highway can be warned faster by the app than by traffic reports that a wrong-way driver is located in their vicinity (ITS Niedersachsen News, 2014). This works by transmitting the mobile data of all drivers to the roadway pillars, whereupon an

evaluation of the data ensues. If a vehicle, which is traveling in the wrong direction, is detected, other drivers in the vicinity are alarmed within a second via message.

3.1.2. Apps for Sending Alarms and Asking for Help

There are various forms of apps to submit alarms or emergencies. Avalanches represent a special scenario, where the person in distress can no longer ask for help actively. The app *iSis*⁹ supports an automatic alarm if the user has an accident or is buried by an avalanche. Therefore, the *iSis* system recognizes the traveled distance, the height differences and the user's mobility in real-time (Floyer, 2013). Users who are conscious can also trigger a manual emergency alarm. In both cases the corresponding resorts, emergency services or registered users (favorites) are alerted via push notification. The user receives direct feedback about his or her call, wherein a first ring tone signals that a distress signal was sent, and a second ring tone indicates that the distress signal has been received. To use the app, an Internet connection or Bluetooth is required. The *Galileo-LawinenFon* uses satellite technology to locate the persons concerned (Meiboom, 2014). This way, a very accurate localization of the position of the device that sends an alarm is possible.

The emergency app *Malteser Notruf-App*¹⁰ is an all-round alarm system and can be used anywhere. It is not specialized for any specific area. With this authorized app people can send emergency calls to predetermined representatives (by SMS) or to an emergency call center (automatic voice connection to the Malteser emergency central). The exact GPS based location and stored information such as pre-existing conditions are forwarded with the call. However the use of this app is fee-based.

3.1.3. Apps for Behavioral Instructions and Support

Apps for behavioral instructions or step-by-step instructions in critical situations provide users with information to act independently in various scenarios. The first-aid app by Malteser (*Malteser Erste-Hilfe-App*) uses images and short texts to guide the user through important actions, based on simple guiding questions to situation-specific provisions (e.g. securing the accident scene) and first aid instructions (e.g. in cases of poisoning or wounds). This content was created based on training requirements for the Assistance Service and should therefore serve as a kind of first-aid training. In addition, the app contains a link to related courses.

The *St John Ambulance First Aid*¹¹ app also works with step-by-step instructions by pictures and brief descriptions for numerous issues, including asthma, drowning, cold and heat accidents. Some instructions differentiate between aid for adults, children and infants (e.g. resuscitation). Additional, auditioned guides can instruct the user by voice.

3.1.4. Apps for Volunteers

The app *TeamRedCross*¹² allows registered users to advertise posts for volunteers or respond to listings. Newly issued alerts that come up within the specified location of the user will be forwarded via push-notification. If the user is interested in the offer, he can prepare on the basis of bullet points, videos or simple quizzes in the app, e.g. he learns how a drowning child can be saved and what should be noted doing this. Then the user can decide whether he wants to accept the commitment. Operations are advertised for situations such as fires, floods, storms and other disasters. As an incentive for volunteering digital badges and achievements are awarded for numerous commitments. The app also allows forming a team with other registered users to be in direct contact with them. Further, alerts can be divided into social networks to inform other people and ask them to volunteer.

Another app for volunteer workers is *Hands2Help*. Using the app requests for assistance from citizens by authorities and support services can be captured spontaneously and routed to the right helpers. These are identified by their profiles and customizable criteria (e.g. skills, access routes and equipment) with the aid of an algorithm. Users are alerted via the app and get information after a certification about their commitment, e.g. for filling sandbags or providing supply to helpers (Hofmann, Betke, & Sackmann, 2014).

3.1.5. Apps for Trained First Aiders

Mobile Retter is an app that is based on a similar principle as *Hands2Help*. With the *Mobile Retter* app trained first aiders that are located in close proximity can be alarmed in parallel to emergency services. The proximity is checked via GPS by the control center. If the first aider accepts the call, he gives feedback to the central office via the app and gets the exact emergency location immediately so that he can move towards that location right way. Due to this physical proximity the mobile first aiders are often at the crash scene to initiate life-saving measures before the emergency services arrive (Stroop, Strickmann, & Kerner, 2015). This increases the chances of survival of the affected. To guarantee a high quality of aid, the access to the app is limited to registered first aiders with reviewed qualifications.

This app is different from the aforementioned ones. The other apps are used in the context of assistance and for information gain. *Mobile Retter* focuses on an effective deployment of people with trained skills in crises. Nevertheless, this app is an example of a sensible solution and effective communication in critical cases.

Taking into account the areas of application of the listed apps for critical and dangerous situations, it can be stated that apps provide a replacement opportunity for other communication means, both for one-way as well as for bi-directional communication. Moreover, in crisis situations various audiences can be addressed with apps and perform various actions with these apps. Table 2 shows a summary of the emphasized characteristics of the described apps.

Likewise, using apps facilitates a combination of different media. Information may be consumed by apps instead of using radio, television, or print media. Warning sirens or vehicles can be replaced by alerts via smartphones and behavioral instructions can be supplanted by using imagery and short text in apps. On the other hand apps also have specific restrictions that should be considered.

3.2. Advantages and Disadvantages of Apps for Critical Situations

The ideas and scenarios of the described apps show the variety of applications for different situations. To analyze the usefulness of the apps, they should be considered in terms of the crisis phases by Leach (Leach & Campling, 1994) and the communication challenges by Hagar (2010). Thus, the advantages and disadvantages of individual apps and their functions can be revealed.

3.2.1. Related to Crisis Phases and Human Behavior

Mayer (2012) posited that the value of apps is determined by quick access to information and need-based services. An underlying advantage of mobile crisis communication is reflected in the prompt reporting. The short path of an announcement to a citizen via smartphone is clearly superior to other communication media such as newspapers, radio and television. It highlights the perceived topicality of information and immediately attracts the attention of users. For direct response apps support another useful function. Location-specific information transfer using detection by GPS can support the assessment of the situation and highlight the personal relevance, cf. Downs (2011). This supports the statement made by [Renner and Gamp \(2014\)](#), as this con-

Table 2. Characteristics of the sample of apps for critical situations

App Name	Communication Direction	Actions	Addressees	Level of Affection
KATWARN	Bi-directional	Consume and participate	Everyone	Any
ubAlert	Bi-directional	Consume and participate	Everyone	Any
ANIKA	One way	Consume	Drivers	2
Galileo-LawinenFon	Bi-directional	Participate	Anyone in avalanche zones	1 + 2
iSis	Bi-directional	Participate	Anyone in avalanche zones + climber	1 + 2
Malteser Notruf-App	One way	Participate	Everyone	1 + 2
Malteser Erste-Hilfe-App	One way	Consume	Everyone	Any
St John Ambulance First Aid	One way	Consume	Everyone	Any
TeamRedCross	Bi-directional	Consume and participate	Everyone	2 + 3
Hands2Help	Bi-directional	Consume and participate	Everyone	2 + 3
Mobile Retter	bi-directional	Consume and participate	Trained first aiders	4

textual information can help to asset the situation. For example, through warning services like *KATWARN* and *ubAlert* that issue location-specific information on danger spots such as major fires or storms, the own risk perception can be increased (see phase *before*). *ANIKA* provides effective situation specific real-time information because the message is directly reported and not relayed through third parties. *KATWARN* even adds behavioral advice to the warning information, so that the users can reduce the loss of control by seeing actual opportunities for action. As a result, the alertness to potential involvement and the motivation for protective measures can be increased (Al-Akkad & Floor, 2014).

On the other hand, using preinstalled information such as guidance documents (Reuter & Ludwig, 2013) can encourage the autonomous action of affected in critical situations (cf. schematic behavior in the phase *during*). The advantage of the apps in this case is that these documents can be used even without Internet and mobile connections. Apps like the first aid apps *Malteser* and *St John Ambulance First Aid* provide step-by-step instructions and serve as support against uncertainty (cf. phase *during*). This provides an advantage in terms of immediate availability compared to other communication media such as information flyers like the “Guide to emergency preparedness and right action in emergency situations” (BBK, 2013). The information can be accessed directly from the app and instruct the actors. Accessing preinstalled content may also satisfy an immediate need for information. If that is not sufficiently, there is the possibility to ask for help, e.g. with the app *Malteser Notruf-App*. This function is a known practice in accordance with the usual handling of calls and messages (cf. schematic behavior in phase *during*). The app also provides the benefit of stored personal data that is sent with the emergency call. If the affected is not able to ask for help, functions such as the implementation of the automated alarm

and call for help are useful, e.g. *Galileo-LawinenFon* and *iSis*. With the localization function victims are rescued quickly, which is especially important if they are buried or unconscious.

After the crisis, people's behavior is characterized by their awareness of the crisis extent, but they cannot deal with the situation and suppress feelings. It was assumed that in this phase the citizens have to deal with the particular experiences and thus require corresponding feedback and support. To ask for help or to provide assistance the users can make announcements with apps, e.g. *Hand2Help* and *TeamRedCross*. Through the request for assistance and the related talk those affected cope better with the crisis, which can also be promoted by offering help.

3.2.2. Related to Information Challenges

Regarding the information challenges by Hagar (2010) mobile communication offers many useful approaches. The importance of information was shown by the detailed reflection of human behavior in crises. So the challenge of changing information needs at various stages of a crisis can be solved with the use of apps. But the needs of affected are not only related to the accessibility of information. The provided information must meet certain criteria.

In crises, it is important that information is quickly and easily accessible in order to avoid information overload (Cromdal, Osvaldsson, & Persson-Thunqvist, 2008; Turoff, Chumer, de Walle, & Yao, 2004). The *Malteser Erste-Hilfe-App* and *St John Ambulance First Aid* contain many details and have several navigation steps before the user reaches the desired information. Likewise, the user has to assess which information fits his or her needs best in the current situation. However, apps such as *KATWARN* may have the disadvantage that the necessary information cannot reach the user, since GPS does not work. Alternatively, it is possible that the user is suddenly confronted with a situation that has not yet been recognized by the authorities and therefore there is no notification about it. Thus, the user experiences helplessness.

The dissemination of information is facilitated by the ability to share it, e.g. *KATWARN* and *iSis*. Furthermore, many apps refer to the source of information contained within the app, so users can obtain content from entities such as government agencies and organizations they trust. However, apps do not provide benefits related to information uncertainty or conflicting information, because these challenges depend on the source of the information. Perhaps users may trust the information in the app and feel guided by its information if they trust the source.

The biggest advantage is the ability to get personalized information, due to location-based information in real time, filtering options (cf. *ubAlert*) and stored user profiles (cf. *Malteser Notruf-App*). Many apps help overcome the challenge to get the right information to the right person at the right time (Hagar, 2010). Another advantage is that a lot of information can be communicated and gathered in one place (cf. *KATWARN*). However, it seems to be rational to use several means of communication. To reach different audiences, apps should be considered as an additional option to communicate the relevant information because of the restrictions of smartphone usage.

3.2.3. General Advantages and Disadvantages

Considering the different featured apps, it is unfortunate that different apps for specific scenarios exist and there are already several solutions for each scenario. The user must decide which app is suitable for him, which can lead to uncertainty and fear of the wrong choice (Schwartz, 2004). This can be a problem especially if the person is in a crisis and the choice of the right app is overwhelming. In this context, it makes sense that the app is installed already before the crisis occurs. If the mobile device has a pre-installed app, there is no need to make a choice, which would promote confidence in the app (Rademacher, 2012). A further advantage of pre-installed

apps is that registration and the collection of profile data can be handled before the crisis occurs, so this information is already present in a crisis situation.

If an app is only available commercially and thus costs money (e.g. *Malteser Notruf-App*) that is a disadvantage in comparison to other information channels. Likewise, it is disadvantageous if additional hardware is necessary, e.g. *Galileo-LawinenFon*. As already indicated, it can be assumed that the usage of some apps is not intuitive (see. *Malteser Notruf-App* and *St John Ambulance First Aid*), so users may resort to more familiar media or functions such as a phone. General limitations of the app usage in crises are battery life and GPS availability.

Based on the assumption that apps represent an additional means of communication in times of crises, many advantages may be recorded. In terms of the level of affection, various groups of people (cf. *KATWARN*) and roles (cf. *Mobile Retter*) can be addressed directly for different scenarios with apps. Another advantage is the ability to get the content and information personalized, e.g. filtering of relevant information in *ubAlert* and create profiles with *Malteser Notruf-App*. Although a direct emergency call is to be preferred, in the case of reception problems a behavior instruction via app can be very helpful to reduce panic reactions. Likewise, it should be emphasized that information as a combination of image, text and language may support different users needs. Table 3 shows a summary of the advantages and disadvantages of the presented apps.

On the basis of the presented issues, the use of smartphones and its mobility constitute advantages for the basic crisis communication. However, only specific apps provide crisis-relevant and needs-oriented features. Compared to other crisis communication channels, the advantage that apps provide is that they allow for the combination of multiple channels. To successfully exploit these advantages, however, several aspects have to be considered.

Table 3. Advantages and disadvantages of the presented crisis-related apps

Advantages	Disadvantages
<p>Speed:</p> <ul style="list-style-type: none"> • Short and quick route towards the notification of users (<i>ANIKA</i>) • Possibility to set an individual, automatic alarm, which sends an emergency call when users have lost the ability to send one by themselves (<i>Galileo-LawinenFon</i>, <i>iSis</i>) 	<p>Reliability:</p> <ul style="list-style-type: none"> • The app usage depends on the battery life of the mobile phone and the GPS availability • Relevant information may not reach the user, if the GPS is malfunctioning (<i>KATWARN</i>) • Different information sources can conflict and undermine the trust in the provided information
<p>Personalization:</p> <ul style="list-style-type: none"> • Location-specific information can be send to the users to help them assess the current situation (<i>KATWARN</i>, <i>ubAlert</i>) • Custom tailored information based on predefined user profiles (<i>Malteser Notruf-App</i>) and filters (<i>ubAlert</i>) • Ability to send personal data embedded in the emergency call to speed up the dispatching process (<i>Malteser Notruf-App</i>) 	<p>Scope:</p> <ul style="list-style-type: none"> • Users can not receive information for crisis situations, which have not yet been recognized by the authorities • Some apps are not free of charge or may require additional hardware to function, which reduces the number of potential users (<i>Malteser Notruf-App</i>, <i>Galileo-Lawinenfon</i>)
<p>Flexibility:</p> <ul style="list-style-type: none"> • There are apps for various roles and groups within a crisis (<i>KATWARN</i>, <i>Mobile Retter</i>) • Possibility to combine multiple channels within a single app • Preinstalled information can be accessed even when the user has no internet connection or GPS-signal (<i>Malteser</i>, <i>St John Ambulance First Aid</i>) 	<p>Confusion:</p> <ul style="list-style-type: none"> • Usually multiple steps are needed to reach the desired information within an app (<i>Malteser Erste-Hilfe-App</i>, <i>St John Ambulance First Aid</i>) • There is an oversaturation of apps for specific scenarios, which may confuse potential users (<i>KATWARN</i>, <i>iSis</i>)

4. REQUIREMENTS FOR CRISIS-RELATED APPS

As already pointed out, many people own a smartphone and can use apps. The trend is rising (Statista, 2015). More and more people own smartphones, which means that the daily life use of these devices also increases. The individually optimized offers of smartphones via apps promote the convenience of users, according to the principle “I need an app that tells me when to do some sports or how the weather will be today” (Rademacher, 2012). The desire for an everyday support and a certain basic trust in the capabilities of apps seem to be a good prerequisite for the use and success of mobile applications in a crisis context. Similarly, benefits of apps can be expected in terms of objectives of crisis communication. Therefore it can be assumed that apps provide a practical alternative and a meaningful additional media to convey relevant information to affected people in crises. In particular, benefits can be seen in terms of human behavior support.

In order to harness the advantages offered by such apps and to counteract the disadvantages, various requirements for a successful solution for mobile crisis communication must be considered. Thus, the coverage and consideration of different functions based on analyzed apps appears to be advisable. With regard to the featured apps it can be concluded that the communication solution should include all of the following functions, in order to present an effective communication and exchange solution for different levels of affection and thus problems during crises:

- The app should offer the option to *get information and news*, which should be done in real time. The information should be communicated to the users directly and attract their attention, e.g. by alerts.
- The ability to *inform oneself independently* about specific content, in the sense of guidance and best practices, provides another important function for the app. This would promote autonomous actions and impart a sense of control. Another important aspect is that such information must also be accessible without an Internet connection.
- The option to *share and disseminate information* is important. It should be possible to share the given information from within the app with friends, acquaintances or other stakeholders (in close proximity) from within the app and distribute crisis relevant content. Thereby people can be addressed who have not received the message, for example, those without the app. Just as well, the app should allow to convey the own status, which is important for the contacts as well as for authorities and helpers.
- Furthermore, the function to *ask for help* appears to be very useful for such an app. Distinction should be made between the ability to dispatch an emergency autonomously and the option of automatic emergency calls. This is helpful as a person can ask for help in a dangerous situation, or the system triggers an alarm if the person cannot do it by himself. The possibility of an automatic aid call is an important advantage of apps in crises.
- An additional function is the option to *offer help* and to become a helper. The app allows coordinating volunteers and deploying them at appropriate places. People may also be prompted to provide assistance through the app.

The various functions are important because all individuals and thus levels of affection must be addressed. For a uniform solution considering all of the affected groups is fundamental. Thus, the personal relevance can be increased, as their behavior can be addressed in different situations, even if their situation or level changes (c.f. Downs, 2011). The precondition is that the app can be used *location-specific* and functions can be *personalized*. Hence, the content should be customized, e.g. with personal details and preferences of usage. With regard to the design and usability, the following aspects of the app should be considered. A combination of the functions and *links between the individual functions* should be added, so that other actions

can occur directly from the various functions, e.g. information should animate to action and contain a forward to the appropriate behavioral instructions. In terms of the mentioned apps with behavior instructions, long navigation routes should be avoided to get the user to relevant content quickly by *referring to other important communication media* (radio, television etc.), so only the most important information is included in the app and available ad-hoc. Here, the reference to general emergency call numbers such as 911 (US) and 112 (Germany) appears to be particularly important.

For the success of a crisis app the following additional notes should be observed. It is essential that user have the opportunity to *receive feedback* from the system for all actions and functions. The fact that a user gets feedback enables him to assess the behavior and to get a feeling of security and control over his or her actions and the critical situation. Furthermore for a useful solution the content is as important as functioning technology. Thus, the emergency service or other sources of information must provide *up to date content*, so the affected have input at various stages of the crisis. Also the communication of uncertain content is important in order to obtain the trust of citizens and to keep them on the cutting edge of things. Taking into account the fact that people do not download such apps in advance of a crisis (c.f. *first phase*), the app should be *pre-installed on mobile devices*.

5. CONCLUSION

This paper discovers the possibilities of apps in relation to critical situations and the necessary functions. In response to the research question, the benefits and crisis-specific characteristics of apps with regard to behavior and communication challenges have been discussed. As factors for the design of an efficient communication app in critical situations different functions were derived based on the needs of people. The design solution addresses the need to be informed during crises, to be guided, to offer help and enable the exchange with other affected. Other crisis communication means can be supported by apps, as apps are used as an additional means of communication, if the user will not be confused by the variety of the available functions.

There is a need to investigate the acquired concept for a communication solution that meets the different requirements of a crisis communication app. Our next steps imply an analysis of user requirements for apps in critical situations. Using these requirements, we will develop a first demonstrator that should be used to establish whether the design concept is sufficient to be an efficient communication app.

Thus, this paper provides a first contribution to addressing behavioral factors in mobile support in crisis communication. The exposed advantages of apps based on a theory of human behavior as a function of perceived risk and taking account of objectives of crisis communications are to be viewed critically, as they serve as an initial theoretical basis and there is no empirical evidence. To determine the usefulness of apps as a reliable helper in a life-threatening situation and its acceptance, further research approaches should focus on the aspect of trust because trust is a relevant factor for the use of an app or smartphone (Rademacher, 2012).

ACKNOWLEDGMENT

We would like to thank Sandra Jürgensmeier, Marius Gördes and Dennis Ziebart for their research help and contributions. This research is supported by a grant from the German Federal Ministry of Education and Research (BMBF) as part of the INTERKOM Project (No. 13N1005, 01/2014 – 12/2016). The paper is an enhanced and improved version of a paper presented at the 2015 Workshop “KritischeHCI” (Karl, Rother, & Nestler, 2015).

REFERENCES

- Al-Akkad, A., & Boden, A. (2014). Kreative Nutzung der verfügbaren Netzwerkinfrastruktur im Katastrophenfall/Creative usage of available network infrastructure in disaster situations. *i-com*, 13(1), 45-52.
- Bean, H., Sutton, J., Liu, B. F., Madden, S., Wood, M. M., & Mileti, D. S. (2015). The Study of Mobile Public Warning Messages: A Research Review and Agenda. *Review of Communication*, 15(1), 60–80. doi:10.1080/15358593.2015.1014402
- Brewer, N. T. (2011). Goals. In B. Fischhoff, N. T. Brewer, & J. S. Downs (Eds.), *Communicating risks and benefits: An evidence-based user's guide* (pp. 3-10). Government Printing Office.
- Cheng, Y., Liang, J., & Leung, L. (2014). Social network service use on mobile devices: An examination of gratifications, civic attitudes and civic engagement in China. *New media & society*, January 30.
- Choi, H., Choi, Y. J., & Kim, K. M. (2012, January). The understanding of building trust model on smartphone application: focusing on users' motivation. *Proceedings of the International Conference on IT Convergence and Security 2011* (pp. 13-20). Springer Netherlands. doi:10.1007/978-94-007-2911-7_2
- Condon, S. L., & Robinson, J. R. (2014). Communication Media Use in Emergency Response Management. *Proceedings of 11th International Conference on Information Systems for Crisis Response and Management (ISCRAM '14)*, University Park, PA, USA.
- Cromdal, J., Osvaldsson, K., & Persson-Thunqvist, D. (2008). Context that matters: Producing “thick-enough descriptions” in initial emergency reports. *Journal of Pragmatics*, 40(5), 927–959. doi:10.1016/j.pragma.2007.09.006
- Downs, J. (2011). Evaluation. In B. Fischhoff, N. T. Brewer, & J. S. Downs (Eds.), *Communicating risks and benefits: An evidence-based user's guide* (pp. 11-18). Government Printing Office.
- Federal Ministry of the Interior (Bundesministerium für Inneres). (2008, July). *Krisenkommunikation. Leitfaden für Behörden und Organisationen* (pp. 19-21). Referat KM1, Berlin.
- Federal Office of Civil Protection and Disaster Assistance (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe). (2013, August). *Ratgeber für Notfallvorsorge und richtiges Handeln in Notsituationen*, Bonn. Retrieved from http://www.bbk.bund.de/SharedDocs/Downloads/BBK/DE/Publikationen/Broschueren_Flyer/Ratgeber_Brosch.pdf?__blob=publicationFile
- Floyer, J. (2013). *Smartphone Avalanche Search Apps—A Review*. Canadian Avalanche Centre.
- Fuchs-Kittowski, F., & Faust, D. (2014, September 7-10). Architecture of Mobile Crowdsourcing Systems. *Proceedings of the Collaboration and Technology: 20th International Conference CRIWG '14, Santiago, Chile* (Vol. 8658, p. 121).
- Hagar, C. (2010). Crisis informatics: Introduction. *Bulletin of the American Society for Information Science and Technology*, 31(6), 6–10.
- Herzog, G. (2004). *Psychologische Aspekte von Großschadensereignissen und Katastrophen*. Springer Vienna.
- Hofmann, M., Betke, H., & Sackmann, S. (2014). Hands2Help—Ein App-basiertes Konzept zur Koordination Freiwilliger Helfer/Hands2Help—An App-based Concept for Coordination of Disaster Response Volunteers. *i-com*, 13(1), 29-36.
- Hughes, A. L., St Denis, L. A., Palen, L., & Anderson, K. M. (2014, April). Online public communications by police & fire services during the 2012 Hurricane Sandy. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1505-1514). ACM. doi:10.1145/2556288.2557227
- Ibrahim, L. F., Albatati, R., Batweel, S., Shilli, R., Bakeer, M., & Al Laban, T. A. (2013). Safety of natural disasters. In *Design, User Experience, and Usability. User Experience in Novel Technological Environments* (pp. 85-94). Springer Berlin Heidelberg. doi:10.1007/978-3-642-39238-2_10

ITS Niedersachsen News. (2014). *Netzwerkpartner starten ANIKA Projekt – Intelligente Erweiterung von Notrufsäulen*. Retrieved from http://www.its-nds.de/media/newsletter/Journal_2_2014_Screen.pdf

Ivarsson, S. (2015). New method for evaluation of crisis communication in exercises—involve the public. *Proceedings of 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM '15)*, Kristiansand, Norway.

Karl, I., Rother, K., & Nestler, S. (2015). Begleiter und Helfer in der Not-Apps für Krisen und Gefahrenlagen. In A. Weisbecker, M. Burmester, & A. Schmidt (Eds.), *Mensch und Computer 2015–Workshopband* (pp. 29–35). Stuttgart: De Gruyter Oldenbourg.

Kaufhold, M. A., & Reuter, C. (2014). Vernetzte Selbsthilfe in Sozialen Medien am Beispiel des Hochwassers 2013 [Linked Self-Help in Social Media using the example of the Floods 2013 in Germany]. *i-com*, 13(1), 20-28.

Köllen, K. (2015, April 4). *Smartphone - So wird das Handy zum Lebensretter*. Wirtschaftswoche. Retrieved from <http://www.wiwo.de/technologie/digitale-welt/smartphone-so-wird-das-handy-zum-lebensretter/11535966-all.html>

Leach, J., & Campling, J. (1994). *Survival psychology*. Macmillan. doi:10.1057/9780230372719

Magnusson, M., & Öberg, L. M. (2015). Crisis Training Software and User Needs—Research Directions. *Proceedings of 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM '15)*, Kristiansand, Norway.

Mayer, A. (2012). *App-Economy*. München: Milliardenmarkt Mobile Business.

Meiboom, M. (2014). *Untersuchungen zum Einsatz von UAVs bei der Lawinenrettung*. Deutsche Gesellschaft für Luft-und Raumfahrt-Lilienthal-Oberth eV.

Palen, L., Vieweg, S., Liu, S. B., & Hughes, A. L. (2009). Crisis in a networked world features of computer-mediated communication in the April 16, 2007, Virginia Tech Event. *Social Science Computer Review*, 27(4), 467–480. doi:10.1177/0894439309332302

Purohit, H., Bhatt, S., Hampton, A., Shalin, V., Sheth, A., & Flach, J. (2014). With Whom to Coordinate, Why and How in Ad-hoc Social Media Communities during Crisis Response. *Proceedings of the 11th International Conference on Information Systems for Crisis Response and Management*. University Park, Pennsylvania (Vol. 12).

Rademacher, U. (2012). Treue Begleiter. Die Psychologie der App-Nutzung. *Research & Results*, 3, 40.

Renner, B., & Gamp, M. (2014). Krisen- und Risikokommunikation. *Prävention und Gesundheitsförderung*, 9(3), 230–238. doi:10.1007/s11553-014-0456-z

Reuter, C. (2014). Communication between Power Blackout and Mobile Network Overload. *International Journal of Information Systems for Crisis Response and Management*, 6(2), 38–53. doi:10.4018/ijiscram.2014040103

Reuter, C., & Ludwig, T. (2013). *Anforderungen und technische Konzepte der Krisenkommunikation bei Stromausfall* (pp. 1604–1618). GI-Jahrestagung.

Roos, B., van Buul-Besseling, K., Streefkerk, J. W., & Neef, M. (2015). Recover Faster from Disaster: Success Factors for a Crowdsourcing Platform. *Proceedings of 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM '15)*, Kristiansand, Norway.

Schwartz, B. (2004, January). The paradox of choice: Why more is less. New York: Ecco.

St Denis, L., Palen, L., & Anderson, K. M. (2014). Mastering Social Media: An Analysis of Jefferson County's Communications during the 2013 Colorado Floods. *Proceedings of the Information Systems for Crisis Response and Management Conference (ISCRAM 2014)*.

Statista. (2015). *Anzahl der Smartphone-Nutzer in Deutschland in den Jahren 2009 bis 2015*. Retrieved from <http://de.statista.com/statistik/daten/studie/198959/umfrage/anzahl-der-smartphonennutzer-in-deutschland-seit-2010/>

Stroop, R., Strickmann, B., & Kerner, T. (2015). Ersthelfer-Alarmierung per Smartphone. *Deutsches Arzteblatt*, 112(24), 18.

Tapia, A. H., & LaLone, N. J. (2014). Crowdsourcing Investigations: Crowd Participation in Identifying the Bomb and Bomber from the Boston Marathon Bombing. *International Journal of Information Systems for Crisis Response and Management*, 6(4), 60–75. doi:10.4018/IJISCRAM.2014100105

Turoff, M., Chumer, M., de Walle, B. V., & Yao, X. (2004). The design of a dynamic emergency response management information system (DERMIS). *Journal of Information Technology Theory and Application*, 5(4), 3.

Van Gorp, A. F. (2014). Integration of Volunteer and Technical Communities into the Humanitarian Aid Sector: Barriers to Collaboration. *Proceedings of the Information Systems for Crisis Response and Management Conference (ISCRAM 2014)*.

Vorst, H. C. (2010). Evacuation models and disaster psychology. *Procedia Engineering*, 3, 15–21. doi:10.1016/j.proeng.2010.07.004

Whalen, M. R., & Zimmerman, D. H. (1990). Describing trouble: Practical epistemology in citizen calls to the police. *Language in Society*, 19(04), 465–492. doi:10.1017/S0047404500014779

ENDNOTES

¹ <http://www.katwarn.de> (accessed: 27-May-2015)

² <http://www.lawinenfon.eu/> (accessed: 01-September-2015)

³ <http://www.malteser.de/erstehilfeapp.html> (accessed: 27-May-2015)

⁴ <https://www.tu-clausthal.de/presse/nachrichten/details/1621.html> (accessed: 01-September-2015)

⁵ <http://informationsmanagement.wiwi.uni-halle.de/projekte/hands2help/> (accessed: 27-May-2015)

⁶ <http://www.mobile-rettet.de> (accessed: 27-May-2015)

⁷ <http://www.traxfamily.com> (accessed: 01-September-2015)

⁸ <https://www.ubalert.com> (accessed: 01-September-2015)

⁹ <http://www.isis-application.com/> (accessed: 01-September-2015)

¹⁰ <http://www.malteser-notruf-app.de> (accessed: 01-September-2015)

¹¹ <https://www.sja.org.uk/sja/support-us/the-difference/helpless/mobile-phone-app.aspx> (accessed: 01-September-2015)

¹² <http://www.redcross.org/mobile-apps/volunteer-app> (accessed: 01-September-2015)

Inga Karl studied Applied Cognitive and Media Science at the University of Duisburg-Essen, Germany (MSc). Currently she is a researcher at the Hamm-Lippstadt University of Applied Science in the project INTERKOM with a focus on Crisis-Related Interactive Systems. Further research focuses on Human-Computer Interaction, Usability and Social Media.

Kristian Rother studied Business Information Systems at the University of Duisburg-Essen, Germany (Dipl.-Wirt.-Inf.). Before entering academia he worked as a programmer, project manager and VP of marketing at a software company. He was a researcher at the University of Duisburg-Essen in the field of Artificial Intelligence. Currently, he is a researcher at the Hamm-Lippstadt University of Applied Sciences with a focus on Human-Computer Interaction, Virtual Reality, Augmented Reality and Crisis-Related Interactive Systems.

Simon Nestler studied Computer Science (Dipl. Inf.) at the Technische Universität München, Germany (TUM) and received a PhD for his work on Human-Computer Interaction in life threatening, time critical and instable situations (Dr. rer. nat.) from the TUM. Currently, he holds a professorship at the Hamm-Lippstadt University of Applied Sciences and leads the Human-Computer Interaction research group. His research interests include all topics in Human-Computer Interaction, Social Media, Mobile Computing, Virtual Reality and Augmented Reality, especially with a focus on Crisis-Related Interactive Systems. Simon Nestler is a member of the German UPA and the German Informatics Society.