Emergency Speaking Communication: Experience from the USA and Europe

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Abstract : For coordination of emergency services, minimizing panic and fast response, effective voice communication in an emergency is critical. However, the approaches toward crisis communication are being changed by modern technologies, such as the use of artificial intelligence, automated alert systems, as well as multilingual platforms, yet there are still a few challenges, and these are mainly connected to the human factor on one side and intercultural adaptability of messages on the other. It is a study to analy ze peculiarities of emergency speech communication in general, and American and European experience respectively. Based on a comparative analysis of crisis communication models, content analysis of scientific publications, statistical analysis of effectiveness of digital communication technologies and cognitive analysis of the influence of stress conditions on emergency service operators, the empirical and research methodology is proposed. The research indicates that the ways in which AMERICANs and EUROPEANS communicate in crises utilize different communication approaches such as centralized automated alert systems for AMERICANs and more intercultural adaptation due to the social aspects of communication that applies to EUROPEANS. Further, the level of stress and emotional burnout of dispatchers significantly impacts the accuracy and speed of information transmission, and thus these dispatchers need of psychological aid and training preparation. It is also proved that the introduction of artificial intelligence and fake news detection algorithms can significantly reduce disinformation during crisis situations. The practical significance of the study is to formulate recommendations for improving crisis communication by integrating digital technologies, increasing the resilience of communicators to stress, and improving the adaptation of messages to the cultural characteristics of the population. Promising areas for further research are the development of adaptive models of crisis communication for a multilingual environment, the integration of artificial intelligence for personalized crisis communication, and the improvement of mechanisms to combat disinformation.

Keywords: crisis communication, emergencies, speech communication, artificial intelligence, automated warning systems, intercultural adaptation, disinformation, emergency services, cognitive factors, digital technologies

Introduction

The modern world faces constant challenges that require a quick and effective response. Natural disasters, man-made accidents, pandemics, military conflicts and terrorist attacks all require coordinated communication between the authorities, emergency services and the public. Voice communication is extremely important in a crisis – its quality is key to eradicating the response speed, reducing panic and coordination of actions. Meanwhile, lack of communication can result in false information disseminated, loss of confidence in authority figures, as well as chaos on the part of the victims. In particular, the peculiarities of speech communication in emergency are of special significance in this regard.

The recent studies are analysed and it is shown that crisis communication is a multifactorial process including cognitive, psychological as well as technological and intercultural aspects. The use of modern technologies including artificial intelligence system, blockchain system, and Internet of Things (IoT) appears important to increase information transfer efficiency [1, 2]. Automated alert systems and mobile applications that expedite emergency

services in sending critical information to the public have been given great consideration [3, 4]. European research regards the intercultural interaction and crisis communication in parallel for multitude environment [5, 6]. Moreover, it should be noted that the human factor is of great importance, as well as the psychological state of the emergency services operators, the level of stress and fatigue have a direct impact on the quality of information transmission [7, 8].

However, a number of questions are still open in spite of this significant body of research. Moreover, the long term psychological effects that digital communication has on the state of the people going through a crisis scene have never really been studied too much. The other question which is relevant is the effective integration of the automated alert systems and the human factor making less likely applications of misinformation and more likely perception of emergency messages. Intercultural differences are still insufficiently studied from the standpoint of the influence mechanism of these differences on the effectiveness of speech communication in crisis situations.

The aim of this study is to investigate speech communication peculiarities in emergency situations based on the American and European practice. The main objectives are:

1. On the other hand, the first task is to identify the key factors that determine the effectiveness of speech communication in crisis situations.

2. To characterize the features of the American and European models of crisis communication.

3.As an approach to understand the role of digital technologies and artificial intelligence in speech communication and handling in emergency situations.

4.To study human factor in provision of effective crisis communication.

5.To outline where crisis communication could be developed and offer suggestions on how such improvement may be made.

These results can be of practical use for building more efficient crisis communication strategies, more usage of modern technologies in emergency situations and creation of new efficient ways of interaction between emergency services and the public.

Analysis of the Latest Research and Publications

Current research on emergency speech communication spans the range of subjects from use of modern technologies to the effects of crisis conditions on communication effectiveness and methods for improving it. Emergency communication systems are given considerable attention to their improvement. There is a special role of blockchain technologies and Internet of Things (IoT), influencing medical and social communications availability and security during emergency situations [1, 2]. Furthermore, speech communication is also highly effective in crisis situations due to a human factor. According to studies, the quality of information transmission is dependent on the psychological state of emergency service operators [7, 8]. Additionally, educational programs and trainings intended to increase communication and teamwork skills are also found to improve interaction during high stress [9, 10].

They also compare crisis communication in different regions and international experience in the same. Tackling American studies engage with technological solutions to the problem of crisis management via automated alert system and mobile apps [3, 4]. In turn, European experience emphasizes the intercultural interaction and the adaptation of communication capabilities based on a multi-lingual environment [5, 6]. An example of some studies related to human interaction with robotic and autonomous systems designed as crisis communicators in high risk situations include Taniguchi et al. [11], Hao et al. [12]. This paper analyzes the impact of information technology over crisis communication in maritime transport and unmanned aerial systems. Specifically, as shown by another study, there are crucial instances on autonomous vessel and within a drone context where in information exchange must be optimized [13].

Emergency communication systems are given much interest in their improvement. Furthermore, the scope of artificial intelligence and avatars for promoting trust in automated solutions in the domain of emergency communication is discussed [14]. It analyzes the impact of information technology on the crisis communication in the maritime transport and unmanned aerial systems. More specifically, it is shown in studies, that the information exchange has to be optimized especially in critical situations on autonomus vessels and during use of drones [13].

They are also looking at the social and cognitive components of communication that takes place during emergencies. Liu et al. [15], Vandrevala et al. [16] have shown that crisis interaction needs not only technical means but also

developed communicators' cognitive skills. The results of behavioral analysis in emergency situations confirm the importance preliminary preparation of training personnel on crisis scenarios [17]. In other words, the cognitive aspects of communication in emergencies, its correct structure and the effectiveness of perception and processing of the message determines effectiveness of its perception and processing [18]. If we consider translation activities in the field of emergency communication, they are defining to ensure interlingual interaction that are very important in international rescue operations [19]. Military-political communication is also a key element in crisis situations, as it determines the effectiveness of cooperation between Ukraine, the European Union, and the United States [20]. Some studies have focused on improving the network infrastructure for crisis communication. For example, the peculiarities of mobile communication and its support in emergencies have been studied [21], as well as the effectiveness of the public warning system through automated notification systems [22].

Despite significant advances in research, a number of issues remain unresolved. In particular, the long-term effects of digital communication on the psychological state of people in crisis situations have not been sufficiently studied. Also, the issue of adapting artificial intelligence for effective intercultural communication during emergencies remains open.

Research Methods

The research methods were chosen to provide a comprehensive analysis of speech communication in emergencies, taking into account technological, psychological and socio-cultural aspects. The methodology is based on an interdisciplinary approach that combines qualitative and quantitative methods of analysis. To collect and process the data, we used content analysis methods of scientific publications, regulatory documents and reports of international organizations related to crisis communication. Comparative analysis allowed us to compare American and European experience, identifying key features and differences in their approaches to crisis communication. The empirical part of the study included the analysis of statistical data on the effectiveness of speech communication during crisis situations obtained from open sources and scientific databases. The use of cognitive analysis made it possible to assess the impact of stressful conditions on the quality of speech communication, in particular through the study of communicators' mistakes in emergency situations.

The methods of system analysis and modeling were also used to determine the relationship between technological communication tools and the human factor in crisis conditions. Information-analytical methods contributed to the development of recommendations for optimizing crisis communication by integrating digital technologies and adapting communication strategies to a multilingual and intercultural environment. Taking into account these methods, a structured analysis of the main factors influencing the effectiveness of speech communication in crisis situations was conducted, which allowed to formulate new approaches to its improvement.

Research Results

In emergency situation, effective speech communication is essential to the timely response, the prompt coordination of the emergency response and the public, in the emergencies. Crisis communication is left to today modern approaches based on the unified application of classic and digital technology, as well as application of psychological approaches in the information management due to the interaction strategies with other culture. According to me, one of the vital components of speech communication is the utilization of the digital platforms and Artificial intelligence (AI) to broadcast the vital information in no time. For instance, the Emergency Alert System [22], and the Integrated Public Alert and Warning System are widely used in the United States, for example, to use mobile networks, television and radio from the government by providing emergency messages. These kind of technologies inform population, in a timely basis, of threat, reducing panic and improving the security. The focus is on intercultural communication and adaptation of communication strategies in the context of a multilingual environment in the European context. This is particularly important in countries that share high rates of migration where language barriers can make or break how people perceive information during emergencies. In the sense of cultural peculiarities of communication, Germany and France have devised multilingual alert systems [5].

However, integration of artificial intelligence with autonomous systems within crisis communication system is another important area for the development of speech communication. It is normal for chatbots and virtual assistants to serve to inform the public in disasters where it frees up emergency service operators. By filtering and structuring the large number of requests in such technologies, a quick response is achieved [14]. Psychological factors including the emotional stability of emergency service operators are studied in terms of their effect on the effectiveness of speech communication during crises. Communication errors [7] have been found to occur following transmissions that were affected by the level of stress and fatigue of dispatchers. For this reason, programs for stress resistance and cognitive development of crisis center staff are being developed and implemented in Europe and America [9]. Another

interesting area is also using the blockchain technologies and the Internet of Things (IoT) to guarantee uninterrupted information exchange during crisis. Such technologies are being implemented in the United States in order to implement cybersecurity and preserve medical data, given the importance of the occurrence during pandemics and natural disasters [1]. Blockchain is being used to build decentralized communication networks, which are functional even in the case of failures of traditional communication systems [2].

As a result, the consideration of the technological, psychological and socio-cultural aspects of the using language in emergencies is the subject of modern approaches to language communication in an emergency. The focus of the American experience is on the application of automated systems and digital platforms and the European focus is on intercultural communication and adaptation of communication strategies in a multilingual environment. Going forward, further research should be made in the combination of artificial intelligence with blockchain in optimization of a crisis communication system.

Since the quality of information exchange largely determines how quickly rescue services can be coordinated and how much trust can be placed in the population, speech communication in crisis situations is very important. Under conditions of stress, high uncertainty, and limited time, communication processes can face significant difficulties. An analysis of current research allows us to identify the main factors that affect the effectiveness of speech communication during crisis situations. Table 1 presents the key factors that determine the effectiveness of crisis communication, with an explanation of their impact.

Table 1. The main factors of the effectiveness of speech communication in crisis situations

№	Factor	Description of the impact
1	Speed of information transfer	The temporal sensitivity of communication determines the speed of response and the reduction of panic among the population [22].
2	Accuracy and reliability	Incorrect or contradictory information can lead to disorganization and loss of trust [3].
3	Clarity of messages	Using simple, structured language without unnecessary terminology improves comprehension [18].
4	Technological means of communication	Automated alert systems and digital platforms increase the availability and speed of information dissemination [14].
5	Human factor and stress level	The psycho-emotional state of emergency service operators affects the quality of information transmission [7].
6	Intercultural adaptation	Multilingualism and cultural sensitivities require adaptation of messages for different population groups [5].
7	Education and training of staff	Crisis communication training can help minimize communication errors during stressful situations [9].
8	Trust in the source of information	Official sources, trusted experts, and well-known organizations increase the level of information perception [16].
9	Use of artificial intelligence	AI technologies improve query processing and ensure uninterrupted communication during a crisis [1].
10	Ensuring information security	Protection against disinformation and cyberattacks is a critical aspect of crisis communication [2].

Source: created by the author based on [1, 2, 3, 5, 7, 9, 14, 16, 18, 22]

Effective speech communication in crisis situations depends on a combination of technological, cognitive, socio-cultural and organizational factors. The most important aspects are the speed, accuracy, and clarity of messages, as well as the use of modern technologies and staff training. In the American experience, the focus of the technological solutions like AI and automated alert systems; whereas in Europe, given more importance has been attributed to

intercultural perspectives and efficacies of multilingual crisis communication. To follow up, further research in increasing such digital tools and strategies to address disinformation.

What is the use of language communication during crisis situation is totally based on the human factor. Research shows that the error rate, speed and clarity of information transferred are quite heavily dependent on the state of emergency service operators' psycho-emotional state, stress, cognitive load and fatigue. Current research shows that under stressful conditions, communication errors are more likely to occur under stressful conditions, which can be serious for a crisis response [7].

Data were collected on communication errors, stress of the caller and dispatcher, and effectiveness of information transfer among emergency response dispatchers, rescuers and crisis center personnel in order to analyze the human factor in speech communication.

Statistical measures of the effect that stress and fatigue have on quality of speech communication in emergency services in the United States are indicated in Figure 1, based on analysis of the data from emergency services in the United States and Europe.

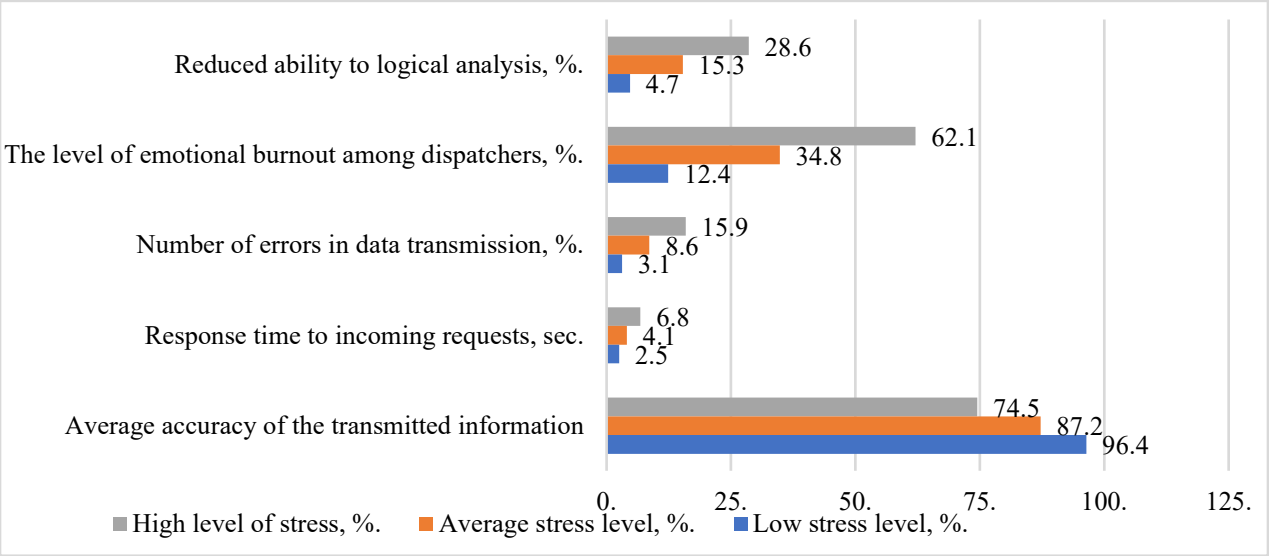

Figure 1. The impact of stress and fatigue on the quality of speech communication in crisis situations
Source: created by the author on the basis of [7, 8, 15, 16]

The statistics show that an increased level of stress and fatigue negatively affects the effectiveness of speech communication. At high levels of stress, the accuracy of information transmission decreases from 96.4% to 74.5%, and the number of communication errors increases to 15.9%. In addition, stressful conditions significantly increase the response time to incoming requests, which can lead to delays in critical situations. It is also worth paying attention to the high level of emotional burnout among emergency service dispatchers (62.1% with a high level of stress), which can lead to further deterioration in the quality of communication. This indicates the need to introduce special stress reduction programs, improve working conditions, and conduct trainings to increase staff stress resistance [9]. Thus, the human factor remains one of the most important elements of speech communication in crisis situations. Optimization of the work environment, training programs and psychological support are critical to improve communication effectiveness and reduce stress-related risks.

Crisis communication is an important component of public safety and effective emergency management. It includes both technological tools and strategic approaches to interacting with the public and emergency services. The United States and European countries have developed crisis communication systems based on modern technologies, but they have different approaches. As mentioned above, the American model is focused on the use of automated alert systems, mobile applications, and centralized communication platforms. In contrast, Europe pays more attention to the intercultural aspect, multilingual adaptation of messages, and decentralized communication networks [5]. Table 2

summarizes the main similarities and differences between the crisis communication systems of the United States and Europe.

Table 2. Comparison of crisis communication in the US and Europe

Criterion	USA	Europe
Management structure	Centralized model (FEMA, DHS)	Decentralized model (EU and national agencies)
The main emphasis in communication	Technologies and automated alerts	Social aspects and intercultural adaptation
Alert systems	Emergency Alert System (EAS), Integrated Public Alert & Warning System (IPAWS)	Multilingual warning systems, SMS alerts, local information channels
Use of digital platforms	Mobile applications, artificial intelligence, integrated databases	Social networks, regional communication systems
Automation of crisis communication	High level of automation, AI chatbots, algorithms for crisis forecasting	Medium level of automation, more emphasis on human factor
Intercultural adaptation	Minimal, the main language of communication is English	High, adaptation to a multilingual environment
Cooperation with public organizations	Limited, the main responsibility lies with government agencies	Active cooperation with volunteer and public organizations
The role of traditional media	Important, the main tool for spreading emergency messages (radio, television)	Important, but the influence of online media and social networks is growing
Level of public trust in the system	High, clearly regulated standards of crisis communication	Variable, depends on the country and local policies

Source: created by the author based on [3, 4, 5, 14, 22]

In today's globalized world, crisis situations often affect multinational communities, which creates additional challenges for effective communication. Intercultural aspects of language communication play a critical role in the process of interaction between emergency services, government agencies, international organizations and affected citizens.

One of the key aspects is the language barrier, which can significantly affect the understanding and accuracy of information transfer in a crisis. In addition, cultural characteristics of information perception determine the effectiveness of communication strategies and the way emergency messages are presented [5]. Table 3 summarizes the main intercultural factors that influence crisis communication.

Next page

Table 3. Intercultural aspects of speech communication in crisis situations

Intercultural aspect	Description of the impact
Language barrier	Lack of understanding of the official language can make communication difficult and increase panic [19].
Cultural differences in the perception of information	In different cultures, the same information can trigger different emotional responses [18].
Gesture and non-verbal communication	Gestures that are acceptable in one culture may have a different meaning in another [5].
Influence of religious factors	In some communities, religion determines the level of trust in official messages and sources of information [6].
Interethnic tensions	In crisis situations, ethnic differences can affect the effectiveness of communication and cause conflicts [20].
Use of multilingual systems	Automatic translation of messages and multilingual information platforms improve the accessibility of information [4].
Trust in official sources of information	Trust in government, media, and international organizations can vary across cultures [16].
Peculiarities of social interactions	The ways in which people are approached, emotions are expressed, and the level of formality can vary significantly between cultures [11].

Source: created by the author based on [4, 5, 6, 11, 16, 18, 19, 20]

Crisis communication is an important component of effective emergency management, but it faces numerous challenges that can significantly reduce its effectiveness. Problems can be related to technological barriers, language and intercultural difficulties, low trust in official sources, spread of misinformation, etc. [22]. To improve crisis communication, it is necessary not only to identify the main problems but also to propose effective strategies to address them. Table 4 summarizes the main challenges in crisis communication and possible ways to overcome them.

Table 4. Key challenges in crisis communication and ways to address them

Key challenges	Description of the problem	Possible solutions
Spreading disinformation and fake news	False messages can cause panic and make coordination difficult during a crisis [3].	Use of verified channels and artificial intelligence algorithms to detect fakes.
Language barrier and intercultural difficulties	Insufficient accessibility of information for people who do not speak the official language of the region [5].	Use of multilingual platforms, automatic translation and iconography.
Low level of trust in official sources	In some communities.	Collaboration with community leaders, transparency of communication, involvement of independent experts.

Information overload	A large number of messages can make it difficult to quickly grasp critical information [14].	Using clear and concise messages, prioritizing important information.
Lack of a single platform for coordination	Information may come from multiple sources.	Integration of digital platforms, centralization of crisis communication.
Problems with infrastructure and access to communication	Power outages or communication networks during a crisis make communication difficult [1].	Development of autonomous communication systems and mobile satellite technologies.
Unpreparedness of the staff	Lack of crisis communication skills among security and healthcare workers [9].	Conducting trainings, implementing crisis communication training programs.
Emotional stress and overwork of communicators	High levels of stress among dispatchers and crisis managers reduce the quality of communication [7].	Psychological support for staff, introduction of variable work schedules.

Source: created by the author based on [1, 3, 4, 5, 7, 9, 14, 16, 22, 23]

Discussion

Studies of speech communication in emergencies have shown that the effectiveness of communication depends on a combination of technological, cognitive, sociocultural and organizational factors. Studies emphasize the importance of digital platforms, artificial intelligence, automated alert systems, and cross-cultural adaptation of messages [5, 22]. However, there are differences between the American and European approaches to crisis communication - a focus on centralized automated alert systems such as the Emergency Alert System (EAS) and the Integrated Public Alert & Warning System (IPAWS) in the American approach and, in turn, an emphasis on message adaptation, the use of social media and regional communication networks to achieve greater effectiveness in a multilingual environment in the European approach [5]. As a result, the methods of realization of such goals are significantly different despite their similarity.

The analysis results indicate that the human factor is what makes speech communication in crisis conditions. It has been shown by research that the informational quality transmitted is directly related to the level of stress and fatigue of dispatchers and emergency service operators [7]. This distortion can arise due to a high level of emotional burnout and cognitive overload, whereby messages are distorted and times to response are slower. Therefore, there is a need to introduce crisis communication training, forge staff stress resistance, as well as utilization of artificial intelligence technologies to lessen the burden on the operators [9]. Nevertheless, the analysis of the role of automated systems and the human factor in the crisis communication does not exist in a unity. Automation has been suggested to reduce operator workloads and shorten time needed to communicate to the public [14]. At the same time European researchers stress that the human part of communication must be preserved, since the automated systems do not consider the psychological or intercultural communication peculiarities of the victims [24].

The second important part is information security and the fight against disinformation in the context of crisis. The uncontrolled spread of fake news can really complicate crisis management, cause panic, disorganize rescue service's actions and all this occurs in the best case of American and European studies [3]. Therefore, crisis communication is supposed to also introduce mechanisms of verifying reliability of the information provided, as well as fake detection algorithms and use official digital channels. While considerable efforts have been made to develop technological solutions in the field of crisis communication, there is a need to explore the effect of these technologies on psychological state of communicators and victims. Especially, it is necessary to find how artificial intelligence can be used to reinforce the role of the human factor in crisis situations without losing emotional connection and trust in the sources of information [1].

Thus, issues dealing with effectiveness of speech communication in emergencies justifies integration of technological innovations, modification of communication strategies to the intercultural communicative environment, and considers human factor. More research needs to be done on developing optimal models of interaction between automated

systems and crisis communication operators, and long term effect of digital technologies on emotional state of crisis communication participants.

Conclusions and Prospects for Further Research

To fulfill the goal of effective emergency service communication speech is a key instrument to communicate between emergency services and the public and the quality of speech directly impacts the degree of trust, response time, and coordination. In order to improve the effectiveness of crisis communication, a combination of digital technologies, automated alert systems, and human factor is required, the study verified. What is new in the results is the mastery of comprehensive interface between technological and cognitive-psychological aspects of information and communication during a crisis, and the main difference between the American and the European models of the crisis communication. The study contributes to the development of recommendations for the introduction of artificial intelligence, multilingual information platforms and stress reduction programs for the emergency service operators allowing to enhance the quality of communication in conditions of high uncertainty. At the same time, the study revealed a number of limitations, including a lack of empirical data on the effectiveness of artificial intelligence in crisis communication and the absence of a universal model for integrating technologies in different cultural contexts. In this regard, promising areas for further research include developing adaptive communication strategies for a multicultural environment, analyzing the long-term impact of digital technologies on crisis communication, and evaluating the effectiveness of new methods of preventing the spread of disinformation during emergencies.

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