Impacting Factors on Human Reactions to Alerts

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ABSTRACT

Crisis response authorities have to deal with the unpredictability of their population's behavior. One of the complex challenges is to understand the people's reaction after an official alert in a crisis situation has been issued. This paper elaborates a knowledge base to describe impacting factors on human reactions in alerting situations. For this purpose, a literature review in the theme of human behavior after warnings was conducted and augmented with information gathered in a series of interviews in German-speaking countries. The outcome is phrased as factors that might impact the human reaction to a warning. This knowledge base shall support crisis management practitioners in the elaboration of alerting strategies as well as allow researchers to systematically structure human behavior aspects for the purpose of modeling and simulating alert effects.

Keywords

Warning, Alert, Human Behavior, Human Reactions, Modeling

INTRODUCTION

Human reaction to alerts and warnings cannot be simplified by a stimulus-response-model (Quarantelli 1990; Mileti and Beck 1975). On the contrary: when asking several individuals that have been caught in disasters, several unique stories and therefore individual behavioral aspects can be gathered (Drabek 1999). Human beings further do not live in isolation; social mechanisms occur, which lead people to behave in a way that is the most appropriate from their perspective (Quarantelli 1990). Human behavior in crisis therefore is a highly complex social process (Drabek 1999), also given the fact that different alerting channels are not always addressing the same people and cannot always deliver the same message.

For crisis responders in the field and for crisis managers in crisis situation rooms it is important to be aware of basic mechanisms and dependencies of human behavior in crisis situations and especially after being alerted. For example, having such knowledge could be useful in the development of new public alert concepts with the aim to improve the effectiveness of population alerting and communication with citizens. This paper presents a literature-based overview of relevant influences on human behavior after warnings, enriched with the opinions of practitioners from Germany.

Human behavior in crises and in specific after alerts has been a research topic for some time already (Drabek 1999; Quarantelli 1990; Rogers and Sorensen 1991; Sorensen 2000). However, much of this research is focusing on specific countries and/or disaster events (Drabek 1999; Peacock 1997) and does not lead to a general conclusion on what factors impact the human behavior after being warned of imminent crises. Mileti and Sörensen provide in their work a general overview on terms and aspects on which warning behavior can depend, including a useful compilation of factors and the corresponding research overview (Mileti and Sörensen 1990). However, results mainly stem from research in the United States, and are thus only partly applicable to our research, which focuses on Europe and especially Germany. Also, the socio-technical environment of humans has changed over the last twenty years. We base our work on a strong collaboration with crisis managers, whom the results in this paper should help to better understand effects of alerting. In addition, experts in simulation can

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use this outcome to model and simulate human reactions to alerts, for example as adjustable parameters in their simulation.

In this paper, we shortly discuss the methodology used for our research, followed by the impacting factors found during the research. Finally, we discuss our findings and provide an outlook on how the results can be used.

METHODOLOGY

In this work, we conducted a comprehensive literature review and extracted cues that were mentioned to have an impact on the reaction of humans to warnings and alerts in crises as systematically described factors. These results where then enriched with statements and assumptions gathered in interviews, which were conducted with experienced crisis managers from German-speaking countries on different administrative levels and functions[1].

Our approach of reviewing literature and complement results with findings from interviews with experts and practitioners has been successfully implemented in earlier research. For example, the ERGO Project (Shaw et al. 2011) used a similar approach in the field of evacuation behavior and warning dissemination including a qualitative approach to find subjective experiences from crisis managers.

IMPACTING FACTORS ON HUMAN BEHAVIOR

In this section, we will use a table schema that was elaborated to capture and compare the factors found during our research. The schema includes fields for a denomination of the **impacting factor**, a **description** (describing what the factor means, what impact it has and (if known) on what), and **assumptions and statements** concerning concrete values of the factor (the context that this factor was mentioned and assumptions concerning this factor like assumed values of the impact or extreme representations of the factor). This section gives an overview of the factors found in the literature, enriched by information from the interviews. Information from the literature is referenced by the source, statements take from interviews are marked with the abbreviation IV.

Table 1: Overview of Impacting Factors

Impacting Factor	Description	Assumptions/Statements concerning Concrete Values
Number of channels	The number of channels used to warn the population has an impact on the speed the message is received.	The more mechanisms to alert the population is used (e.g. sirens and radio/TV), the faster the population can be reached, finally resulting in quicker reaction (Lindell and Perry 1987).
Informal Relaying of Warning	People that handover warning information to other people influences the message's amount of recipients.	More indirect warning dissemination leads to higher speed in reaching people and also to a higher believe rates (Lindell and Perry 1987).
Social Media Usage	Social Media Usage facilitates immediate information sharing (Landau 2011 p. 6).	The more people use social media, the more likely is that they are quickly informed on occurring crisis (Palen et al. 2009).
Precondition: Understanding	A basic influence is people's understanding of messages (Lindell and Perry 2004; Mileti and Sörensen 1990 pp. 5–2)	This influence is always relevant to tourists, students or immigrants staying in a country without speaking the native language (IV).
Risk Perception (Perceived Obviousness, Perceived Suddenness, …)	People react differently on how they perceive the danger of the disaster. Subjective evaluations of risk are significant correlates of evacuation behavior.	People behave differently, depending on how they assess their own vulnerability, sometimes contradicting the officially communicated risk (Gaillard et al. 2008; Kalkstein and Sheridan 2007; Stein et al. 2010). The more obvious dangers are to people, the more they realize situation and follow recommendations from authorities (IV). In very obvious dangers a single word (e.g. "stay") is enough to have the recipient follow an instruction or recommendation (IV). People react differently to alerts predicting incidents in long-term future as opposed to alerts predicting incidents in short-term future (IV).

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[1] **Levels**: Municipal, District and State; **Functions**: Chief of Fire Rescue, Crisis Contingency Planner, Crisis Communication/PR Responsible, Medical Attendance Responsible

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Impacting Factor	Description	Assumptions/Statements concerning Concrete Values
Natural Signs / Environmental changes	In disasters, natural effects can serve as a warning message to the population, which can influence their behavior even before the raise of official warnings.	Natural signs can give the population a head-start to take protective actions (Gaillard et al. 2008). If it is 3am, dark and cold, people tend to react more stressful than on a sunny afternoon at 2pm (IV).
Emotional State	A positive initial feeling and a balanced emotional state influences people's capacity to think rationally.	People with a positive initial feeling/a low stress level are able to think rationally, in contrast to stressed people (Vorst 2010) (Zhao et al. 2008).
"Cry Wolf Effect"	When warnings are sent out in too high frequencies, people's protective behavior and perceived importance of the threat decreases.	"Initial warnings have been associated with increased anxiety and a higher likelihood of response, while repeated warnings result in less perceived risk" (Kalkstein and Sheridan 2007). Over-warning leads to disregarding (IV).
Frequency of message delivery	The possibility to receive a message and also if people believe the message can be influenced by the frequency a message is sent out.	If the same message is sent to the public in a frequent manner, people will more likely believe and act according to the message (Mileti and Sörensen 1990).
Presence of the Warning	Who and where the warning was disseminated influences whether people receive the warning (Mileti and Sörensen 1990 pp. 3–7).	Whether people find information on media channels is an influence on their perceived personal situation and ability to act (Geenen 2009 p. 87). Whether a warning is raised by a local or a higher authority influences human reactions (IV).
Practicability of Recommended Action	The way how the message is worded and which content the message has is directly influencing the likeliness, speed and ability of the recipients to act.	Authorities have to take into account the following aspects: How is the message received at the recipient? Can the message content be put into action, and how quickly? How the message reaches the population and how they interpret the message (Weidringer 2011 p. 93)
Phrasing of the Message	A clear wording, short sentences and simple language leads to a better comprehension of the message.	The usage of specialized terms may lead to a lack of comprehension, e.g. technical terms "15 millirem" or crisis-specific terms like "hypocenter" (Lindell and Perry 2004). Warning messages should be transporting precise facts (Geenen 2009 p. 83)
Information about Imminent Danger	How the danger is described in a message towards the population has an impact on their likeliness to act.	The transmission of a perceivable danger to the population, including the severity, the expected impact and timeframes of leads to quicker problem realization. Additionally, the expected future change of the danger can be included (Geenen 2009 p. 84)
Trust (Cultural, Situational, …)	Trust in the message content, the channel and the sender is impacting the relevance for the individual.	Messages transported through different channels have different degrees of credibility; however, if the message is delivered by a government official, even through mass media, are more likely to be believed (Quarantelli 1990). Different messages from different authorities cause major distrust (IV). If the police raise an instruction via an online message less people follow than if they and raise it via loudspeaker alerts (IV).
Peer Group Behavior	Peers, like neighbors and friends, can have a big influence on a person's behavior. Also individuals gather in groups and are led by community leaders (collective movement).	For evacuation decisions, people turn to their closest peers/their neighbors, to see what they are doing and base their decisions thereon. Additionally their social system might dictate them to listen to what their leader says what's best (Gaillard et al. 2008; Stein et al. 2010)
Nativity in the Area	Being familiar ("born and raised") in the area of the disaster gives the people a different view on the happenings and thus changes their behavior according to what they have learned over the years.	People that were born in the area may have own or learned experiences, which makes them more risk-aware. Additionally, they normally know how to interpret signs of nature that precede a disaster, and thus can react to them better (Gaillard et al. 2008).
Personal Characteristics	Characteristics like age, presence of children or elderly, gender, race, disability and income can be a constraint on how humans behave in a crisis. Additional characteristics like wealth and access to resources or being a minority can have an impact on a person's disaster behavior.	Wealth was mentioned in the sense that with more money and influence it can be easier for a person to behave in a life-saving way (Dillon et al. 2011; Kalkstein and Sheridan 2007; Stein et al. 2010). Dependent on people's age and generation they range from the helpless to the experienced (IV). Some old people need help from others, also in crisis situations (IV). Younger people know less how to help themselves than people in the middle ages (IV).

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Impacting Factor	Description	Assumptions/Statements concerning Concrete Values
Experience in Crisis Situations and the Knowledge of Risk	Knowing about the risk and earlier experience in a disaster has an impact on the behavior, even if this knowledge comes from stories of others (friends, etc.). Also near-miss experiences can have an effect on a person's risk awareness.	People with disaster experience learn from mistakes and behave differently. This behavior is increased if similar events happen regularly (i.e. every few years) (Gaillard et al. 2008). Behavior changes if people know someone who was a victim of a disaster (Kalkstein and Sheridan 2007). If a crisis experience was a near-miss event, people are likely to believe that next time it will go well again, even when knowing the statistical probabilities (Dillon et al. 2011).
Emergency training	Emergency training may cause significant influence on the response stage behavioral reactions.	The frequency of selecting the action of instructing others to leave and carrying out immediate evacuation increased with the emergency training level (Zhao et al. 2008). An increased level to understand alerts can be trained from early on: specific media and methods can be developed to train the population to be aware of alerting and how to react (i.e. e-learning programs) (Geenen 2009 p. 87).
Social Confirmation	The interpretation of warning messages is often a group decision, and thus has an impact on every individual in the group.	Recipients of warning messages do not normally respond directly as individual persons but in a social group (Quarantelli 1990).
Interaction and Exchange with Peers	Peers like family and friends can have an impact on a person's decision to take action or not.	Social networks not only relay warning messages to others, but also use their network for searching for further information (Perry and Lindell 2006). In rural areas, it is more likely that people share and seek information with their peers like family and neighbors, whereas in the city people are more self-centered (IV).
Self-Organisation and Situational Altruism	Depending if people are organized in social groups and know each other's competencies, they can function as a self-organizing community that can help in responding to the crisis.	Situational Altruism emerges when new victims have been created and when there is doubt that the existing institutional resources are able to deal with the needs of the community (Dynes 1994). In rural areas, and also with older generations, people will use their manual skills and will more likely to help themselves and each other is needed, instead of fleeing or calling authorities for help (IV).

DISCUSSION AND OUTLOOK

During the elaboration of this work, especially during the interviews, a few issues were discovered that require further action. The interviewed practitioners do not yet consider the behavior of population in their crisis response and contingency plans. This paper should point crisis management authorities into the direction of using the knowledge about their population to make the populations behavior in a crisis more calculable.

The research presented in this paper should also be a resource for simulation experts and scientists dealing with human behavior in crisis situations. Using this overview to implement a model and a simulation of human behavior will, for example, be the next step within our research (Engelbach et al. 2011). Besides a quantification of the factors by targeted empirical studies, extending the regional scope of the research is planned. This should show differences between countries and cultures, which has been started already in the Alert4All project for four European regions (Kluckner et al. 2011).

To further advance in this topic, a collaboration of research and practitioners will be indispensable in the future to elaborate a deeper theoretical knowledge base from experience in the field. The research in this paper serves as a good example where such collaboration has worked well. We are convinced that such collaboration should be done in large scale research to locate possible trends and gaps in the field of crisis response.

CONCLUSION

Factors that might have an impact on how the population reacts when being warned of imminent danger are provided as result of a comprehensive literature review, accompanied by statements from interviews with practitioners in the field of emergency management in German-speaking countries. This overview includes aspects from practical experiences and is aimed to support practitioners in the elaboration of alerting strategies. Additionally, future research might profit from the presented outcome, for example for modeling and simulating of human behavior after alerting.

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