Disaster Managers' Perception of Effective Visual Risk Communication for General Public

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Abstract

Risk communication is one of the measures that should be implemented to increase the awareness and preparedness of the general public in order to attain disaster risk reduction. Among the various forms that can be used in communication campaigns, visualizations are appropriate to disseminate information about spatial phenomena such as natural hazards. In order to be effective, communication campaigns should be designed according to the specificities of the targeted audience. Risk and disaster managers are seen as a source of information about the latter as their tasks put them in direct contact with the general public and they need to communicate risks. Hence it is assumed that investigating their perception on the informative needs of the general public can help to design effective visual risk communication campaigns and to evaluate them.

1 Introduction

During the ongoing decade disaster risk reduction has received more and more attention from society and is now considered a global issue. This is emphasized by the adoption in 2005 of the Hyogo Framework for Action (UNISDR 2007). It acknowledges that the vulnerability to disasters is increasing due to phenomena such as demographic changes, urbanization, environmental degradation and climate change and that this is a menace to "*the world economy, and its population and the sustainable development of developing countries*" (UNISDR 2007). Nevertheless, examples such as the Katrina hurricane in 2005 and the Japanese tsunami in 2011 show that this is also valid for developed countries.

In the risk management cycle (prevention, preparedness, response and recovery), communication is one of the key parameters, among others, to manage the consequences that an event has on the community. The general framework on risk governance proposed by the International Risk Governance Council (IRCG) (Renn 2005) shows that communication is the central element. Indeed, it is linked to all 'stages' of the risk governance: from pre-assessment to risk management, highlighting the complexity of the role of communication.

Risk communication has several purposes. However, usually it aims at fulfilling one specific objective and the communication campaign can be declared effective if the latter is met. One possible risk communication's goal is the increase of awareness and preparedness of the general public. Multiple means and tools, including visualization, can be used to do so. In order to assess their effectiveness direct testing of changes in awareness and preparedness should be conducted. However, before starting this type of research, preliminary information is needed. Indeed, communication campaigns should be designed to fit the needs of the targeted audience. One possibility is to investigate the opinions and perceptions of risk and disaster managers as there are assumed to have a practical experience of the communities in which they work. Questionnaires can be used to gather data on the perception of risk and disaster managers concerning the requirements for risk communication to specific groups in the community they work in. If the analysis of the collected data reveals significant elements for risk communication in the community, these elements will be used to design visuals for risk communication.

2 Risk communication

In addition to a global increase of the vulnerability to natural hazards, three social trends encourage the diffusion of hazard and risk related information (Fildermann 1990): the growth of the information society, the increased reliance on high technology systems and the growing interest in health and security.

Risk communication is a complex process that is constituted by several elements (Höppner et al 2010):

(i) Actors that are involved and that have different characteristics and perceptions which have to be taken into account when designing risk communication efforts in order to make them effective (Lundgren and McMakin 2004).

(ii) Mode(s), channel(s) and tool(s) that refer to the way risk communication is implemented. The possibilities are multiple to practically disseminate a message although their relative performance may be variable depending on the context.

(iii) Message(s) that is the core of the communication. The content should follow several principles to make the communication effective: it has to fit the audience needs, it should be transparent (what is known and not known), the language should be adapted to the audience and it should be

embedded in wider frames (the effectiveness of short-term communication may be related to long-term communication).

(iv) Purpose(s) or goal(s) that the risk communication is aiming at. They are various and a given communication effort can consider one or several of them.

Although its purposes are multiple, risk communication can be seen as a mean to raise awareness, improve knowledge or change behaviors and beliefs of involved stakeholders (exposed people, experts and managers, decision-makers, general public and media). In case of crisis (e.g. occurrence of a natural hazard), the importance of communication is crucial to minimize damage and save lives as it influences the response of all concerned parties.

3 Visual communication

In addition to verbal and written means of communication, visualization can be used. In a broad sense, visualization can be defined as the representation using visuals. It has become an important topic of research in the last decade due to the extension of the size of data-sets produced by the most recent data acquisition techniques (Post et al 2002). Due to increasing computing power, new research fields such as 'Information Visualization' and 'Data Visualization" have emerged. Visualization can also be used in communication. Trombo (1999) defines visual communication as "*a process of sending and receiving messages using visual images and representation to structure the message*".

Visual communication can be implemented through a wide range of means: pictures, movies, charts, graphics, maps or objects. Moreover, lately, increasing use is made of new technologies such as Geographic Information System (GIS), web-based platforms and Smartphone applications which all have a strong visual component.

In general, the advantages of visual communication "*include the capacity to convey strong messages, making them easy to remember; condense complex information and communicate new content; provide the basis for personal thoughts and conversations, contributing to people's memory and issue-awareness; and communicate idea in an instant using many different media and contexts*" (Nicholson-Cole 2005). Geospatial solutions, i.e. based on maps, are particularly well adapted to communicate about natural hazards as the latter "*have a strong spatio-temporal component*" (Dransch et al 2010). The authors specify the large variety of potential objectives of maps: (i) improve risk perception (increasing knowledge and understanding, enabling appropriate risk assessment, allowing information accessibility), (ii) support personal risk framing (creating a personal view, allowing confirming information with others through interaction) and (iii) establish credibility (informing objectively or giving consisting information).

Nevertheless, visual communication has limitations and drawbacks. Bresciani and Eppler (2008) listed the sources of potential negative effects of visualization: (i) cognitive designer induced effect: ambiguity, over-complexity/simplicity and

unclearness, (ii) cognitive user induced effect: depending on perceptual skills, misuse, and high requirement on training and resources, (iii) emotional designer induced effect; disturbing and boring, (iv) emotional user induced effect: visual stress and prior knowledge experience, (v) social designer induced effect: inhibit conversation and unequal participation and (vi) social user induced effect: cultural and cross-cultural differences altered behavior.

4 Effectiveness and its evaluation

As seen previously, visuals can have potential positive as well as negative effects that should be taken into account when designing communication efforts in order to make them effective. This is particularly valid for risk, emergency preparedness and crisis communication for which a failure can lead to disastrous consequences. Therefore, it is necessary to determine what constitutes effective visualization. Moreover, the evaluation of risk and crisis communication's effectiveness allows improving future programs, choosing between alternative efforts and justifying them (Rohrmann 1992, 1998). The need for evaluating risk communication efforts is stressed by several authors (Penning-Rowsell and Handmer 1990, Covello et al 1991, McCallum 1995, Lipkus and Hollands 1999, Lundgren and McMakin 2004).

Effectiveness of risk communication and the criteria to assess it is widely discussed in literature. Rohrmann (1992, 1998) proposes a relatively vague definition of effectiveness: "*the degree to which an initial (unsatisfactory) situation is changed toward an intended state, as defined by the (normative) program objectives*". On the other hand, the author listed a large amount of very specific criteria that can be used to evaluate the effectiveness of risk communication: (1) content evaluation (correctness, completeness, comprehensibility, meet of user needs, personal relevance, ability to be believable, not frightening or hurtful, and ethic), (2) process evaluation (identification, inclusion and motivation of relevant actors/parties, feedback and difficulties that occurred running the program) and (3) outcomes evaluation (improvement of comprehension, knowledge, problem awareness, involvement and change of behavior, beliefs or attitudes of the targeted audience). The particular criteria for evaluating visual displays for risk communication and cartographic visualization of risk as well as uncertainty are respectively comprehension, acceptance, dose-response consistency, hazard-response consistency, uniformity, audience evaluation and direction of communication errors (Weinstein and Sandman 1993, cited by Lipkus and Hollands 1999) as well as accuracy and congruence, accessibility, retention, change in perceived risk and subjective measures of quality and usefulness (Bostrom et al 2008).

Few examples of evaluation of effectiveness were found in literature. Moreover, they focus on users' requirements, ability to read the communication means, ability to understand the content, or satisfaction with the diverse components of the tool(s). No published evaluation of the impact of visuals for risk communication was found (Charrière et al (in press)). When talking about impact, we refer to

effectiveness as the degree to which the purpose(s) of the communication has been met ("outcome evaluation": Rohrmann 1992, 1998). Here visual communication practices are considered to be effective if they result in a change in the target group's preparedness and public awareness, as defined by UNISDR (2009), i.e. "*the extent of knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards*".

5 Studying the effectiveness of visualization

This research, which is part of the Initial Training Network 'Changes', aims at determining what elements make a visualization tool effective for risk communication. More precisely, what is the most effective visual for a given purpose, message, phase and audience? It is highly probable that different visualization tools will have different levels of effectiveness depending on the content and the stakeholders involved. Visuals can have various forms: graphics, pictures, movies, maps as well as objects. Each of them presents characteristics that can make them more effective relatively to others for a given situation. The focus of the research is hence to determine which visual is more effective for risk communication, in prevention and preparedness phases, linked to short lead-time hydro-meteorological hazards occurring in alpine areas.

This research is relevant because it is important to understand what are the best existing visual communication practices and what makes them more effective than others in order to improve further developments of risk communication principles and practices. The social significance of the research is relatively obvious as the improvement of the dissemination of information to all involved stakeholders is believed to increase their awareness, improve their knowledge or change their behavior or beliefs; and hence reduce their vulnerability to natural disasters. As no examples of evaluation of effectiveness in terms of impact was found, the scientific relevance of the research lies in the development of a methodology to evaluate the effectiveness of visualization tools as well as in the technical guidelines for future visualization tools that will arise from the evaluation.

6 Risk and disaster managers' perception of general public's needs

As a starting point to conduct direct testing of effectiveness of visual communication to increase awareness and preparedness of the general public to hydro-meteorological hazards, the risk and disaster managers' perceptions and opinions about the communication needs of the general public in France, Italy, Romania and Poland will be assessed. Indeed, to be certain that any risk communication practice is effective the design should fit the targeted audience's needs (Lungren

and McMakin 2004). These can be determined by direct user needs assessment, that are highly time consuming and complex due to the large variety of social, economical, psychological characteristics of the individuals that compose the general public. Hence, it is also interesting to conduct research on the perceptions and opinions that risk and disaster managers have about the needs of the public. Due to their tasks, some of these actors are in direct contact with the public during any of the phases of the risk management cycle (prevention, preparedness, response and recovery) and therefore have a practical experience of the awareness and preparedness of the population. Moreover, depending on the country and responsibilities of these managers, it is their duty to inform communities at risk and they should know on which basis to do this.

Under the assumption that perceptions and opinions of risk and disaster managers regarding the requirements for risk communication in a community can help to design effective risk communication practices, a standardized questionnaire is formulated. The questions relate to the level of awareness and preparedness, to past risk communication efforts made in the respective working area as well as to future risk communication designs in terms of content and visual tools. Detailed topics are provided in Table 1.

If the assumption above mentioned proves to be correct, the elements highlighted by this questionnaire will be the basis for the testing of the effectiveness of visual communication targeting the general public. The anticipated results are the specification of priorities in terms of (i) sub-groups of the general public to address communication campaigns to, (ii) the phase(s) of the risk management cycle for which the risk communication campaigns should be designed, (iii) the content of the message(s) that should be included in the communication campaigns and (iv) the visualization tools that should be used.

Table 1: Detailed topics and related questions' themes of the standardized questionnaire.

TOPICS	QUESTIONS ON THE FOLLOWING THEMES…
Awareness	Definition of the concept, comparison of awareness levels of sub-groups of the community
Preparedness	Definition of the concept, comparison of preparedness levels of sub-groups of the community
Past communication campaigns	Types, frequency of dissemination, effectiveness, appropriateness of the content depending on the audience
Future communication campaigns	Link between content and audience, improvement and priority of action depending on the phases of management cycle
Legal requirements	Laws that require communication to the general public in all disaster management's phases
Visualization	Communication of uncertainty, appropriateness of visualization tools depending on the audience

While the questionnaire's dissemination is under process in different case studies in Italy, Romania and Poland, preliminary results in the French case study show that opinions on awareness and preparedness levels of different sub-groups

of the general public are similar among risk and disaster managers. Moreover, although knowledge and opinions on past risk communication efforts are highly various, there is a common agreement that improvements can be made in particular concerning the dissemination of information related to individual mitigation measures and emergency procedures. In terms of visualization tools that should be used to communicate to different audiences, opinions of risk managers are not completely homogenous. Nevertheless, some combinations of visualization tools and types of audience are revealed: graphs, charts and maps for risk managers; Smartphone applications, interactive environments and websites for adults and children; information boards for tourists. In addition, pictures and movies appear to be universal mean of visual communication (i.e. appropriate for all types of audience) in the opinion of risk managers. From these findings we can assume that risk managers have determined from their experience that visual risk communication practices should be audience specific and that this is not only a theoretical guideline. Moreover, the use of geospatial mean, such as maps, is no seen to be the most appropriate tool for communicating risk to the general public as a whole. It suggests that geospatial information and tools might not be the top priority when targeting the general public on the contrary of managers and decision-makers that crucially need such things (Neuvel and Zlatanova 2006). In addition, more than 75% of the surveyed risk managers believe that there is a need to communicate uncertainty to the general public. This is an indication that they have faced or believe they will face situations where the unavoidable uncertainty issue can not be dissimulate to the public without having consequences (e.g. decrease of risk avoidance or trust). In terms of the way of communicating uncertainty, although the risk managers prioritize the use of probability over return period, the visual form is almost always preferred to numbers and text.

7 Perspectives

This study is believed to assist the development of further research in the effectiveness of visual communication to increase awareness and preparedness to hydro-meteorological hazards of the population of several alpine countries. Increasing awareness and preparedness to natural hazards is one of the element that determine risk behaviors (Enders 2001). Hence there is a link between these factors and risk avoidance. Awareness and preparedness are site specific processes, not only from the point of view of the natural phenomena but also from the perspective of the specificity of the community that faces them. Indeed general public has contextual characteristics deriving from cultural, social, economic… conditions. And these should be taken into account to design risk communication campaigns that are effective, i.e. that meet their goal(s). Due to their tasks, some of the risk and disasters managers might be in contact with the general public and have opinions and perceptions on the level of awareness and preparedness of the general public and on how much and how it is needed to improve them. Then their knowledge can be beneficial in order to design effective risk communication cam-

paigns that are part of the overall goal of disaster risk reduction. Taking this into account in addition to direct testing of the impact of visualization on the awareness and preparedness of the general public has at least two benefits. First, it can be used as substitutive information when direct assessment is too time consuming or too complex due to the high variability of the characteristics of individuals in one community. Second, if it is combined to direct testing, it can provide an assessment of the correspondence of risk managers' opinions and perceptions on the effective visual risk communication practices with their real effectiveness. This can hence allow adapting or changing existing ineffective practices into ones that would have a real impact on awareness and preparedness with the goal of increasing risk avoidance of the general public.

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