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Abstract

Migrants, ethnic minorities and people from culturally and linguistically diverse (CALD) communities are often more vulnerable to natural disasters due to cultural barriers and limited proficiency in the dominant language, which sometimes undermine their ability to access, interpret and respond to warnings. Technology can assist in engendering culturally and linguistically appropriate communication with CALD communities if key challenges are identified. This study contributes by reviewing relevant literature with the aim of ascertaining the most pressing challenges requiring technological interventions. Three broad issues (i.e., trust, message tailoring, and message translation) are identified and discussed, and potential solutions for addressing these issues are recommended.

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Disaster Risk Communication in Culturally and Linguistically Diverse Communities: The Role of Technology [†]

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Abstract: Migrants, ethnic minorities and people from culturally and linguistically diverse (CALD) communities are often more vulnerable to natural disasters due to cultural barriers and limited proficiency in the dominant language, which sometimes undermine their ability to access, interpret and respond to warnings. Technology can assist in engendering culturally and linguistically appropriate communication with CALD communities if key challenges are identified. This study contributes by reviewing relevant literature with the aim of ascertaining the most pressing challenges requiring technological interventions. Three broad issues (i.e., trust, message tailoring, and message translation) are identified and discussed, and potential solutions for addressing these issues are recommended.

Keywords: disaster; CALD; culture; language; communication; technology; ethnic minority; message; warn; linguistically diverse

1. Introduction

The world is experiencing major social and environmental transformations that impose adaptation challenges for cities and regions. International migration is accelerating and societies are becoming more culturally and linguistically diverse (CALD) [1,2]. Australia is a good example: the country's population comes from over 200 different countries, with around 300 different languages spoken at home [3]. Nepal et al. [4] also point to Houston—a multicultural city of over 2.2 million residents speaking more than 90 different languages.

At the same time that this cultural and linguistic diversity is occurring, cities and regions are facing increasing frequency and intensity of environmental disasters imposed by climate change [5,6]. This duality poses a significant challenge for governments and emergency agencies who must devise effective ways of communicating the risks posed by natural disasters. Migrants and CALD communities are particularly vulnerable to natural disasters and emergency events for several reasons, including unfamiliarity with new environment, lack of established family networks, inexperience with disaster events, lack of emergency plans, limited literacy and fluency in the dominant language (e.g., English in Australia and Portuguese in Brazil), inability to access community resources due to physical and social isolation, low income and poor socio-economic conditions to support recovery from disasters, and limited insurance to minimize loss [1,3,7–10].

Language and cultural barriers pose significant challenges in communicating disaster risk to migrants and CALD communities. For example, limited proficiency in the dominant language of communication can be a significant impediment to how emergency information is accessed and interpreted [1,11]. Cultural and linguistic differences may distort the meaning of emergency warnings, which are often riddled with conflicting jargon from emergency agencies [11]. Panic in emergency situations can further blur the ability of people with limited proficiency in the dominant language to comprehend and communicate effectively in that language [11]. Unfortunately, time, system and personnel constraints mean that emergency services adopt a utilitarian approach to risk communication, which does not take the individual's language and cultural needs into account, but rather aims to send the same message to as many people as possible in the shortest timeframe and in the dominant language [3]. This communication approach can be considered inadequate in the face of modern technological advancement, particularly knowing that it can sometimes result in warnings and messages that are too generic to provoke appropriate and desired responses from multicultural communities [12]. Hence, there have been several calls for more research aiming to address communication barriers with CALD communities and the need to explore technological solutions to delivery culturally and linguistically appropriate services that can help curtail the disproportional impact that disasters have on CALD communities [4,12,13].

Motivated by this problem, this study contributes by reviewing relevant literature with the aim of ascertaining the most common and pressing problems in the domain area as well as the role of technological solutions in addressing them. Three broad issues (i.e., trust, message tailoring, and message translation) are identified and discussed along with suggestions on ways in which information technology can help address the problems. The following section presents the methodology adopted.

2. Methodology

This study employs a systematic literature review approach to retrieve relevant articles. The literature search was conducted using academic databases such as Scopus, Web of Science and IEEE Xplore. The search strategy was based on a combination of keywords as follows: "natural hazard" OR disaster OR crisis OR flood OR hurricane OR tornado OR "volcanic eruption" OR earthquake OR tsunami OR avalanche OR landslide AND ethnic* OR race OR racial OR language OR "linguistic* divers*" OR "cultural* divers*" OR migrant OR CALD OR cultur* OR minorit* AND warn* OR messag* OR communicat*. This search returned a total of 1609 articles after removing duplicates. 61 of these articles were immediately excluded because they were not written in English. Articles belonging to unlikely relevant fields of study were then isolated and examined for relevance. This resulted in the exclusion of 174 articles as follows: Nursing (43), Agricultural and Biological Sciences (32), Energy (32), Biochemistry, Genetics and Molecular Biology (27), Chemical Engineering (14), Pharmacology, Toxicology and Pharmaceuticals (9), Chemistry (4), Dentistry (4), Immunology and Microbiology (4), Neuroscience (4) and Veterinary (1). The title and abstract of the remaining 1374 articles were examined to ascertain their relevance to the study. This resulted in the exclusion of 1355 articles. The remaining 19 articles were thoroughly examined and included in the study.

3. Results and Discussions

Relevant information extracted from the retrieved articles has been grouped into three common themes or problem areas relating to the communication of disaster risks to migrant and CALD communities. These problem areas are presented in this section and discussed in relation to potential technological interventions.

3.1. Tailoring of Messages

The need for tailoring of disaster warnings and messages is one that is recurring in the literature. There are concerns that targeted messaging that addresses the unique cultural and

information needs of CALD communities is often not provided by emergency agencies [3]. Burke et al. [10] reiterated the need to provide tailored and culturally appropriate messages (e.g., emergency alerts, text messages, and news coverage) to CALD communities. In tailoring messaging to CALD communities, certain factors should be considered, including the individual's past experience with natural disasters (e.g., trauma) [1,11,14,15]; level of knowledge and expectations [11]; timing of the warning [14]; psychological, physical, geographical, social and economic factors [3]; personal emergency plan if available [14]; shared local values and shared everyday experiences [15]; and culture and language factors [1,11,15,16].

Culture and language are particularly crucial in delivering messages to CALD communities. Culture and language are inseparable and also strongly linked; culture is, in fact, implicit in the language of communication and therefore should be considered when framing messages for CALD communities [1]. Rozakis [17] talks about organisational culture within disaster-specific agencies and its impact on emergency operations, including risk communication. Appleby-Arnold et al. [15] also reported that culture and risk perception are intrinsically intertwined. According to Tang and Rundblad [16], the failure to pay adequate attention to the ethnic and cultural background of citizens, when tailoring messages, can potentially undermine how hazard warnings are interpreted. But, how can the tailoring of messages be operationalized in real-world emergency situations where time and human resources are limited?

Artificial Intelligence (AI) techniques can help to facilitate effective tailoring of disaster warning messages to citizens, taking the above identified factors into consideration. AI is a promising solution, but there are inherent challenges such as availability of training data set, potential litigations arising from errors, computer processing power, privacy concerns and societal demand for accountability in the implementation of ethical moral machines [18]. These challenges are key research priorities that should be explored in future research. In a typical emergency scenario where the ratio of emergency support workers to citizens is very small and the resources to provide personalized service is grossly inadequate, AI-powered chatbots can potentially harness details about the varying information needs of different individuals and accordingly tailor real-time communication to meet these needs. In this two-way communication, citizens will be able to request safety-critical information and obtain rapid feedbacks that take their personal circumstances into account. Future work will explore the in-depth role of AI and associated technologies in delivering such services to CALD communities. Importantly, attention needs to be paid to the development of culturally intelligent AI machines that are sensitive to the culture and communication protocols within different language and ethnic groups. There are several studies (e.g., [19–21]) proposing *cultural information systems* for acquiring information and knowledge about people's culture. Information from such systems can potentially help to support the development of cultural awareness in AI machines.

3.2. Translation of Messages

In supporting CALD communities during emergencies, several researchers have emphasised the need to provide tailored materials (e.g., emergency alerts, warnings, text messages, and news coverage) that are conveyed in the native languages of the people [9,10,12,22]. Following the 2011 Queensland flood, both the Multicultural Development Association (MDA) and the Ethnic Communities Council of Queensland (ECCQ) reported that “the absence of translated messages during the flood resulted in many CALD communities not adequately taking heed of the warning messages, underestimating the risks to which they were exposed, and therefore not taking appropriate protective action” [1] (p. 470). Similarly, “the 30 deaths, most of them of Mexican descent which occurred in 1987 when an F4 tornado came down in Saragosa, Texas, was attributed to the failures translating and transmitting the warning message into Spanish on time” [7] (p. 536). In an ideal situation, all disaster risk communications, including evacuation and hazard maps (e.g., flood maps) are expected to be written in different languages, particular in high disaster risks zones where many tourists and migrants visit or live [22]. When hazard information is provided in the

native language of CALD communities, the people feel more engaged in the communication and the disaster event, with a greater tendency to personalise the risks and take appropriate responses [12].

However, there are several challenges associated with providing multilingual warnings and communication during emergency events. The first concern is that of accuracy in translation. In Texas for example, there was at least one incident of a local radio station broadcasting inaccurate emergency weather warnings to Spanish communities because of imprecise translation of the words “watch” and “warning” [12]. This occurred because of the wrong use of the word ‘aviso’ as a substitute for the word ‘warning,’ which unfortunately has no direct translation into Spanish when used in the sense of communicating an impending disaster [12]. The other key issue is that the translation was done hastily as is typical of most emergency situations. Besides the time constraint to conduct appropriate translation of messages, there is also the problem of limited resources to provide multilingual communication to meet the personal needs of different language groups in emergency events. Several studies (e.g., [8,9]) have noted that emergency agencies often lack sufficient multilingual personnel to support communication with CALD communities. Given these significant challenges, Benavides [12] recommends exploring available advanced technology to provide multilingual alerts.

Artificial intelligence has emerged as a viable technology for supporting disaster risk communication due to recent advancement in natural language processing and other machine learning methods like neural networks. There are already systems (e.g., the POLINT-112-SMS system for supporting emergency information management and decision making) that are designed to rely on natural language processing to meaningfully process short message service (SMS) texts provided by the humans [23]. While AI-powered language translation may not be ready yet for deployment in safety-critical environments such as natural disasters, there is hope in the near future that neural networks and other machine-learning methods led by Google will be able to do language translation for real-time operational purpose.

The supervision/training of such machine learning algorithms can be supported by inputs from human representatives in the CALD communities, otherwise known as “gatekeepers”. The gatekeeper concept is similar to the Promotoras Model wherein multilingual representatives of CALD communities are trained and equipped to provide health advice to their communities using the native language [7]. Gatekeepers are therefore multilingual representatives of CALD communities, who are well informed on matters affecting their communities and can act as intermediaries to facilitate communication between their communities and emergency agencies [1]. In other words, gatekeepers break communication barriers by acting as the conduit through which emergency information and other time-critical resources from the larger community can be collected, filtered and disseminated seamlessly to specific CALD communities in forms that are both relevant and culturally appropriate. Future research seeking to apply artificial intelligence techniques in providing multilingual disaster warnings to CALD communities can explore gatekeepers to help improve machine translations.

3.3. Trust

Trust is a crucial factor in disaster risk communication, which when broken can negatively impact a person’s predisposition to accept or respond appropriately to emergency warnings [11]. Due to a residue of discrimination and perceived racial disparities in disaster response efforts (e.g., black USA citizens hanging on roof tops during Hurricane Katrina), ethnic minorities and people from CALD communities may be less likely to take official warnings seriously because they may not trust government authorities as credible sources of information [8,24,25]. West and Orr [24] added that messages in the press are also likely to be seen by ethnic minorities as biased, inaccurate and unbalanced. Nonetheless, the high vulnerability of minority groups and CALD communities means that they still remain in greater need of government support as compared to the larger community [25]. Hence, from a technological perspective, we recommend that in designing information systems to support CALD communities, features that are likely to build trust by signifying meaningful shared identity (e.g., icons, flags, colors, and languages of CALD communities) should be included while

those that reinforce mistrust (e.g., use of government logos) should be avoided. Ideally, representatives or users from CALD communities should be properly involved in the design and development of the system, ensuring a culturally appropriate product is delivered. Consultation with CALD communities will also help ascertain which government and non-government bodies are trusted and less trusted, as this is bound to vary by regions, language groups, migration patterns and other aspects of their history.

Several studies have reported that migrants and people from CALD communities often prefer to receive emergency information through trusted sources, typically family, friends, gatekeepers and smaller discussion groups within their social networks [1,10,25]. The responses of CALD communities to time-critical warnings and evacuation orders are often delayed due to time wasted in seeking confirmation from family, friends or social networks [12]. This delayed response contributes to the disproportionate impact of natural disasters on ethnic minorities and people from CALD communities. From a technological perspective, it is important to explore innovative ways by which such response delays can be reduced. This is a crucial issue and one that has not been investigated in the literature. The role of technology can be championed from two dimensions. First, can technology (e.g., persuasive system designs) help to prevent people from CALD communities in engaging in the time-consuming confirmatory process wherein CALD communities seek the corroboration of warning messages with trusted family, friends or like-minded people in their social networks? Otherwise, can technology help to speed up the confirmatory process?

This further raises an important question of what should be the most appropriate communication channel(s) for sending emergency messages to CALD communities, assuming these messages were successfully translated to CALD languages? There are various channels that come to mind, including local radio stations, social networks (e.g., Facebook, Twitter), instant messaging apps (e.g., WhatsApp, Viber, Meebo, Kik, WeChat, Messenger), Ad hoc software systems, and broadcast TV stations. All of these channels provide some opportunities, but also convey their unique challenges, which need to be properly investigated in future research. For example, one may question the appropriateness of social networks as a source of conveying time-critical emergency messages given that these platforms (e.g., Facebook) are inherently inundated with enormous distracting media like viral videos and pictures that will detract the user's focus and cognition from the much needed rapid processing and sense-making of emergency messages. Essentially, the appropriateness of a given communication channel may vary across and within CALD groups, depending on several factors such as age (e.g., younger generation may be more active on social networks whereas senior citizens may prefer traditional media like local radio or broadcast TV, although it is important not to stereotype age groups). Another variation in the preference of communication channel could be the migrant's country of origin (e.g., WeChat may work for Chinese migrants whereas Indonesian migrants may prefer emergency communication on Twitter) [26]. While a multimodal communication approach might seem more tenable, it is vital that emergency agencies work together with peak multicultural organizations and leaders to better understand the varying profiles of their CALD communities and consequently devote limited resources to activate those channels that work best for communicating emergency messages to those communities.

Another key issue with trust lies with technology itself. Wilson and Tiefenbacher [8] noted that ethnic minorities and people from CALD communities, particularly the older generation, tend to show less understanding and trust in information technology used for conveying emergency messages. Here, the focus is not on building new technologies, but on developing linguistically and culturally friendly training, workshops and sensitization programmes to help improve the uptake of relevant technology used in communicating disaster risks to CALD communities. Researchers from an Information Systems (IS) background would argue though that the design of such technology needs to take the "ease of use" into consideration, particularly in relation to older users. Finally, trust building can occur at the preparedness phase of emergency management, when emergency training and education are community-led with only appropriate supporting resources from emergency agencies. When the risk is imminent, people will tend to repeat the learned behavior, adequately embracing technologies and tools they have become familiar with during the training sessions.

4. Conclusions

Ethnic minorities, migrants and people from culturally and linguistically diverse (CALD) communities often face significant difficulties in accessing, interpreting and responding to disaster warnings. This is mainly due to limited language proficiency and other cross-cultural communication barriers that can sometimes undermine appropriate dissemination and response to emergency information. Technological advancement provides opportunities to explore computational means of engendering culturally and linguistically appropriate communication during emergency events. However, limited knowledge about the main militating factors dampens understanding of the most relevant technological solution to adopt. This study has contributed by reviewing relevant literature and providing knowledge about the most pressing challenges requiring technological interventions. Three broad issues (i.e., trust, message tailoring, and message translation) were identified and discussed, and potential technological solutions for addressing these issues were recommended. The study provides a platform for developing technological solutions to help meet the information needs of CALD communities before, during and after disaster events.

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