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Risk Communication on Floodings: Insights Into the Risk Awareness of Migrants in Rural Communities in Austria

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The Alpine region is expected to be considerably affected by climate change and an increase of settlement area exposed to natural hazards. To respond to emerging challenges due to climate change, land-use changes, and sociodemographic and migration issues, an integrated management of natural hazards is needed, including appropriate approaches to risk communication. This study—which included a quantitative street survey, semistructured interviews (Leitfadeninterview), and focus group discussions carried out in 9 Austrian municipalities prone to flooding—found that residents with foreign-born parents and foreign-born residents were underrepresented in local governments and in voluntary organizations related to disaster risk management and therefore often do not participate in decision-making. Nonetheless, ethnicity was often not the

prevailing factor that determined vulnerability and modes of coping. Instead, social networks and ownership structures had an important influence on people's ability to recover from past events and prepare for future events. Study participants who had not recently been affected by natural hazards, including floods, generally perceived them as having a low probability of recurrence and ranked them lower than other (daily) risks and struggles. This article aims to contribute to a better understanding of efficient communication as well as target-group-oriented communication channels and contents that foster risk awareness and private adaptation capacity among migrants in rural Austria.

Keywords: Risk communication; protection-motivation theory; migrants; floods; disaster risk reduction; property-level flood-risk adaptation; climate change adaptation.

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Introduction

Natural hazards affect living conditions in mountain regions worldwide. The Alpine area in Europe has limited area for permanent settlement due to topography and natural hazards; exposure of people and buildings varies depending on their economic activities and settlement patterns (Fuchs et al 2015). Observed climatic changes for Austria show an increase in annual flood runoff in the range of about 20% of Austrian catchment areas within the last 30 years (APCC 2014). In addition to projected rising temperatures, increases in mean annual precipitation are expected. Nonetheless, high uncertainties and considerable spatial and temporal variability remain (Chimani et al. 2016). In the light of ongoing changes in climate and society (APCC 2014; Gobiet et al 2014; IPCC 2014; Blöschl et al 2017), a more flexible management of natural hazards is of great

importance to cope with these uncertainties (Walker et al 2014; Thaler et al 2016). The recent concept of risk governance (IRGC 2017; Rudolf-Miklau and Kanonier 2018) encourages commitment on the part of all actors involved and promotes public engagement to support property-level flood-risk adaption. Risk communication is an essential part of this approach (IRGC 2017), which requires a supportive environment for communication between public and private actors. A number of studies have suggested that information on risks enhances the public's knowledge and awareness, encourages changes in attitudes and behavior, and increases public confidence in risk management agencies (Fuchs et al 2009; Wachinger et al 2013). However, Rollason et al (2018) showed that current passive and active information instruments, such as existing hazard maps, fail to develop capacities for understanding and responding to floods in a resilient way.

Risk communication, defined as the exchange of information about risks, can be depicted by a simple model consisting of the message source, message design and content, delivery channel, and target group (Covello et al 1986). It has multiple aims: promoting awareness, transferring knowledge, providing behavioral advice, and warning of disasters (Fernández-Bilbao and Twigger-Ross 2009; Höppner et al 2012). The many actors involved in disaster risk management (DRM) and the production of risk knowledge (Spiekermann et al 2015) add to the complexity of the communication challenge. In order to effectively exchange information, traditional 1-way provision of information is being replaced by 2-way exchanges (Höppner et al 2012; Ping et al 2016), for example, participatory approaches to the development of risk maps (Fakhruddin et al 2015; Luke et al 2018) or identification of options to manage local flood risk (Maskrey et al 2016). Evaluating projects in Great Britain, Twigger-Ross et al (2014) showed that an interactive exchange of knowledge about hazards and risk between decision-makers, experts, and the affected public is needed to improve community resilience.

In affluent communities in Austria, as in other developed economies (Feldman et al 2016), many channels for risk communication exist. Printed media, television, radio, and in-person communications (Lindell and Perry 2012; Tang et al 2015) are supplemented with increasing frequency by Internet-based information-sharing applications and social networking sites, such as Twitter and Facebook (Panagiotopoulos et al 2016). Growing awareness of the heterogeneity of target groups (Martens et al 2009) has led to recognition that the public itself is a very heterogeneous group. People, communities, and vulnerable groups assess information differently, take action on different issues, and may need or prefer specific communication strategies (Martens et al 2009; Feldman et al 2016; UNISDR 2017). Although a variety of information materials have been developed for experts and laypeople (Fuchs et al 2009; Meyer et al 2012), there is a need to better understand tailored communication (Haer et al 2016) for subgroups.

This article reports the results of the “Climate change adaptation and protection from natural hazards” project focusing on risk communication for people with a migration background. This term refers to both residents with foreign-born parents and foreign-born residents, following Statistics Austria (2015). The project sought to identify the information channels and types of risk information that risk-management professionals used to reach out to people potentially affected by natural hazard events, the places that potential information recipients searched for information about natural hazards, and whether there were any differences in these patterns between people with a migration background and a comparison group without a migration background.

The article explores whether people with a migration background knew experts and authorities in the field of

DRM and whether they participated in decision-making and communication processes. The experts in turn were asked how they currently identify and address different target groups in risk communication and whether they know any good-practice examples and entry points for inclusive and targeted risk communication.

Target groups in risk communication

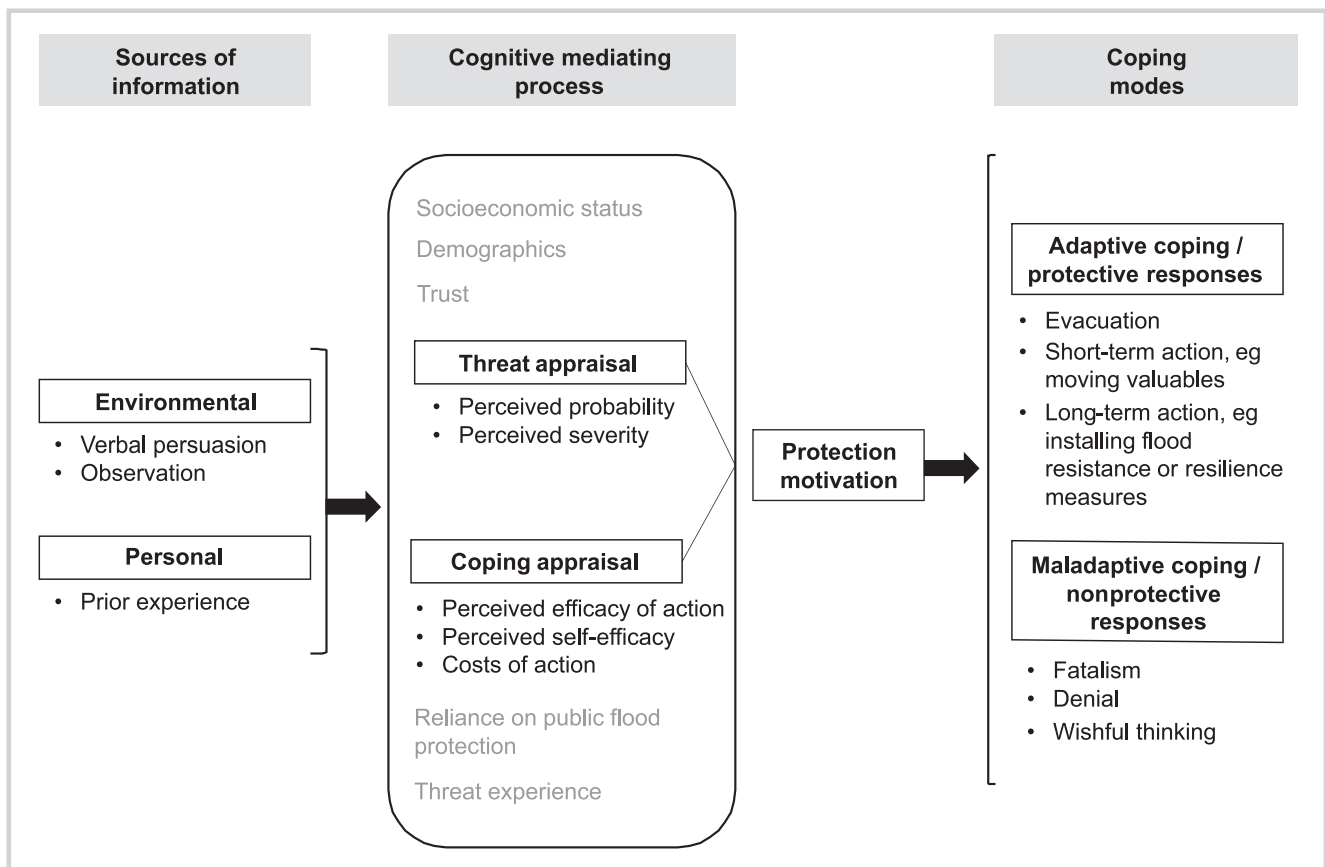
There is an ongoing discussion among climate change communication specialists about audience segmentation, which was recently picked up by the field of disaster risk reduction (DRR) to better understand the diversity of a community and to enhance the effectiveness of communication via tailored information (Bostrom et al 2013; Hine et al 2014). Although some authors have raised concerns that audience segmentation amplifies a polarizing view, Hine et al (2014) argued that the awareness of the existence of different groups is sufficient to reconsider existing communication strategies. A United Nations guideline on DRR communication (UNISDR 2017: 4) pointed out that “the public comprises all people in society, spanning old, young, rich, poor, male, female, urban, rural etc. Yet, if you target everyone, you target no one.”

People-centered risk communication, taking into account the specific needs of different people, was acknowledged by the Intergovernmental Panel on Climate Change (IPCC 2012) as a key factor in DRR. Therefore, communication processes should include local risk perceptions and local framing of risk. It has been acknowledged that different groups of people and different locations need different warnings (Fielding 2012). Variables that influence the effectiveness of flood-risk warnings include social and demographic characteristics, such as age, gender, socioeconomic status, and ethnicity, as well as language skills and special needs, including visual and hearing difficulties (Tapsell et al 2005; Tapsell et al 2010; Bačanović 2015).

Interactive hazard maps that show potential risks for the settlement area are regarded as a valuable risk communication tool (Houston et al 2017) and the most commonly used tool in the European Union (Luke et al 2018), depicting the probable extent and depth of flooding under different conditions. There have been efforts to evaluate and develop risk maps for different target groups; for example, Fuchs et al (2009) distinguished between experts and laypersons. Maps are often visualized differently by people with technical knowledge and understanding of technical terminology than by people without that specialized knowledge, but technical language is not considered suitable for use in public information documents about risk and emergency management (Cronin et al 2004; Fuchs et al 2007; Holub and Fuchs 2009).

It is widely acknowledged that many social disadvantages exacerbate vulnerability to natural hazards

FIGURE 1 Factors influencing decisions on whether to take action to protect oneself from a hazard. Figure represents protection-motivation theory, originally proposed by Rogers (1975) and modified by Floyd et al (2000), adapted to flood risk. Gray boxes indicate the 3 processes leading to adaptation measures. Gray text indicates factors influencing individual motivation to protect against a certain hazard. (Figure by Weber 2019)



(Tapsell et al 2010). Often, people with a migration background are assumed to be more likely to be exposed to the impact of natural hazards due to a potentially higher risk of poverty (BMASK 2013; APCC 2014) with weak financial capacity, resulting in low adaptive capacity and lack of money to invest in adaptation (Prettenthaler et al 2008). The level of risk awareness regarding climate change and natural hazards is assumed to be lower than their awareness of nonnatural everyday threats and economic, social, political, and environmental pressures (Działek et al 2013). Language issues are expected to impede the understanding of crucial information in emergency situations (Martens et al 2009) and hamper participation by individuals from socioeconomic groups with low levels of education.

Protection-motivation theory

Originating in psychological research (Rogers 1975), protection-motivation theory explains how appeals to fear affect health attitudes and behaviors. It is applicable to “any threat for which there is an effective recommended response that can be carried out by the individual” (Floyd et al 2000). It has been applied to more than a decade of

research on flood-related issues and factors driving preventive intentions and behaviors (Grothmann and Reusswig 2006; Poussin et al 2014; Babicky and Seebauer 2019). The overall protection-motivation theory model developed by Floyd et al (2000) includes 3 processes—information gathering, cognitive mediation, and coping (Figure 1). These were applied to flood risk and potential private protection measures as follows:

1. Information can be characterized as environmental (received from others—eg relatives, neighbors, the media, or experts—or through observation) or personal (prior personal flood experience).
2. Cognitive mediation appraises the threat (the likelihood of a flood and its likely severity and consequences), individuals’ potential to cope (the efficacy of potential actions as well as self-efficacy or ability to carry out the actions), and the cost of potential coping actions.
3. Coping behavior consists of individual actions; these may be adaptive or maladaptive (protective or nonprotective).

A meta-analysis of research on flood-prevention intentions (Bamberg et al 2017) confirmed that both threat

FIGURE 2 Volunteer firefighters in the center of Kremsmünster, Upper Austria, evacuation during a flood in 2002. (Photo © Freiwillige Feuerwehr Kremsmünster, reproduced with kind permission)



appraisal and coping appraisal are significantly associated with flood-prevention intentions. Factors that influence protection motivation include socioeconomic status, demographic characteristics, trust, and reliance on public flood protection and institutions (Bubeck et al 2012; Bamberg et al 2017). In contrast, Bradford et al (2012) found no direct influence of worry and awareness on preparedness but confirmed a positive effect of previous flood experience on worry, awareness, and preparedness. Rollason et al (2018) asserted that protection-motivation theory “demonstrates the complex, contested, and highly personal nature of the linkage between communication and the adoption of protective behaviors.”

Study area and research approach

The study focused on people with and without a migration background who lived in or near an area prone to flooding. Fieldwork was conducted in 2017 and 2018 in rural mountainous areas of Austria in the federal states of Lower Austria (region of Triestingtal, with the municipalities of Altenmarkt, Pottenstein, Berndorf, and Leobersdorf) and Upper Austria (region of Steyr-Kirchdorf, with the municipalities of Hinterstoder,

Windischgarsten, Grünburg, Kremsmünster, and city Steyr). Both study regions are vulnerable to flooding, have a long tradition of flood protection, and have experienced several floods within the past decade (Figure 2). Both study areas have also experienced migration for a long time and are characteristic examples of non-urban municipalities that have experienced heavy industrial development and employment in-migration.

The project was designed as a case study using both qualitative and quantitative methods (Table 1). Websites of municipalities and fire brigades, municipal official journals (Amtsblatt), folders and brochures available at municipalities, and online applications were reviewed and analyzed to see if they contained informational material on natural hazards, public flood protection measures, residual risk, documentation of past events, and property-level flood-risk adaptation. This procedure helped to gain insight into the context within which the research participants operated (Bowen 2009).

During the qualitative part of the research, 201 residents were questioned in a standardized face-to-face street survey, of which 167 met the inclusion criteria of living in a case-study area and being over 18 years old. On average, 19% of the residents of the case-study areas had a

migration background (authors' calculations based on Statistics Austria 2016); but about 35% of respondents in the street survey had a migration background as a result of aiming to increase the size of the sample. The survey asked about individuals' experiences with natural hazards, related damage to property, risk perceptions, and the sources they relied on for information about natural hazards. Their responses were analyzed using descriptive statistics.

After general insights had been gained from the street survey and document analysis, 56 semistructured interviews were conducted with (1) a total of 33 experts, of whom 13 were from the municipal government, 7 from the Austrian Service for Torrent and Avalanche Control and the Federal Water Engineering Administration, 6 from fire brigades, 3 from regional administration, 1 from a nongovernmental organization, 1 from civil protection, 1 architect, and 1 history expert; and (2) 23 people (11 with and 12 without a migration background) living in flood-prone areas. Participants' responses were used to gain a deeper understanding of current concerns and problems expressed by regional DRM and the local residents.

For qualitative content analysis (Mayring 2000; Kuckartz 2016), all interviews were transcribed and coded with the qualitative data analysis software Atlas.ti. The main codes were developed based on the interview guideline and the research questions, following a deductive approach (Diekmann 2007; Kuckartz 2016). This method was extended to a mixed approach after Gläser and Laudel (2010) and Kuckartz (2016) that made it possible to modify the initial codes and create new subcodes. The coding was carried out by 3 researchers using a coordinated approach. The data were then analyzed, similar to the approaches of Braun and Clarke (2006), Kuckartz (2016), and Ranney et al (2015), by creating clusters to identify recurring themes and using these as a framework to observe and analyze the results. A key step was to find links between different subcodes and aggregate the survey data.

Subsequently, 4 focus group discussions were held with a total of 28 participants—including government officials, emergency responders (eg members of fire brigades and civil protection), representatives of nongovernmental organizations, and local residents—who had been invited to attend via e-mail, phone call, and direct mail. Researchers opened the discussions by giving a short presentation on the project (Henseling et al 2006). This initiated a discussion on private and public flood protection, residual risks, flood experiences and lessons learned, information and communication, and recommendations and ideas. The results of all focus groups were clustered and contribute to overall results

Results

The results of the different surveys are depicted along the following identified subtopics: (1) warning and

information before an emergency, (2) hazard maps, (3) personal flood experience (4) memories of past events kept for the future, (5) public flood protection and residual risk, (6) property-level flood-risk adaptation, (7) warning and information channels, and (8) target-group-specific information.

Warning and information before an emergency

According to participants in the street survey and interviews, the main sources of information and advice on flooding are the local fire brigades and municipal governments, followed by Internet sources (Figure 3). A specific Internet source was rarely mentioned; a typical response was “I would type in ‘flood’ on Google” (woman, migration background). People with a migration background ranked the categories “family and friends” and “colleagues” higher as information sources than did people without a migration background.

Knowledge about hazard maps and hazard zones

Flood hazard maps, considered an important element in risk communication, are distributed to the public in the case-study regions mainly by the federal government via freely available WebGIS applications. Only 4 out of 23 interviewees were aware that their property was located in an area at risk of flooding; residents with a migration background had less knowledge in this regard than members of the comparison group. One person answered: “I did not know about it when I purchased the house . . . an elderly neighbor informed me later on about the flood risk” (female, with migration background). Another person was aware of the risk but felt safe after public flood-protection walls were built. Experts reported that public information events—usually coordinated by municipalities cooperating with the Austrian Torrent and Avalanche Control—had recently become a common practice after the finalization or revision of hazard maps, although this was not compulsory. When they occur, these information events are welcomed by the local population, but participants were mainly residents with a personal interest in hazard-related issues.

Personal flood experience

Almost 80% of the respondents to the street survey said that they had experienced natural hazards themselves or within their community, and around 50% had been affected personally (with similar rates among people with and without a migration background) (Figure 4), but only one-fourth said they expected natural hazards to occur within the near future (sum of “yes” and “probably”). People with a migration background rated this as even less likely than the comparison group.

Several interviewees had been surprised by the intensity of the flooding in 2002, especially those for whom the

TABLE 1 Research methods and topics. (Table extended on next page.)

Method	Sample size	Sample description
Analysis of public documents	16 websites Brochures and folders Municipal official journals	9 municipal websites 7 fire brigade websites 5 folders and brochures Official municipal newspapers of Steyr and Leobersdorf
Quantitative street survey	167 participants	Local residents 51% female, 49% male 35% migration background 65% no migration background Response rate 80%
Semistructured interviews	23 participants	Local residents 65% female, 35% male 48% migration background 52% no migration background Average age 52 years
Expert interviews	33 participants	Experts 82% female, 18% male 70% local, 30% regional 13% migration background 87% no migration background Fields of expertise/institution: 41% municipal government 21% Austrian Service for Torrent and Avalanche Control and the Federal Water Engineering Administration 18% fire brigade 9% regional administration 3% architect 3% civil protection 3% historian 3% nongovernmental organization
Focus groups	28 participants in 4 groups (2 in each study region) 10 participants in Triestingtal, 18 participants in Steyr-Kirchdorf	Experts and residents 21% female, 79% male 3 residents who were also experts in the following fields: 36% municipal government 21% fire brigade 18% Austrian Service for Torrent and Avalanche Control and the Federal Water Engineering Administration 11% regional administration 7% nongovernmental organization 4% civil protection 4% architect

flooding reached the above-ground living space as well as the cellar, and still worry during strong and long rainfall. “The worst was and still is for me that if it rains now for 1 to 2 days, then I get nervous and start checking the gauging information even at night” (male, migration background).

The respondents in the street survey were asked where the last flood caused damage. The most frequent answer was the cellar (27%). Many respondents stated that there was no way to prevent groundwater from entering their cellars. The second most frequent answers were damage to roads (16%) and nearby houses (16%). Damage to own houses and gardens accounted for 12%.

Memories of past events kept for the future

In Triestingtal, 7 major floods and several smaller, more local floods have occurred since 1882 (Schießl and Schilder, 2000), but study participants recalled mainly the floods of 1991, 2002, and 2014. In Upper Austria, a hundred-year flood in 2002, which caused heavy damage and financial loss, was still remembered. The years 2009 and 2013, when floods happened, were mentioned in the interviews, too. However, the municipal websites had little or no information about floods in the last 100 years. Some fire brigade websites presented historical flood pictures. Otherwise, except for a few flood marks on buildings, most municipalities were not actively seeking to keep the

TABLE 1 Extended. (First part of Table 1 on previous page.)

Method	Analysis	Subtopics
Analysis of public documents	Topics “floods,” “flood risk” were used as keywords for searching the websites	Hazard maps Memory of past events kept for future Public flood protection Residual risk
Quantitative street survey	Descriptive statistics were derived from the responses	Personal flood experience Property-level flood-risk adaptation
Semistructured interviews	Responses were subjected to qualitative content analysis (Kuckartz 2016; Mayring 2000)	Hazard maps Personal flood experience Memory of past events kept for future Public flood protection Residual risk Property-level flood-risk adaptation
Expert interviews	Responses were subjected to qualitative content analysis (Kuckartz 2016; Mayring 2000)	Warning and information before an emergency Hazard maps Memory of past events kept for future Public flood protection Residual risk Property-level flood-risk adaptation Warning and information during an emergency
Focus groups	Records and discussion were subjected to content analysis (Kuckartz 2016; Mayring 2000)	Personal flood experience and lessons learned Property-level flood-risk adaptation Residual risk Recommendations and good practice

memories of past floods alive. One expert said that even the media only show interest in natural hazards when damage occurs: “Nowadays, the media make a big fanfare and a few days later it is completely uninteresting again” (male expert, without a migration background).

Perceptions of public flood protection and residual risk

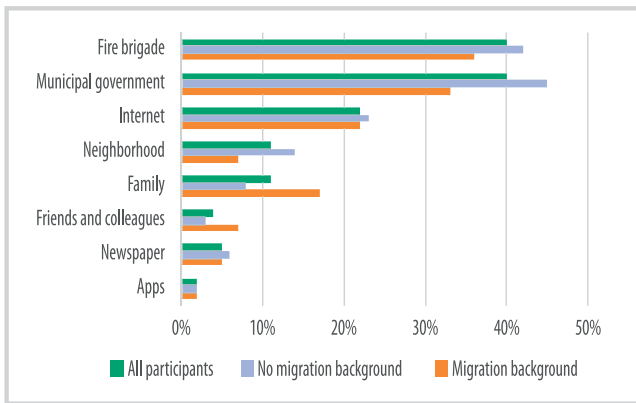
Survey participants in general knew about recent public flood protection measures through public information events, personal local contacts, or having noticed the construction work. However, our analysis indicated that the residual risk for private properties that remains after the implementation of public measures is not discussed on municipal websites or in other official municipal communications. If mentioned at all it is expressed rather vaguely, for example: “Of course 100% protection is not possible.” One exception was in a municipal official journal (*Amtsblatt*) produced by the city of Steyr, which stated: “All these measures can alleviate the flood hazard, but in no way eliminate it. Steyr will still need to be prepared for flood ... and recommends that those who may be affected carry out preventive measures themselves” (Stadt Steyr 2006). Most local communications focused on finalizing technical protection measures, which will contribute to guaranteeing safety from now on and barely addressing the issue of residual risk.

Some respondents were very confident about public flood protection and mentioned the lowering of riverbeds and new higher bridges, providing more space for the water. These interviewees expressed a sense of protection by, and trust in, the municipal government, public flood-protection efforts, and local fire departments. Especially in Lower Austria, respondents had already witnessed the effectiveness of recently built public flood protection and confirmed their trust in it. However, other interviewees perceived a lack of information resulting in uncertainty and questioned whether existing infrastructure would provide sufficient protection against future floods. Several people noted that it often takes a long time until measures are finalized. In the meantime, they feel uninformed (or even misinformed) or completely uninvolved in the process, diminishing their trust in officials.

Property-level flood-risk adaptation

Most of the experts, in particular those in the field of natural hazard management, said that risk perception and the motivation for self-protection declined as time passed after an event. Of participants in the street survey, 27% had set up private adaptation and temporary mitigation measures. The most common adaptation strategies were systems to block the water (such as sandbags and permanent installations at windows and doors) and storage of valuables away from flood-prone areas such as cellars, garages, and even ground floors. The latter option

FIGURE 3 Sources of flood-related information identified by survey participants (n = 167). Multiple-choice question: “If you imagine that you will get questions about flooding, where do you think you will get good recommendations and information?” Results show the percentage of answers relative to total answers given per group and category. Answers choosing “other” were excluded.



was the most common strategy among participants with a migration background, whereas participants without a migration background were far more likely to invest in technical flood protection. During and after an event, local home-improvement stores were highly frequented to buy water pumps or building material, and people affected by floods often received discounts.

Among participants in the street survey, like in Austria as a whole (Statistics Austria 2015), people with a migration background were more likely than others to rent rather than own their home. Some local stakeholders said that residents can ask for information about private adaptation measures through in-person interviews with municipal building authorities. But for the most part, the only people who request this information are property

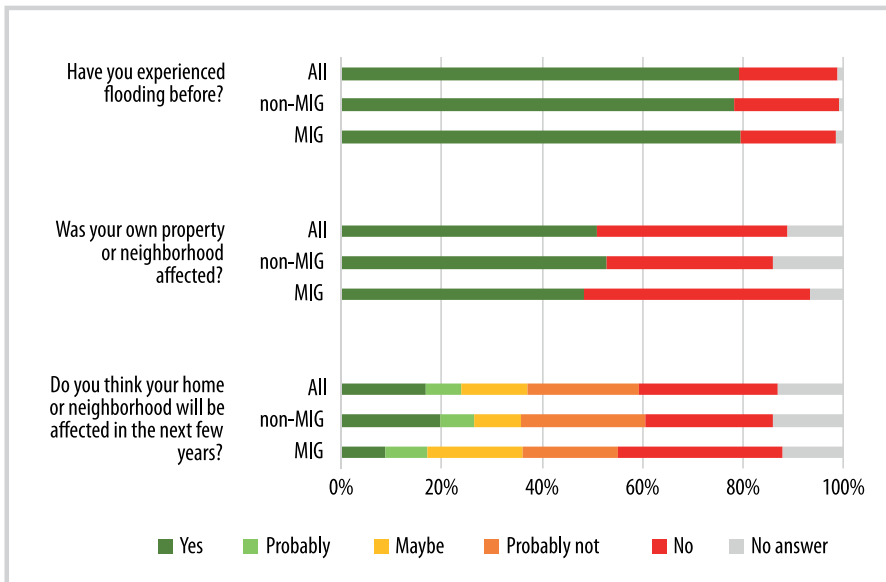
owners constructing a new building. Numerous brochures on private flood preparedness in Austria already exist, and there are plans to publish new ones, including multilingual versions, by the civil protection service and fire brigades. The brochures, however, were never mentioned by residents as a source of information; sometimes not even municipal authorities and local DRR experts were aware of them.

Warnings and information during an emergency

Interviewees mentioned a variety of emergency information sources. All age groups frequently mentioned websites and online applications provided by the federal states (Lower and Upper Austria) and hydrographic services (eg ehyd.gv.at) that provide real-time information from gauging stations about water levels. People living in hazard zones expressed the need for accurate, timely, and on-demand information. Text messaging for alarms was limited to users who registered in advance for the service and was not used frequently. Sirens were common in all case-study municipalities. Although they target everyone within hearing distance, residents were more likely than visitors to have the awareness and experience needed to respond appropriately to a siren signal.

Some municipalities in Upper Austria have experienced emergencies that required evacuation. Directly communicating face-to-face and by loudspeaker proved to be effective in those cases. Some interviewees mentioned that a few residents—especially men, elderly

FIGURE 4 Survey participants’ experiences of flooding and expectations regarding future events. Single-choice questions: (1) Have you ever experienced flooding? (answers: yes, no, no answer); (2) Was your own property or neighborhood affected? (answers: yes, no, no answer); (3) Do you think your home or neighborhood will be affected in the next few years? (answers: yes, probably, maybe, probably not, no, no answer).



people, and people with a migration background—refused to follow evacuation instructions, which put them in danger. Both experts and interviewees with a migration background denied that language barriers existed during emergency situations, as neighbors and children quickly and adequately translated instructions by firefighters or other authorities. Voluntary organizations working in DRR, such as fire brigades, are unable to translate emergency information themselves. A couple of interviewees expressed the view that voluntary organizations would benefit from a diversity of members, for example more female members or members with a migration background. However, changes can be observed in youth groups of voluntary fire brigades (Feuerwehrjugend) that have a rising proportion of members with a migration background.

Table 2 summarizes key channels of communication on floods and shows the extent to which specific target groups are addressed. It further identifies, whenever possible, the effectiveness of the channel.

Target-group-specific information

Information on hazard zones was only available in German and used technical language. Expert and stakeholder interviews revealed a lack of awareness of target groups. Some experts from municipal authorities and federal administration did not consider themselves responsible for risk communication or recognize it as an issue and therefore had not considered potential target groups. “So far, our department has not felt so responsible for risk communication because we are more than busy with the implementation and planning of flood control measures and maintenance,” said a DRM expert in Lower Austria (male, without a migration background). Mostly, experts did not recognize any differences in DRM related to gender, age, or other demographic characteristics. However, a few experts mentioned that they use some channels targeted to specific audiences in the context of environmental issues like waste prevention. One example here is the city of Steyr, where—besides the lengthy experience in flood protection—cooperation between institutions is key to risk perception. The fire brigade works with a charitable institution and translators to conduct fire exercises for people with a migration background. These experiences and contacts offer valuable transferable lessons for DRM efforts elsewhere. In addition, efforts are currently underway to establish a joint strategy by the federal fire service association of Upper Austria and the federal integration point to promote membership in voluntary fire brigades among people with a migration background (OÖ Feuerwehrverband and IST 2017).

Discussion

Among study participants, people with a migration background relied, like people in the comparison group, on

municipal governments and fire brigades for information on natural hazards. This finding was unexpected, as several studies have indicated that information channels for migrant groups differed from those for nonmigrant groups due to language issues and a lack of connections with the host society (Heuser et al 2013). These findings also suggest that the information exchange between municipalities, fire brigades, and all inhabitants needs to be strengthened and built upon. Printed informational materials and websites are not sufficient for risk communication in general (Stickler 2012). Instead, to better engage people with a migration background in risk communication processes, low-threshold channels (Heuser et al 2013) such as door-to-door informational visits and personal contacts that communicate flood-risk information tailored to local circumstances are needed. One occasion municipalities can use to communicate with residents is the release of new hazard maps.

In the context of DRR and climate change adaptation, there are a variety of information materials on hazards, risks, and individual adaptation options, but these are often not available at one spot, are not tailored to local circumstances or specific target groups, and are only available in German. Instead of translating information materials into other languages, use of simpler and more accessible language was suggested by experts in the survey, advice that is echoed in the literature (Fielding 2012; O’Sullivan et al 2012). This could make it possible to overcome barriers to understanding and reach residents with little local knowledge—newcomers from both inside and outside Austria—and lower education levels.

Although research suggests that a lack of language skills is an obstacle in emergency response (Burke et al 2012; Baćanović 2015), participants in this study did not recognize any language barrier, as neighbors and children translated instructions. However, the results of this study support evidence from other studies (Martens et al 2009; Freeman 2014; BMASK 2015) that people with a migration background are underrepresented in local government and voluntary organizations like fire brigades, and therefore often do not have the chance to participate in decision-making processes.

Austria has a long tradition of volunteerism, especially in rural mountain areas. Members of fire brigades benefit from participating, and gain versatile practical knowledge about DRR. This is also true for people with a migration background or people who have recently moved to the region from elsewhere in Austria, who can contribute their own knowledge to their family and friends. In turn, voluntary organizations can benefit from new members whose language skills and cultural understanding increase the organizations’ capacity to reach people during a crisis.

Awareness of public protection measures contributes to observational learning, which influences coping modes. However, the perception of existing protection measures as effective (so far) also fosters a feeling of safety and reduces individuals’ motivation to do their own preparation.

TABLE 2 Natural hazards communication channels.

Type of content	Channel	Intended recipients	Effectiveness of channel
Preparedness phase			
Hazard maps	Online (WebGIS applications)	Local residents in hazard zones	People with a migration background were less informed than others about location of their own property relative to hazard zones; information is available only in German, and language is technical
	Local events giving information about revision of hazard maps	Local residents and property owners	No detailed information was available as there was no information about who attended the meetings; mainly residents with personal interest participated
Memory of past events	No information on municipal websites	Local residents	Residents mostly relied on personal experience
	Little or no information on local fire brigade websites	Local residents	Residents mostly relied on personal experience
Public flood-protection measures	Public events at the local level	Local residents and property owners	No detailed information was available as there was no information about who attended the meetings
	Municipal websites	Local residents	Respondents were very well informed about public flood-protection measures
Residual risk	Municipal official journal	Local residents	The existence of public flood-protection measures often hampered the awareness of residual risks
Property-level flood risk adaptation	Brochures and folders (only in German)	Members of the public nationwide	No survey respondent mentioned the brochures
Response phase			
Warnings and general emergency information	Online applications provided by federal states and hydrographic services, publishing data on water levels and gauging stations (eg ehyd.gv.at)	Local residents prone to hazards	Residents who are worried about floods recall up-to-date information about water levels; information is only available in German
	Text messages from emergency services	Local residents	Acceptance varies in municipalities but is rather low and limited to residents who are registered for the service; information is only available in German
	Sirens and alarms	Everyone near the siren	People are alerted to hazardous conditions
Information about evacuation	Direct contact by emergency services (eg face-to-face and by loudspeaker)	People living in an evacuation area	Those who are at home and get in touch with the emergency services; sometimes translation is needed

Besides environmental sources of information, personal knowledge and prior experience are connected to protection motivation. This research confirms the assumption that risk awareness is rather low among people with a migration background (Działek et al 2013).

Another reason for low protection motivation is that people tend to forget the consequences of natural hazard

events rather quickly (Wagner and Suda 2004) if remembrance is not constantly kept alive. The municipal websites reviewed for this study contained little to no information about historical floods, with the city of Steyr in Upper Austria as an exception due to its long history of flooding. For example, the city website contains information on funding opportunities for private

adaptation measures and a list of companies offering flood-resilience technologies. The informational materials reviewed for this study contained little information on adaptation measures and hazard zones. Few interviewees appeared to know whether their own property was located in a hazard zone. The awareness of risk exposure was even lower for people with a migration background. Nevertheless, within this project it was not possible to detect if the information about natural hazards was understood.

Similar to findings from other research, protection motivation was rather low among our study participants, and the implementation of private protection measures is tied to legal restrictions, depending on the location within hazard zones, property rights (Cutter et al 2003), and building types. One possible explanation for this could be the lack of information transfer to tenants about potential natural hazards, which is not obligatory. For people with a migration background, this has a decisive impact because they are more likely to rent than own.

Only a few of the risk communication efforts in Upper Austria reviewed for this study considered different target groups—for example, initiatives promoting membership of people with a migration background in fire brigades and fire extinguishing exercises with translators. Some promising approaches are to connect communication strategies with existing local initiatives and local stakeholders (Twigger-Ross et al 2014) or bottom-up initiatives (Seebauer et al 2018). For example, information on natural hazards can be combined with information on stockpiling for large-scale blackouts, other environmental topics (eg waste prevention), or daily weather forecasts. In addition, given that many people visit home-improvement stores after a natural hazard event, these stores are a promising place to promote property-level protection systems in rural areas, preferably before an event occurs.

Conclusion

The results of this study contribute to the understanding of the cultural and social dimensions of climate change impacts and adaptation and of DRM, DRR, and risk governance. They expand knowledge of information and communication channels in rural Austria as well as risk awareness and protection motivation of people with a migration background. Protection-motivation theory offers a useful framework for discussing information contents and channels that influence individual protection behavior. Unlike most earlier studies (Grothmann and Reusswig 2006; Babčický and Seebauer 2019), this study used a predominantly qualitative approach. Therefore, the results are limited to a smaller sample. The research showed that most of the experts related to DRM did not think of different target audiences when providing information about natural hazards. Particular challenges for them are to consider the diversity within target groups and the variety of conditions in areas prone to natural hazards. This requires a collaborative approach between all stakeholders and institutions working in fields with responsibility for DRM and climate change adaptation (such as municipal and regional authorities, emergency services and fire brigades, associations working with migrants and the population itself), as well as a bottom-up approach. To provide entry points for collaboration, guidelines were developed that address a variety of actors and aim to find ways of better integrating people with a migration background and other new residents of rural mountain areas in Austria in the management of DRR (Stickler et al. 2019).

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