

The role of risk perception and community networks in preparing for and responding to landslides: a Dolomite case study

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1 Introduction

In the Alps, natural hazards are part of everyday life and tied into local history and culture. Communities live with permanent risk and have to cope frequently with the impact of small and sometimes major events. These events help shape the livelihoods, identity and resilience of communities. They represent important markers for risk perception, and are manifest within social knowledge networks.

This chapter presents results from a study in the small alpine community of Badia (South Tyrol/Italy). Badia was selected as an emBRACE case study due to the fact that its population had recently experienced the effects of a large landslide event, which took place in December 2012, causing damages to buildings and leading to partial evacuation. The objective of the study was to understand what we can learn from the empirical experience of a community in terms of community resilience and how risk perception, local knowledge and social networks contribute to resilience within and amongst communities. Understanding the social system and people's perception of risk as a component of it can make an important contribution to risk management (Renn, 1998) e.g. by contributing in shaping a more effective community response. It can also assist the responsible authorities in their development of disaster planning activities and contribute to the development and improvement of strategies for disaster risk reduction (Eiser et al., 2012; Davis et al., 2005). Therefore, our research looked at interactions and networks among different risk management organizations and actors, but also between them and the population. We believe that a fuller grasp of what community resilience might be involves both an understanding of the top-down policy network responsible for the strategic "big picture" and also of the community network, which may have its own resilience, but which is also often responsible for the plan implementation.

Another objective was to highlight how these results, which we obtained within a very specific context, are linked to the broader discussion about the key aspects relevant for community building, about how resilient community networks look and about how our results can be made useful elsewhere.

2 Badia and the Alpine context

This case study focuses on the situation within the municipality of Badia in the Eastern part of the Italian Autonomous Province of Bolzano. This Province, also known as South Tyrol, is entirely located in the Alps. Italy's northernmost province lies at the border with Switzerland and Austria and is at the geographic and cultural crossroads of central and southern Europe. This is also reflected in the region's history, until 1918 it was part of the Austrian - Hungarian Empire and was almost completely German-speaking, whilst at the end of the First World War it was occupied by and annexed to the Kingdom of Italy. Between the two World Wars the fascist regime led by Mussolini strongly fostered the migration of Italian speaking population from other parts of Italy to South Tyrol and activities linked to German culture and language (schools, newspapers, folk festivals) were forbidden.

After World War II the first agreement was signed between Austria and Italy that claimed an autonomous region of Alto Adige (South Tyrol) and its neighbouring province Trentino and ensured the rights of cultural minorities, also including the small language group of Ladin, based in some upper valleys in the Dolomites. However, the following years were marked by increasing tensions and conflicts among the different population groups and it was only in 1972, after several international negotiations and thanks to a new package of reforms, that the "the South Tyrolean question" was solved by giving the Province of Bolzano a considerable level of self-government. The current institutional framework represents a model for settling interethnic disputes and for the successful protection of linguistic minorities. These minorities belong to both the German-speaking and also the Ladin-speaking indigenous population¹, which represents the majority in the case-study municipality of Badia. The municipality of Badia comprises 3,458 inhabitants (ASTAT, 2015), covers an area of approximately 82 km² ranging from about 1200m up to more than 3000m of altitude. Badia - as do many municipalities in the Dolomites - benefits from a double tourist season: in summer representing an environment for hiking and other activities, in winter providing numerous options for snow sports, principally downhill skiing (Franch et al., 2003), but with inter-valley skiing and gastronomy (often combined) also growing in importance. Tourism represents the main contemporary source of income.

Life for the inhabitants of Alpine regions in general, and in the higher valley of the Dolomites such as the Val Badia in particular, is characterised by its very special topographic setting. Compared to other European areas that are, for example, at risk of large river floods or earthquakes, alpine regions face a greater variety of natural hazards. On average, these hazards occur at a higher frequency, but are mostly associated with a smaller damage potential. Historical documents prove a long history of damaging events and, accordingly, a vast knowledge of the local populations underpins a capacity to deal with these events. This leads to a strong identification of the local populations with their environment and a territorial (or geographic) identification, which incorporates natural as well as cultural and social aspects (Pollice, 2003). In recent times, the utilisation of favourable and rather easily accessible areas in the valleys has augmented significantly, due to growing activities in tourism, industry and settlement extension.

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¹Ladin stems from a Latin dialect and is associated with Rhaeto-Romance languages.

As a result, an increasing number of buildings as well as lifeline and traffic infrastructure have been constructed in hazard prone zones. This fact has led to a significant accumulation of assets in hazard prone areas and has increased the risk of losses, entirely independent from the frequency or magnitude of the hazardous events themselves.

Within this context, our work focusses on a landslide that occurred in December 2012 in the municipality of Badia. This movement was mainly triggered by heavy precipitation and temperature variations in the weeks and months before the event. The landslide covered an area of overall 42.5 hectares with a maximum extent of 400 m width and 1500 m length. Consequently, 4 residential buildings were entirely destroyed and 37 people in four Hamlets in the immediate vicinity needed to be evacuated. In addition, the down sliding material threatened to create a lake by damming the riverbed of the Gader stream (Mair & Larcher, 2014) putting critical infrastructure and energy supply at risk. In the light of risk perception and local knowledge, it is very important to mention that there had been a previous landslide at exactly the same position around 200 years previously.

Figure 1 shows a comparison of the extent of the two landslides (1821 and 2012), the landslide of 2012 and the destroyed houses.

--- Fig 1: The case study area ---

The landslide within the municipality of Badia activated a number of response mechanisms, developed by the provincial government. Since 1972, based on the principle of subsidiarity, Bolzano has the primary responsibility for managing the risks of potentially damaging events such as natural hazards and to carry out all activities in this respect, as long as the extent of the emergency event does not exceed the provincial capacities. Besides the provincial administration, the municipalities constitute an additional main player in risk governance in South Tyrol, supported by locally-based volunteer organisations. There are two main processes at this local level, which have linked policies and legal instruments: a) the spatial planning process and the local hazard zone maps and b) the emergency planning and the local civil protection plans. The first are laid down by the Provincial Spatial Planning Act (PA, no. 13, 1997) and oblige all municipalities to elaborate a hazard zone plan of all hydro-geological hazards and to document their particular risk level. Once approved, this becomes a legally binding and integrative part of the land use plan, the main spatial planning instrument at municipal level, which focuses predominantly on land use designation and building development (Hoffmann, 2010). For the second process, in each municipality the first person responsible for civil protection is the mayor, who organises municipal resources according to pre-established plans made, in order to cope with specific risks in the territory of the municipality. The mayor has to implement and turn into action the strategies and plans of emergency interventions developed at regional level. In the case of emergency, the mayor has to coordinate the rescue services and represent the interface between them and the population. Additionally, each municipality has its Communal Operative Centre (Provincial Law n.15/2002 art. 3), comprising municipal officers and experts, which supports the mayor in the assessment, decision-making and crisis management. The same law foresees that each municipality should prepare and adopt a *Communal civil protection plan* as a common tool for emergency planning and response and allows the collection and integration of data at provincial level. The municipality of Badia developed and adopted its *Communal civil protection plan* in 2010 and organises and carries out regular emergency drills in order to “test” the plan. The existence of a *Communal civil protection plan* as well as the regular emergency drills revealed themselves as very important for underpinning

community resilience. More detailed information about the risk governance as well as the hazard context and about the landslide event in 2012 can be found in the emBRACE project deliverable 5.4 (Pedoth et al., 2015).

3 Two types of communities and a mixed method approach

In the light of the above-described context and the recent experience of 2012, and according to the types of communities described in the emBRACE deliverable 2.1 (Birkmann et al., 2012), in our case study we investigated two principal community types.

Geographical communities are those with identifiable geographical or administrative boundaries or arising from other forms of physical proximity. They are the boundary of choice for many disaster management functions although, while likely to be affected by the same type of natural hazard, the boundary can contain much variability. In our case study, the geographical community is delimited by the administrative borders of the municipality of Badia and includes all people who reside in the area.

Communities of supporters comprise in this context, communities of people drawn from organizations (both statutory and voluntary), who provide disaster-related services and support. In our case study, this community comprises two levels: 1) The provincial level, including officers and experts from different departments within the Province of Bolzano involved in risk management (e.g. the Provincial Civil Protection, the Geological Office, the professional Fire Brigade) and 2) the local level, including the volunteer organizations, the officers and experts of the municipality, the local based divisions of the Province of Bolzano and the local division of the Carabinieri (the national military police of Italy). Many members of this group are also members of the geographical community they support and may be affected in the same way.

Within our case study, we adopted a mixed-method approach, including quantitative and qualitative methods in order to collect different types of empirical data and get a better understanding of which key factors influence resilience, how to assess them and how they are connected. This approach reflects our conviction that both quantitative and qualitative methods - used together - can contribute to a better understanding of the underlying nature of resilience (see also chapters, 9- the need to structure qualitative data and 10 Q2 indicators). As Edwards (2010) suggests, the use of mixed-method approaches can generate “added-value” in several ways. For example, quantitative methods and qualitative methods can be mutually informative in multiple stages of research and can help in “triangulation”, i.e. using different forms of data to explore the same phenomenon. Our approach included the use of questionnaires comprising different types of questions (elucidating both quantitative and qualitative data) distributed to the entire adult population of Badia, qualitative expert interviews and quantitative and qualitative social network mapping.

4 Risk perception, risk attitude and response behaviour

In our study, we understand risk perception to be influenced by, an awareness of risks associated with the area in which people live, knowledge about past hazard events or personal experience of them, and perceived probability of future events. Against the above described hazard background, we were particularly interested in people's risk perception and if it increased after the event experienced in 2012, in accordance with the literature (e.g. Perry and Lindell, 1990; Becker et al., 2001; Johnston et al., 1999). Risk perception is a major factor that influences people's motivation to support or implement preparedness, prevention and adaptation measures, but at the same time people tend to be less worried about risks they know and with which they are familiar (Jurt, 2009). Kuhlicke et al. (2011) suggest that risk perception and risk attitude are influenced by factors such as values, attitudes and feelings, as well as by cultural determinants. These latter aspects are of particular interest for our case study because the community we look at belongs to a linguistic and cultural minority within the region and thus has an inherently strong cultural identity. The historical and geographical settings also contributed to this.

We investigated these aspects through a questionnaire distributed in April 2014 to all adults living in the municipality of Badia (2523 questionnaires): 1232 questionnaires (48, 8%) were returned of which 163 were not filled out so the final response rate was 43% (N=1096). A comparison made with the official census data of Badia confirmed that our respondent group is showing a similar composition as the population and the respondents in terms of gender, age and language group (Astat, 2015); however other biases may exist in the responses collected.

Case study findings show that Badia residents have a high risk awareness in terms of knowing that they live in a risky area. Nevertheless, before 2012 they did not expect and/or prepare for an actual event occurring. In fact, for 50% of respondents the possibility of such an event happening was unimaginable. While risk awareness is positively correlated with the age of respondents, elderly people being more aware of living in a high risk area, the perceived risk and concern about future landslide events is not related to age and is distributed relatively evenly among all age groups. Further, people do not perceive themselves, as individuals, responsible for mitigation and protection against natural hazards and the knowledge about existing measures is quite low. Indeed, people have a high trust in authorities and civil protection actors and perceive them as bearing principal responsibility. The event experienced in 2012 had a huge impact on people's risk perception. Subsequently, people that were directly affected now perceived the future probability of landslides as significantly higher than those who were not, e.g. 30.6 % of the affected people think that they are very likely to suffer again from limited mobility due to a landslide, whereas only 13.8 % of the unaffected do.

Another part of the study looked at where people get information from; about past hazards as well as following emergencies. The most important information sources for *past hazard knowledge* are other village and family members, rather than media. When looking in more detail at differences among age groups, results show, as expected, that young people use the media more often than the elderly do. Surprisingly, there was no difference by age group in relation to the information source "family and village members". This source was the most important information source among all age groups, including young people. Following an event, the family and the community are also an important information source. In December 2012,

after the landslide occurred, people used family and community sources as much as the media to obtain information. More detailed information about the survey results can be found in the emBRACE deliverable 5.4 (Pedoth et al., 2015).

4.1 Risk behaviour profiles

In a second step, we were interested to find out whether there are subgroups with similar response behaviour within the population in order to identify different profiles. Therefore, we had to select characteristics on which we wanted to base the analysis. Based on literature (Peacock et al., 2004; Calvello et al., 2013; Kuhlicke et al., 2011) and our knowledge of the case study we selected the following aspects as input variables for a cluster analysis.

- a) Personal experience of past landslide events
- b) Active participation in the recovery operation
- c) Awareness of living in an area of high landslide risk
- d) Feeling of being at risk since the landslide event in 2012

We chose four questions from the questionnaire as input variables, which in our opinion were a good representation of the above stated aspects. This qualitative selection was afterwards statistically tested in order to carry out the cluster analysis. We chose the SPSS™ TwoStep clustering method that allows handling very large datasets and is capable of dealing with both, continuous and categorical variables or attributes. If the desired number of clusters is unknown, the SPSS TwoStep Cluster Component determines the optimal number of clusters automatically (IBM, 2001) by comparing the values of a model-choice criterion across different clustering solutions.

In our case, the use of the TwoStep method gave the possibility to manage different types of answers e.g. binary (yes/no) for the variables a,b, c and Likert scale (from 1 to 5) for variable d. As the results, the procedure yielded four clusters.

Next, we proceeded with the interpretation of the four clusters and with looking at characteristics within the different clusters in terms of age, gender and “degree of being affected by the landslide”. Figure 2 shows the four identified “risk behaviour” profiles:

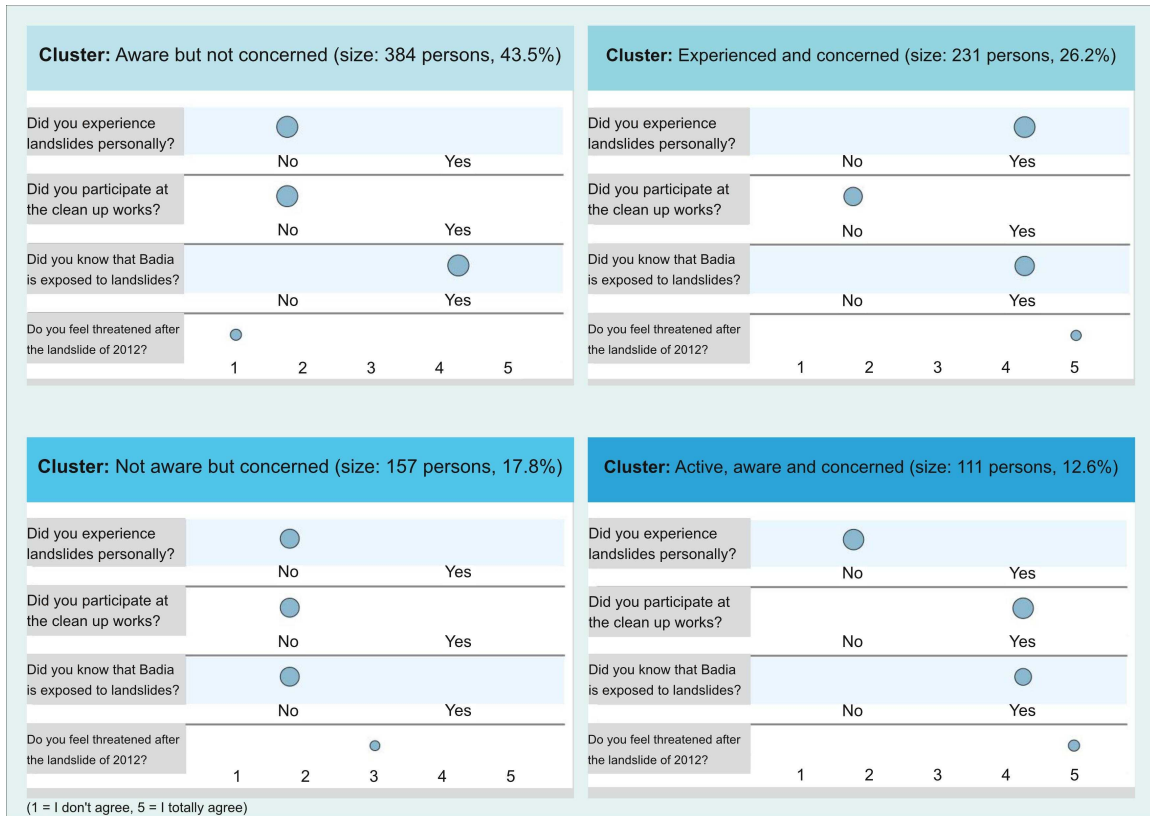


Figure 2: Aware, experienced, concerned, active: The four “risk behaviour profiles”

The cluster “**Aware but not concerned**” includes the most respondents (384 persons, 43.5%). People belonging to this group knew that Badia is exposed to landslides but had no previous personal landslide experience, did not actively participate in the clean-up works and do not feel threatened by future landslides. The large size of this cluster is explained by the fact that most people of Badia were not directly affected. Indeed, within this cluster 83.6% of the respondents were not directly affected by the landslide (compared to a proportion of 73.5% for the overall responses).

The cluster “**Experienced and concerned**” is the second biggest cluster (231 persons, 26.2%) and shows a high awareness of natural hazards. Additionally and in contrast to the first group, respondents belonging to this group had already personally experienced a landslide event in the past. Most of them stated that they did not participate in the clean-up operation; however they indicated that they are concerned and feel threatened by future landslides. 33.8% of respondents within this cluster were affected in some way by the 2012 landslide which is above the percentage of the entire population (26.5%) and represents the majority of total affected people. This adds to the evidence for the contention that being affected by an event raises concern.

We named the third cluster including 157 persons (17.8%) “**Not aware but concerned**”. Respondents in this cluster claimed that they were not aware that their municipality is exposed to landslides, that they did not experience an event in the past, and they were not involved in

the response activities in 2012, but they do feel at risk of being affected by a landslide in the future. We can legitimately hypothesize that the landslide event in 2012 changed the perception of people belonging to this group, they were not aware in the past, had no past hazard experience but after the 2012 event they feel more at risk for future landslide. Interestingly, 71.8% of the respondents within this cluster are females.

The smallest cluster (111 persons, 12.6%) is “**Active, aware and concerned**”. People belonging to this group did not experience previous landslides but were aware that Badia is exposed to them. The interesting fact is that although (or because) they were involved in the clean-up works, since 2012 they feel highly threatened by possible future landslides. 37.8% of people that were affected by the landslide are within this group. This is, again, a relatively high percentage given that only 26.5% of the overall population was affected. Furthermore, 69% of the respondents within this group are males.

In summary, we can say that the size of the clusters reflects the fact that most people were not affected by the landslide. The great majority is aware of living in a landslide prone area but does not feel threatened by it. A glance at the spatial distribution of the inhabitants explains this: the biggest settlements in the valley are located at the valley floor and are therefore relatively safe (Figure 1). The composition of the clusters did not reveal any patterns in terms of age, which seems to have no significant influence on the risk perception. The fact that the cluster “Active, aware and concerned” is comprised mostly of men can be explained by looking at the cultural context, men are more active in volunteer organisations such as the fire brigade or the mountain rescue unit than women are. The large proportion of females within the cluster “Not aware but concerned” could not be explained based on the collected data and our case study context knowledge and would need further investigation before any firmer conclusions could be drawn.

Temporal variation in people’s perception of response and recovery actions

Part of the questionnaire aimed at understanding the temporal dimension of response behaviour looking at how people perceived the response and recovery activities carried out by public authorities and organisations in charge. The degree of satisfaction could be expressed on a scale from 1 (very satisfied) to 5 (very unsatisfied) and tackled the different aspects such as information provision, execution of clean-up and safety works, coordination of action forces or presence of politicians. All aspects were assessed for two periods: immediately after the event and 16 months later (when answering the questionnaire).

Results show that when looking at the entire population satisfaction tends to decrease or remain stable over time but seldom to increase. Also for this aspect, we wanted to understand if there are differences for certain subgroups and in particular if the level of satisfaction and its change over time is influenced by the age (dividing all respondents into 3 groups) and the degree of being affected from the recent landslide. We built the group of affected people by using the results of one question where the respondents could express if they were hit by the landslide in terms of destroyed assets, financial losses, limited mobility or water/electricity shortages. To perform this analysis we computed the weighted mean for each of the eight aspects (e.g. the mean satisfaction with the safety works of the “affected” group soon after the event). We treated the data as metric (although it is present on an ordinary scale) by assuming equidistance between the characteristics from 1 to 5. On this scale we define 1=I don't agree 5= I totally agree, in other words the higher the number the higher the agreement.

The two charts in figure 3 show the temporal variability of the response behaviour of the affected group for the eight aspects linked to the response and recovery phase. It is immediately visible that affected people are less satisfied than non-affected people, in both periods. The figure shows also that satisfaction of both affected and non-affected people decreases during the 16 months.

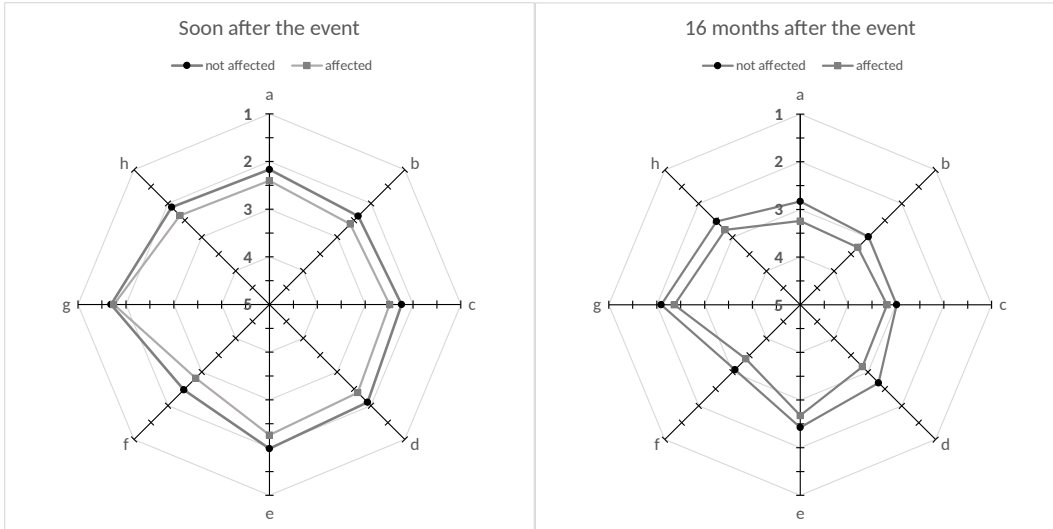


Figure 3.1: Temporal variation of satisfaction of persons affected/not affected by the landslide related to a: Information regarding the landslide in the media; b: Information regarding the clean-up efforts; c: Information-evenings; d: Execution of clean-up works; e: Security works; f: Participation and presence of politicians; g: Coordination of the action forces; h: Psychological aid.

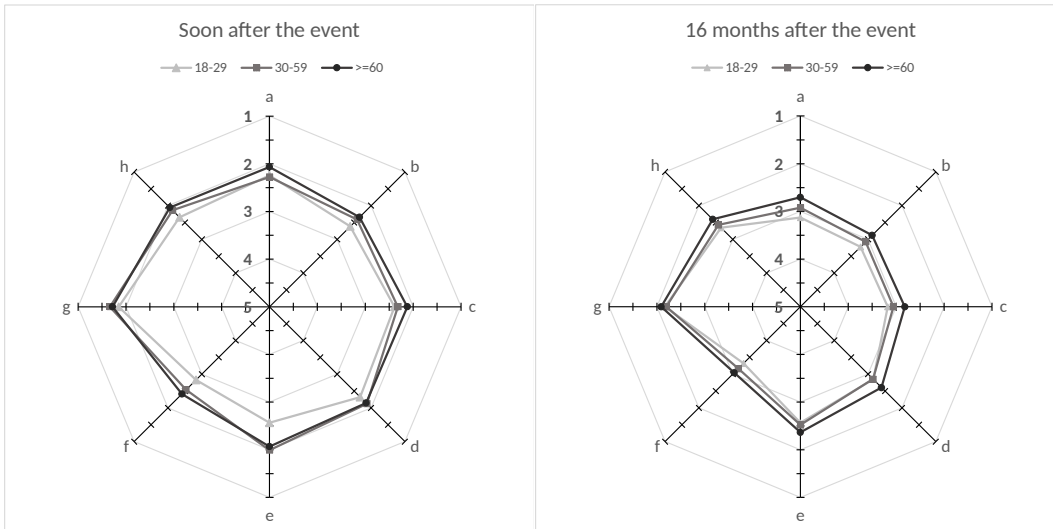


Figure 3.2: Temporal variation of satisfaction among three age groups related to a: Information regarding the landslide in the media; b: Information regarding the clean-up efforts; c: Information-evenings; d: Execution of clean-up works; e: Security works; f: Participation and presence of politicians; g: Coordination of the action forces; h: Psychological aid.

In order to test if the satisfaction level differs between the different groups (affected people, not-affected people) in two time frames separately, we applied the ANOVA test. We can confirm that at the 0.05 significance level there are differences in mean satisfaction among affected and unaffected people for all aspects except for the coordination of action forces soon after the event, which received the highest level of satisfaction among both groups. The aspect with the lowest satisfaction for both groups is participation and presence of politicians. One interpretation of this could be that the 'action' forces were physically present and their work was immediately visible and tangible, whereas the influence of politicians has less concrete and visible impact.

Considering different age classes we can confirm that only for the aspects "Information regarding the landslide in the media 16 months later", "Information - evenings after 16 months" and "Participation and presence of politicians soon after" the differences among satisfaction levels were significant. These results cohere with the above described findings, related to different use of information sources among age groups.

Looking at figure 3.1 and 3.2 a trend of decline in satisfaction overtime becomes clearly visible. In order to test this observation statistically, we applied the Paired-Samples T Test procedure for comparing the means of satisfaction level. Generally, considering the significance level equal to 0.001, we can confirm that the mean satisfaction for all considered aspects differs in two time frames, both for affected and non-affected people and for different age classes.

These results are of particular interest and benefit for the local authorities, since this was the first time that they had a representative picture of people's perceptions and satisfaction with their work, rather than only individual or ad hoc complaints or positive feedback through personal contacts or the media. Additionally, these results also underscored potential recommendations in terms of communication policies suggesting a need to better integrate, besides modern information technologies, face-to-face information sharing and to improve the long-term support of the population.

5 Community networks

As stated in the introduction of this chapter, our study had two main research lines. The first looked at people's risk perception and is based on the SPSS analysis of the questionnaires as described in the section above. The second one is dedicated to social networks within and among communities. A social network consists of a set of actors and a set of relationships, simultaneously presenting structure and processes, which are often multi-dimensional and multi-layered. Although social network analysis often uses quantitative methods to generate numerical measures of structural properties (Borgatti et al., 2002), there is a body of literature arguing for the use of visual data using participatory mapping techniques (Schiffer et al., 2008; Emmel and Clark, 2009), archival narratives (Edwards 2010) and in-depth interviews (Heath et al. 2009). However, researchers are increasingly using methodologies that can capture both quantitative and qualitative dimensions of the networks under study. Crossley (2010) argues that quantitative and qualitative approaches have different strengths and weaknesses but they are broadly "complimentary". Quantitative data allows formal network analysis but it needs to be supplemented with methods of qualitative observation to deepen our understanding of what is

“going on” *within* a network (p.21). Bishop and Waring (2012) in their study of interpersonal relationships in healthcare delivery networks, find that – while mathematical properties of social networks utilising graph theory and statistical analysis present interesting data on the structure of ties – they sidestep other important elements of patterns of social relationships, such as their meaning and their implications for network members. Such phenomena can be understood using qualitative ethnographic data.

Edwards (2010) further notes that social network analysis offers a particular opportunity for mixing methods because networks are *both* structure and process *at the same time*, and therefore evade simple categorisation as either quantitative or qualitative phenomena. “A mixed-method approach enables researchers to both map and measure network properties and to explore issues relating to the construction, reproduction, variability and dynamics of network ties, and crucially in most cases, the meaning that ties have for those involved” (p.6). Furthermore, mixing methods enables researchers to gain an “outsider” view of the network in terms of the structure of the network (which could not be seen by any individual actor), but also to gain data on the perception of the network from an “*insider’s* view, including the content, quality and meaning of ties for those involved; combining methods allows mapping the evolution of the structure of networks over time using panel surveys, and exploring the reasons for change using qualitative methods” (p.18). Finally, using a mixed approach allows us to better understand existing networks within the communities as well as the ways horizontal and vertical ties between members of social networks transmit information and provide access to resources at critical times (Aldrich, 2012).

One questionnaire item addressed the existence of networks and collected data on the respondents’ trusted networks by asking people which institution or organisation they go to for help and support in the case of a hazard event occurring. In response to the question, respondents could name up to 6 actors, listing the most important first. Taking the total number of answers, a frequency analysis was carried out in order to analyse which were the most-contacted organisations. In order to perform this analysis all answers had to be translated and checked for comprehensiveness, as the original data were in three different languages and handwritten. Answers which had essentially the same meaning were then aggregated. In a second step, using the software Gephi (Bastian et al., 2009) we carried out a modularity analysis, which targets the detection of community structure, by making partitions of the network into sub-networks that are more densely interconnected. Figure 2 shows the created network with all connections between respondents and institutional actors using coloured nodes for different institutions.

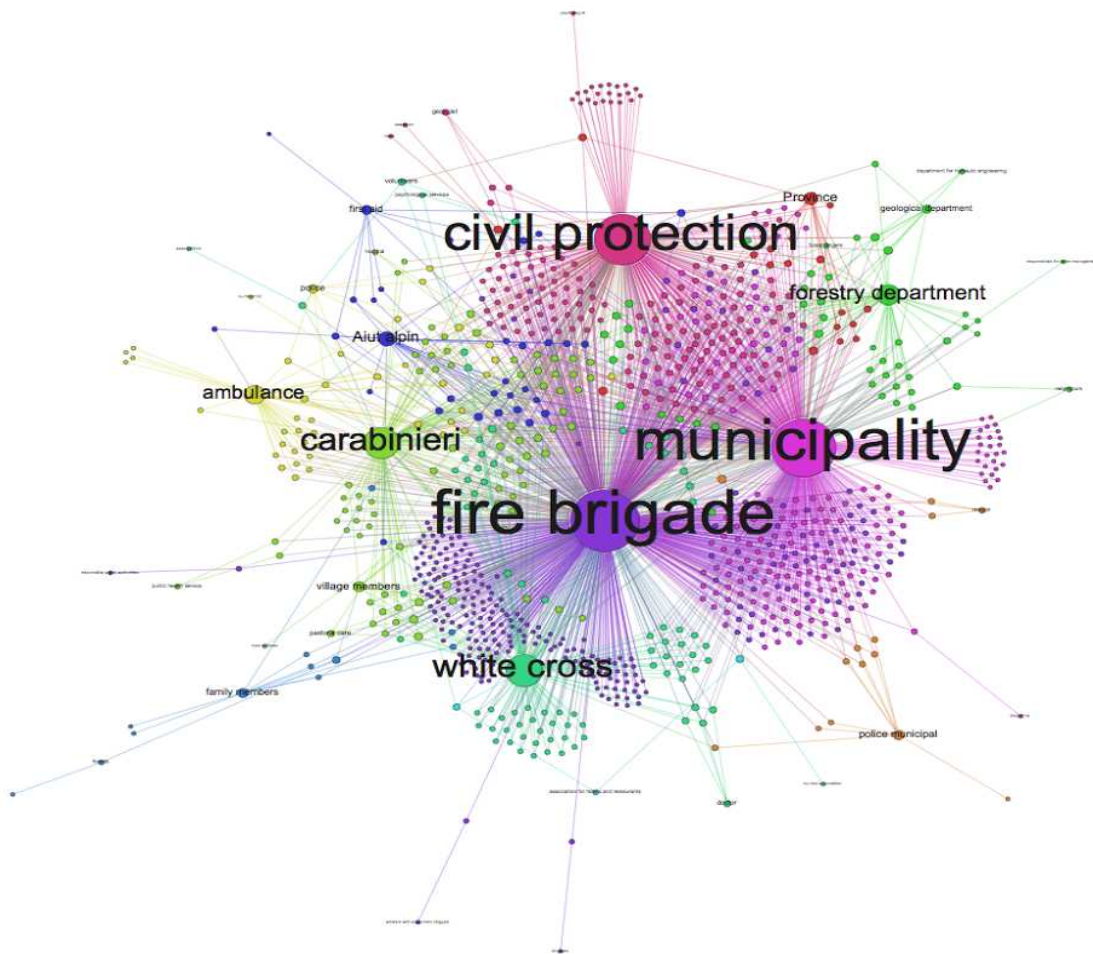


Figure 4: The population network shows all connections between respondents and institutional actors using coloured nodes for different institutions

The network map in figure 4 clearly identifies the key actors according to the people living in Badia and which actors tend to be contacted together in case of emergencies. In order to take into account the difference in importance according to the ranking of the institutions, we carried out an additional analysis for the institutions that were named first. Finally, we carried out an analysis to see whether an institution was named first without any other institutions named or whether it was named first among other institutions. Within this analysis the hypothesis was assumed that if an organisation is the only one named, then it is considered more important than if it is named among others.

Results show that there is a significant difference between the first (Fire Brigade), the second (Municipality) and the third (Civil protection) actors. The fire brigade is not only mentioned most often as first and therefore more important actor, but also mostly either out of one or out of two. The municipality is named much more often first out of two than out of one, so more often together with a second actor. When summing up the answers of the first two actors they were cited 807 times first out of 917 answers. This shows that these two **local** actors are the most

important institutional actors people look to following an event. In terms of resilience this confirms the importance of local presence of key actors in the territory. Knowing the actors working in the organisations has a two-way effect, by leading to greater trust and the actors being part of the community leads to a better understanding of the community needs and perceptions.

The analysis described thus far has allowed us to understand who the key organisations are, in terms of frequency of recall, taking into account the entire population without looking at differences within the population, i.e. we did not investigate if people with certain characteristics connected and ranked connections differently than others. Another assumed hypothesis was that people’s perception of an organisation and their satisfaction with its work and its engagement after the landslide event influenced the mention and the ranking.

In order to investigate this, we combined the network question with the questions about whether or not respondents think there is a need for improvement in services provided by key organisations. The need for improvement was assessed for a list totalling 14 items (7 shortly after the event and 7 in ‘the present’). Respondents were categorised as happy (two or less improvements needed) or unhappy (three or more improvements needed) and for the two groups a network analysis was carried out in order to see whether the group of “happy” people connected differently than the “not happy” group. Figure 5 shows the results for the two groups, the node size reflects the proportion of times they were named, and the colour intensity the proportion of times they were named first.

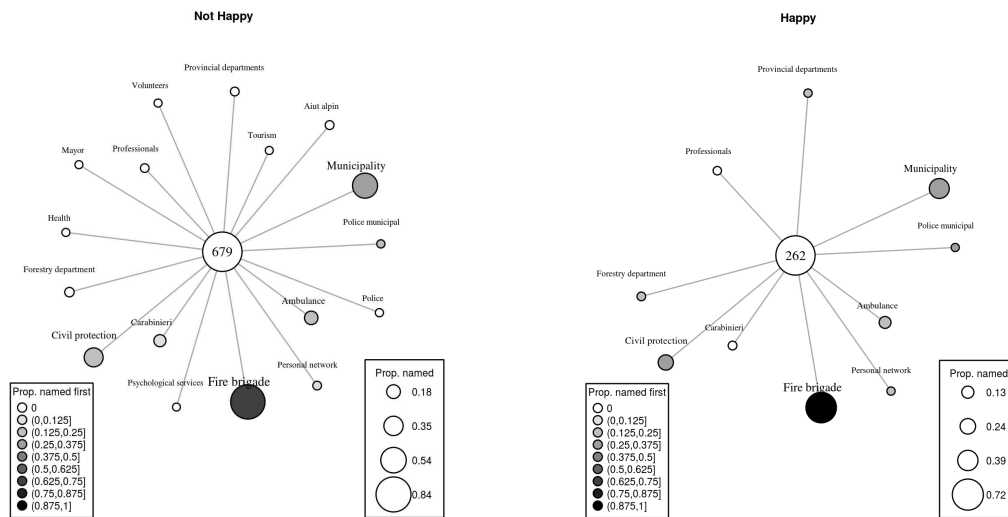


Figure 5: Networks showing how the two groups of “happy” and “not happy” people connected to the different organisations. The node and font size represents the number of links; the colour intensity of the organisation’s node reflects the proportion of times they were ranked as most important.

The two graphs show that “happy” people were more focused in their answers connecting to fewer organisations, whilst answers of the “not happy” groups are more spread. Statistically the differences were tested using the Chi-squared test for difference in proportion between the two groups. It revealed that generally people belonging to the “not happy” group said they are connected more and that they connected more with Carabinieri, civil protection, municipality, and with the mountain rescue team. For all other actors there were no significant differences. Additionally, the happy-group gave more precise answers naming concrete organisations rather than generic descriptions. Within the not-happy group, and in contrast to the-happy group, we see generic terms such as volunteers, health or police in addition to the specific ones such as Carabinieri, municipal police, ambulance or (volunteer) fire brigade, which are representing both. Finally, the happy group named organisations that are clearly linked to risk management (except “personal network”) whilst within the not-happy group we also find organisations that are not directly linked to risk management such as “tourism”.

The network results described up to this point took as input data the results from the population survey. The advantage of this data collection method is the possibility to collect relatively large amounts of data and to visualize big networks. Furthermore, it allowed a bottom-up approach to identify the key actors according to the population of Badia. The disadvantage is that as the questionnaires were filled out by people independently so the network questions had to be simple and easily understandable without additional explanation needed. Therefore, it was not possible to collect additional information on the quality of links or to complement the data with additional qualitative information. At the same time, this additional information is particularly important when looking at the organizational network² where quality, trust, coordination and information exchange are crucial to understand the network itself as well as being able to reflect on the resilience of the network.

We investigated these aspects through single semi-structured interviews with experts from the organisations identified as key actors in the survey. Some of interviewed experts have a double role, they are members of the community of Badia but belong at the same time also to the organizational network because of their engagement in a volunteer organizations (e.g. volunteer fire brigade) or because working for local organizations with tasks in risk management (e.g. local civil protection unit). During the interviews, we applied a qualitative social network mapping in order to map and visualize patterns of responsibility, the relationship and the power of the different authorities and actors involved and responsible for natural hazard management, communication and coordination flows during emergencies, and the linkages between the organizational network and the community. The figures below show examples of created paper maps and their visualization with the software Gephi (Bastian et al., 2009).

2 For this study we use “organisational network” for the network of the community of supporters

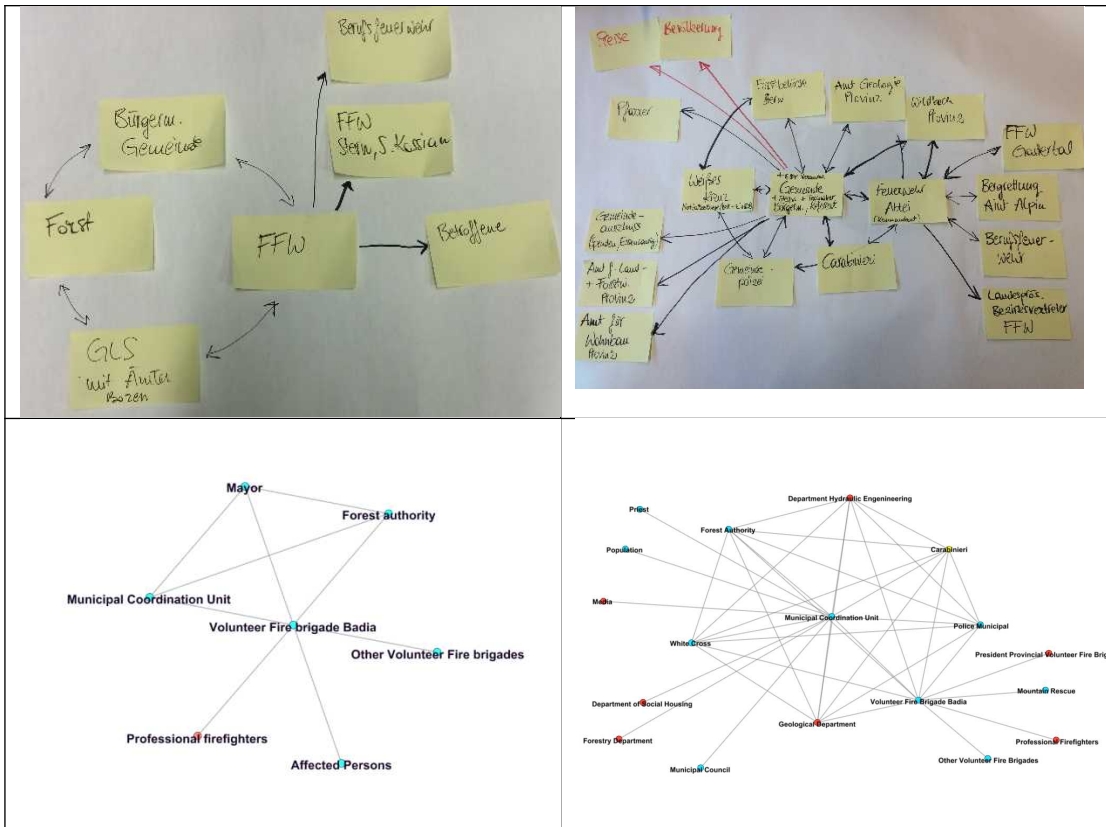


Figure 6: Two examples of hand drawn network maps made during individual interview sessions and corresponding visualisations with Gephi

The maps were also used as a basis of participant narrative about how the relations had changed during the various phases of disaster planning, response and recovery how the network can be improved and become more resilient in the future.

Results show that all maps have a highly connected core network, and a high level of coherence between them. This shows that the actors have a similar view of the network, which is very important in a crisis or disaster situation. Further details about network characteristics (dynamics, modularity and redundancy) are reported in the emBRACE deliverable D4.2 (Matin et al., 2015).

Qualitative data from the interviews reveal that after the event in 2012 the network worked very well. Five main reasons, according to the interviewees were:

- existence of regular emergency exercises
- short activation time of the network (in case of the landslide event in Badia it needed only few hours to be fully operative)
- previous personal knowledge of other network members which enables the work, especially during emergencies and secures trust in information and quality of work performed
- the locally based network, including a physical base with facilities for the network members

- few links to the outside: to the media, the population and the organizations at higher level.

Results show also that the network structure, who is part of it, and where the responsibilities of each member lie, are very clear for the response phase. However, for the medium and long term the network structure and its functioning is not so clear, some members are not involved anymore due to their tasks being clearly linked to the response phase (e.g. the fire brigade), whilst others become new members of the network (e.g. the department for social housing). Links and responsibilities are less defined and less clear, partly due to the fact that the network is no longer operative as continuously as it was in the first days after an event and activities are less-well defined and urgent in the long term (e.g. financing of rebuilding activities, future zoning and land use of the area) than they were in the short term after an event.

Maps generated from the survey were used to explore the perceptions that the interviewed actors had of the structural patterns, for example to comment on any inaccuracies or missing data, and more importantly, the respondents' interpretations of the network view (Sloane and O'Reilly, 2013). Thus, the combination of survey and interviews provided triangulation or cross-referencing to test the reliability of network maps and therefore helped in estimating the amount of "measurement error" involved in quantitative analysis (Lubbers et al., 2010). This design allowed both an "outsider" view on the network structure and an "insider" perspective of the network (Edwards, 2010) and helped to investigate whether the organisations named by the population are "the right ones", i.e. the one people *should* contact, as foreseen by the existing emergency plans. Experts validated the map by confirming that the identified key actors are the ones people should contact and appreciated the map for giving a good overview of the huge survey response, and its effectively representing a validation tool for the recently introduced local emergency plan. In terms of resilience of the organisational network, all interviewees agreed that the response network proved to be resilient due to the above mentioned characteristics and that there were no missing links or marginalized actors.

6 Conclusions and discussion

The emBRACE case study offered a great opportunity to investigate community resilience by working in close contact with the community of Badia and public authorities in South Tyrol. Moreover, it allowed to collect empirical data in order to get a better understanding of which key aspects influence resilience, how to assess, describe and possibly measure them. The work was inspired by the Autonomous Province of Bolzano; these authorities recognised and supported the study's focus on communities and the inclusion of social-science perspectives and methods in the often technical and natural-science-dominated research on risk and natural hazards.

Findings show that even though people living in Badia have high risk awareness, they did not expect and prepare for a manifesting event, nor did they perceive themselves, as individuals, clearly responsible for mitigation and protection against natural hazards. Indeed, people have a high trust in authorities and civil protection actors and perceive them as the main responsible actors. This, on the one hand can contribute positively to resilience (e.g. by generating trust in information and advice coming from these actors), but on the other hand can also result in low motivation for undertaking preparedness measures. We think that both trust in authorities and

individual engagement are important and that the balance between the two, according to the geographical, institutional and temporal context are key aspects for community resilience.

The interpretation of the different risk behavior profiles shows that people who are concerned about future landslide events had either personally experienced a landslide event in the past or participated in the clean-up work after the event in 2012. Results of comparing the two groups affected –not affected by the landslide point in the same direction, showing that personal experience, not only recently but also if in the past, together with active involvement in the response phase lead to a higher risk perception especially when thinking about the future.

Results show the importance of local and traditional knowledge. Family and other community members were shown to be a very important knowledge and information source, for past hazard events as well as in the context of the 2012 event. Being part of the community and having a strong personal network enables access to information coming from “real faces” and appears to be very important for community resilience. The feeling of community belonging and the strong presence of social networks also proved to be very important as a crucial support to deal with the impacts of natural hazard events. In terms of resilience-building, it may be very important to provide key community members with relevant information, as results show that these individuals’ personal networks function as dissemination and information channels.

People appear satisfied with the way authorities and supporters dealt with the event, particularly with the coordination of action forces. Also, results from the interviews with key actors of the community of supporters point in the same direction and confirm the well-functioning and good management of the response phase. This is partly due to the fact that in the first days and weeks after an event happening, the public and media attention is high and during this period additional resources and funds are available. This is true for financial and human resources, but also in terms of solidarity and sympathy. On the other hand, results show that 16 months after the event the satisfaction with provided information and recovery actions decreased significantly. In terms of resilience, our findings show that it is important to look not only at the short term after a disaster, but also to the mid and long term. Thus, it is essential to foresee and improve strategies for the mid and long term, especially concerning information, because the impacts on peoples’ risk perception, their feelings of danger and concern about future hazards last far beyond the first weeks and months after an event happening.

Results from the social network mapping indicate the importance of persons who belong to both geographical and support communities and who act as linking nodes - having vertical relationships between them. The results of the population network, which illustrated to which organization people go for help and support in case of an event, reflect well and are coherent with the actions foreseen inside the existing local emergency plans. All results from the different analyses carried out for the network, such as frequency, centrality and importance of actors, show that the two most important actors are the volunteer fire brigade and the municipality of Badia. Both of them are locally based and people working for them are not only members of the community of supporters but also members of the community they support. In terms of resilience, this confirms the importance of local presence in the territory and the interconnection between the geographical community and the community of supporters: knowing actors working in the organization increases trust, and the actors being part of the community leads to their better understanding of community needs and perceptions. Having these two elements existing *beforehand* are crucial during crises and emergencies.

Our study confirms, as suggested by Taylor et al. (2014), the usefulness of maps for structuring the knowledge of a range of significant actors and re-presenting that knowledge in a way that is quickly and relatively easily usable and understandable by other actors in other positions in space and time. Furthermore, it allowed us to compare the individually created maps showing that different actors have a similar view of the network. This turned out to be (together with other identified key factors such as the short time needed to activate the network, the existence of a local civil protection plan and regular emergency exercises) very important for a resilient network with no missing or conflicting links and marginalized members.

One could argue, and it could be interesting for further research, that some of the characteristics that proved to be positive for resilience in this circumstance could also weaken the stability and the resilience of the network under other circumstances. The fact for example that the network is “highly personalized” and actors know and trust each other could become critical for the network if one or more of the actors is not available for any reason or has to leave.

The study focused on the network and its functioning after the landslide event in 2012 but results suggest validity for other kind of hazards. The alpine region faces multiple hazards, yet the structure and underlying regulations of risk management are the same and should guarantee more in general the protection of people and goods. The composition of network members can vary slightly according to the type of hazards and include additional experts. Despite this wider validity of the network and its hazard independency, its experiences are strongly linked to well-known Alpine hazards (i.e. avalanches, landslides, rockfalls and flooding). It would be interesting for further research to understand if the network performs in the same way and results is resilient even if confronted with unknown hazards.

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Figure Captions

Figure 1 The case study area

Figure 2 The four “risk behaviour profiles”

Figure 3 Temporal variation of people's perception of response and recovery actions

Figure 4 The population network

Figure 5 Networks for Happy and not happy groups

Figure 6 Hand drawn network maps made during individual interview sessions and corresponding visualisations with Gephi