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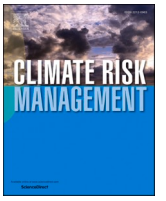

Fostering social learning through role-play simulations to operationalize comprehensive climate risk management: Insights from applying the RESPECT role-play in Austria

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ABSTRACT

This paper describes an analytical-deliberative process, centered around the RESPECT role-play simulation, conducted to foster the operationalization of comprehensive climate risk management (CRM) in Lienz, southern Austria, a city that is representative of many alpine regions. We hypothesize that fostering social learning via participatory stakeholder engagement processes aids closing prevailing science–policy–implementation gaps in CRM, which are often a result from insufficiently clear roles and responsibilities, diverging stakeholder interests, priorities and risk perceptions, and inexistent or incipient cooperation mechanisms. To test this hypothesis, we co-developed and conducted a role-play simulation centered on riverine-flood risk—the most pressing climate-related risk in the Lienz case-study region. Based on our analysis of qualitative data gathered ex ante and ex post the intervention, we found role-play simulations to have a high potential for fostering social learning in CRM. After taking part, the diverse societal stakeholders were found to better understand: i) the interacting dimensions and drivers of riverine-flood risks; ii) the diverging risk perceptions; and iii) each other's interests and needs in addressing such risks at the individual and institutional level. Role-play simulations are a promising transdisciplinary method for engaging societal stakeholders beyond traditional policy- and decision-making communities in informed and inclusive public debate around challenges and solutions to CRM. The methodological and practical insights gained in this Austrian case study may be transferred to the management of other climate-related risks.

1. Introduction

While considerable uncertainties remain regarding the exact contribution of anthropogenic climate change to disaster risk and related impacts, increasing losses from extreme events, both globally and at a national level in Austria, have emphasized the importance of comprehensively addressing climate-related risks (IPCC, 2012, 2014; UNISDR, 2015). The complex interactions among socio-cultural, political, economic, and biophysical processes within socio-ecological systems pose significant challenges in terms of understanding and managing climate-related risks. An increased focus is thus required on linking climate change adaptation (CCA) and disaster risk reduction (DRR), leading to what has been broadly termed climate risk management (CRM) (IPCC, 2014). Such a focus is

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in line with international disaster risk and climate policy frameworks and with the Sustainable Development Goals (SDGs) of the United Nations. The Sendai framework (UN, 2015a) emphasizes the synergies between understanding risk, strengthening risk governance, investing in resilience, and enhancing preparedness. The Paris Agreement (UNFCCC, 2015) stresses the need to foster comprehensive risk assessment and management to deal with climate-related risks. Target 13.1 of the SDGs seeks to "strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries" (UN, 2015b).

As many climate-related risks affect private goods (buildings, cars, health) and public goods (infrastructure), CRM aims to include private actors (citizens, companies, insurance providers, NGOs) and public actors (public administration at the municipal, provincial, and national level), whose combined efforts are deemed crucial to managing potential future climate-related risks. However, while the ability of diverse stakeholders to act collectively and share responsibilities is considered vital to building climate resilience, collective responses are often impeded because stakeholders' roles and responsibilities are not defined and because they have competing priorities and differences with respect to risk perception, adaptive capacities, and areas of responsibility (Moser & Ekstrom, 2010; Susskind et al., 2015). Legislation and policy practice in Austria and elsewhere have evolved over the years towards a partly explicit, partly implicit understanding of the role of each actor in preventing, financing, responding to, or recovering from climate-related extreme events. Leitner et al. (2020) (building on Schinko et al., 2017) report on the complex governance system at the intersection of DRM and CCA in Austria and find that an integrated and comprehensive approach to managing climate-related risk is still in its infancy.

In many countries, including Austria, DRM has traditionally been the domain of experts working in tandem with public authorities and has therefore been framed as a techno-economic top-down rather than a social bottom-up issue. Moreover, to date, the prevailing supply-driven model in science of delivering climate information from "providers" to "users" along the whole CRM cycle—from monitoring, analyzing, and evaluating climate-related risks all the way to identifying and implementing appropriate risk management measures (Schinko et al., 2017)— has not led to the implementation of CRM policies and actions at the scale so urgently needed in light of growing climate variability and extremes. Klein et al. (2014) argue that the effectiveness of scientific knowledge in enabling concrete CCA and DRR in practice depends on how that knowledge is developed, shared, and used to achieve desired objectives. Moreover, the Sendai Framework (UN 2015a) highlights that effective DRR hinges on closer public, private, and societal collaboration.

With integrative management and risk-based decision-making principles being promoted, stakeholder engagement and participation are regarded as key for an effective and just CRM (Ottinger, 2013; Challies et al., 2016; Solinska-Nowak et al., 2018), particularly in the context of progressing climate change (Abad et al., 2020; Gerber et al., 2021). Participatory decision-making is expected to result in "better decisions and plans, improved implementation and compliance, more beneficial social outcomes, greater legitimacy of planning processes and, ultimately, better environmental impacts as compared to top-down, administrative decision-making" (Challies et al., 2016, p. 2). Inclusive participation is in line with the principles of good governance for human development, as proposed by the UN Department of Social and Economic Affairs (UNDESA, 2012). The World Meteorological Association (WMO, 2006) identifies potentially strong merits of participatory stakeholder involvement.

Decision-making has traditionally been thought to consist mainly of intellectual effort or thinking that draws on science, planning, facts, and verbal capacities. However, according to Mintzberg and Westley (2001), there are at least two other modes of decision-making that can be employed. One is seeing, which involves art, visioning, imagining, and the visual representation of ideas. The other is doing, which makes use of craft, learning through experience, venturing, and gut feelings. This claim can be further supported by experiential learning theory (Kolb, 2014), which posits that the process of learning (understood broadly as the totality of human experience) should include and balance the following: i) abstract conceptualization (the mode of thinking); ii) reflective observation (the mode of seeing); and iii) active experimentation and concrete experience (the mode of doing). It is the task of transdisciplinary research to use these different modes to generate appropriate methods and tools to disentangle the complex distribution of competencies and responsibilities while at the same time taking into consideration the diverging risk perceptions of different stakeholder groups or individuals.

Increasing attention is being given to the concept of risk layering to provide structure for these complex risk management decisions (Mechler et al., 2014; Schinko et al., 2016). Risk layering involves the identification of efficient and acceptable interventions based on the recurrence of hazards and the allocation of roles and responsibilities to reduce, finance, or accept risks. Disaster risk is complex, as it lumps together frequent events with minor impacts and infrequent but devastating catastrophes. Not all disaster risk can be eliminated, and it is imperative to know which risks should be reduced, which should be insured against, and which will need to involve governmental or international aid efforts. With this in mind, segregating risk according to risk preference via risk layering has raised general interest in several areas of risk policy and management (e.g., agriculture, finance, and insurance). In the insurance sector, risk layering has predominantly been debated at a conceptual level, discussing portfolios of risk financing instruments (comprising e.g., ex-ante financial parametric insurance, post-disaster financing, reserve funds) that may be suitable for different layers of disaster risk (Cummins and Mahul, 2008; Mechler et al., 2016). Some methodological development has occurred with regard to the empirical and modeling analysis of climate-related fiscal risk and its financial implications for different layers of risk (see e.g., Hochrainer et al., 2014). Nevertheless, these conceptual and methodological developments have so far not been translated into an operationalization of risk layering in practice through stakeholder engagement processes, particularly at lower governance levels, such as the municipality.

Building on this increasing interest in, and need for, broader societal participation in CRM by both research and practice, this paper aims to present insights from a recently concluded transdisciplinary research project, which developed and applied an analytical–deliberative process, centered around the RESPECT role-play simulation incorporating the notion of risk layering. The research project was conducted in the city of Lienz in southern Austria. Role-play simulations have been suggested as a means of streamlining the competences and actions of diverse stakeholders at various levels of governance (Rumore et al., 2016). Players, by assuming the roles of other actors, can distance themselves from their own personal beliefs and develop a reciprocal understanding and acceptance

of the interests and resources of their co-players (Geurts et al., 2007). Moreover, temporarily freed from everyday limitations, players become more open and creative, often entering into meaningful discussions and coming up with innovative solutions to the in-game problems (Solinska-Nowak et al., 2018). Hence, role-play simulations can build capacity for collective responses and provide new avenues for communities to adapt to climate risks (Rumore et al., 2016). Given that role-play simulations and similar "serious" games have been proven valid in complex policy-making contexts, they may also prove an effective tool in CRM (Parson, 1997; Mayer, 2009; Haug et al., 2011; Abad et al., 2020).

The key objective of the role-play simulation in Lienz was to draw on social learning theory (Pahl-Wostl and Hare, 2004; Reed et al., 2010) in order to formulate an aligned understanding of how local risks, roles, and possible actions might be defined and shared among multiple societal actors. To achieve this objective in a truly participatory way, we set preparatory steps to initiate a co-design process which comprised a literature/media review and semi-structured key-informant interviews. This preparatory work resulted in the selection of riverine-flood risk, the most pressing climate-related risk in the case-study region, for the role-play simulation. In a next step, we worked with key stakeholders in the region to identify a broad list of potential flood risk management measures as a basis for jointly designing risk management portfolios in the role-play simulation.

The remainder of the paper is structured as follows. In section 2 we provide background information on the Austrian case study. In section 3 we present an overview of the state of the art of the role-play simulation methodology, going on to describe in detail the RESPECT role-play simulation design and its experimental set-up. In section 4 we present the results from our application of this participatory methodology in the city of Lienz, Austria. In section 5 we discuss the insights gained from analyzing qualitative data resulting from participant feedback, focusing particularly on the effectiveness of the role-play intervention in terms of changing participants' attitudes to risk. We reflect critically on our efforts to draw important lessons learned about what worked well and what challenges were encountered. We also consider what our focus will be in future transdisciplinary research to support just and meaningful stakeholder inclusion and participation and, eventually, to foster social learning in CRM practice and policy.

2. Background on the Austrian case study

Austria has been exposed to recurrent flooding and has been hit by large-scale events, for example, in the 2013 extreme Central European floods, which led to substantial losses for the country (estimated at €0.9 billion) (BMI, 2014). In 2014 the Austrian Panel on Climate Change (APCC) produced one of the first comprehensive national assessments of climate change worldwide, which showed warming in Austria to be stronger than the global average, leading to increasingly severe risk and the need to upgrade adaptation efforts (APCC, 2014). A countrywide assessment of the costs of climate change, conducted in 2015, demonstrated the already large cost implications of unmitigated climate change for public and private actors (Steininger et al., 2015). While climate mitigation efforts take place at different levels from local to global, climate-related risks emerge predominantly at the local to subnational level. Flooding typically affects catchments, for example, the Danube River basin flooding event in June 2013 (BMLFUW, 2015). Spells of drought also affect agricultural subregions, for example, the 2018 agricultural drought which occurred predominantly in the northern and eastern parts of Austria (Hagelversicherung, 2018). CRM is therefore a local challenge, but with linkages to decisions at other administrative scales.

In Austria, the management of climate-related risks is recognized both in the national adaptation strategy (Federal Ministry for Sustainability and Tourism, 2018) and the federal flood risk management plan (BMLFUW, 2015). At the local level, all federal states have either developed an adaptation strategy (Upper Austria, 2013; Styria, 2015; Vorarlberg, 2016; Salzburg, 2017) or have integrated adaptation into existing climate strategies and plans (Vienna 2009; Lower Austria, 2011; Tyrol, 2015; Carinthia 2018) and other policy fields (Burgenland) (Umweltbundesamt, 2019a). Cities and municipalities have also started to prepare for, and respond to, climate-related risks (Umweltbundesamt, 2019b).

These recent developments (more comprehensively summarized in Leitner et al., 2020) highlight the need to further align CCA and DRM agendas in practice and for planning at the subnational, national, and international levels. The overarching objective of the Austrian research project RESPECT (Responsibility and Risk: Operationalizing comprehensive climate risk layering in Austria among multiple actors) was to support the implementation of comprehensive CRM in Austria by working closely with relevant stakeholders at subnational and local levels to close the gaps between research, practice, and policy. In particular, the city of Lienz in the Austrian federal state of Tyrol, one of the most active cities in Austria in fostering CRM and resilience building at the local level, serves as our case study region. We were able to draw on existing risk assessments and databases and to build on well-established stakeholder relations (Hama et al., 2016). Moreover, the city of Lienz is representative not only of the Austrian federal state of Tyrol but of other alpine regions that are highly risk-prone to a number of hazard types due to their topography and high socio-economic exposure, including a particularly high riverine flood risk.

3. Methodology

3.1. Role-play simulations for enhancing social learning

Role-playing originates from the acting sector and is historically linked with drama. During the twentieth century, role-play was introduced as a therapeutic procedure in psychotherapy and gained importance in business training and educational settings (O'Sullivan, 2011). According to Aronson & Carlsmith (1968), the participatory method of role-playing is defined as an "as-if" experiment, in which participants are asked to take the role of a particular person in a particular situation and behave "as if" they were that person (Hendrick & Jones, 1972; Van Ments, 1983; Wakefield et al., 2012). Role-playing puts the participants at the center of the

method and emphasizes the characters' respective actions (Lowenstein & Bradshaw, 2004). During the role-play, the participants act in a given scenario which, while representing a fictional situation, is closely connected to reality (O'Sullivan, 2011). Role-plays operate in a "no-penalty zone" (O'Sullivan, 2011), which looks like, seems like, but is not actuality (Heathcote, 1991). As a result, participants are permitted to test attitudes and decisions without facing real consequences and worrying about the result. Because of its ability to help participants consider ideas from different perspectives (O'Sullivan, 2011), role-playing is widely accepted as a powerful instrument for changing perspectives and behaviors. Some of the most important advantages and disadvantages of the role-play method are listed in Table 1.

Role-plays offer great flexibility with respect to the setting (e.g., range and depth of focus), design (e.g., number and profession of players) and fields of application (e.g., teaching and research). As a result, there are numerous variants and classification methods. They all agree, however, that role-playing is "concerned with representing and exploring different people's point of view" (O'Sullivan, 2011).

Role-plays are generally divided into two basic approaches: i) Wohlking & Gill (1980) distinguish between method-centered and developmental role-playing and ii) Etcheverry et al. (1986) distinguish between structured and unstructured role-plays. Van Ments (1996) finally combined the terms into the "structured/method-centred" approach and the "unstructured/developmental" approach. The first approach includes a clear set of guidelines for proceeding and is typically applied to training, practicing techniques or skills, and handling specific problems. In contrast, the second approach concerns changes in attitudes, emotions, or cognition. However, situations can be more complex, generally requiring spontaneity and improvisation. Participants are typically asked to integrate and apply previously acquired learning, for example, as is practiced in the field of psychology (Park et al., 2011).

Another method of classification involves three analytical distinctions by Hamilton (1976), which are summarized in Cohen et al. (2007) as follows: i) the "imaginary-performed" distinction, whereby participants may be asked simply to imagine, or actually perform a situation. One example of an imaginary-performed distinction would be individuals filling in a questionnaire requiring them to imagine a social episode that has been described to them; ii) the "scripted-improvised" distinction, which analyzes the scope of action, including any restrictions, is determined by the form in which the performance will take place and the guidelines related to the performance; iii) the "verbal-behavioral" distinction takes into account the activities of participants, which may be verbal responses, or behavioural, involving something much more akin to acting.

3.2. The RESPECT role-play simulation methodology

As well as clarifying technical-physical risk issues, a role-play simulation has the potential to capture and, to some extent, resolve the social-political complexities of CRM (Mayer, 2009). We hypothesize that role-play simulations, by facilitating inclusive, reflexive, and transformative stakeholder processes, have ample potential for i) enabling diverse public, private, and civil society actors to better understand the interacting dimensions of climate-related risk and potential management options in their specific local context, ii) engaging participating stakeholders in informed public debate around the differences in risk judgment among (presumably) knowledgeable experts and (presumably) naïve laypeople (Slovic, 1987; Bostrom, 1997, 2003; Sjöberg, 2001), and iii) support the breaking down of cultural, political, and institutional barriers to collaboration in local CRM. To test these hypotheses and to leverage the transformative potential of the role-play method for CRM, the RESPECT role-play simulation, focusing on riverine flood risk, was developed, pre-tested in a research environment, and implemented in the city of Lienz in southern Austria.

3.2.1. The RESPECT role-play concept

Taken together, the features of the RESPECT role-play simulation concept represent what Van Ments (1996) denote a "structured/method-centred" approach, which is designed to handle a specific problem – namely to identify roles and responsibilities in local CRM – and includes the following clear set of guidelines. The RESPECT role-play concept (Lintschnig et al., 2019) uses possible future flood risk scenarios to identify a portfolio of feasible risk management measures according to different layers of risk. Risk layering involves the identification of efficient and acceptable interventions based on the recurrence of hazards and the allocation of roles and responsibilities to reduce, finance, or accept risks (Mechler et al., 2014). The future risk scenarios are integrated into the RESPECT role-play concept in the form of storylines co-developed with key stakeholders in the study region and building on the region's most recent climate and socioeconomic data. Storylines provide narrative descriptions of plausible pathways that lead to the development of future climate-related risks. Possible futures are described mainly by words and not numbers. Tables or graphs, although recognized as valuable tools for communicating climate-related risks, can be too complex for lay people (Alcamo, 2008; Shepherd et al., 2018). Nevertheless, the storylines developed are substantiated by quantitative data. The RESPECT role-play concept (Lintschnig et al., 2019)

Table 1
Advantages and disadvantages of the role-play method.

Advantages of role-playing	Disadvantages of role-playing
It affects people's attitudes and has the potential to change them	It is time-consuming and requires resources (e.g., a space and equipment)
It enables people's behavior to be trained	Simplifications could be misunderstood
It gives rapid feed-back on actions and decisions	Learning will depend on the skills of the participants and the qualifications of the game leader
It strengthens the exchange of opinions	It may not be taken seriously by the participants
It bridges theory and practice	The simulation leader cannot control the learning process

Source. Adapted from Riis et al. (1995).

requires players to work out the responsibilities of public- and private-sector actors with respect to different CRM measures provided to the participants in the form of a descriptive catalog. They then need to elaborate from the perspective of their respective role-play character as characterized by the distributed role cards upon the effectiveness of the adaptation measures for two contrasting risk categories that differ in their return period and in the level of stress imposed by risk (risk layering).

3.2.2. *The design of the RESPECT role-play simulation*

Following Wohlking & Gill (1980), the RESPECT role-play is structured into three functional phases (see Fig. 1). At the beginning (A), the participants are introduced to the role-play setting in a warm-up phase before (B), when the participants step into their roles and the major part of the enactment takes place. Afterwards, (C) the players leave their roles and the role-play is completed by a debriefing and discussion.

3.2.2.1. Warm-up phase (A). Following the welcome and round of introductions, the host provides some general information about the role-play as well as an overview of how the workshop process will progress and its goal. At this stage, it is important to declare the basic principles relating to the role-play requirements and to emphasize the need for good interpersonal manners to be maintained. According to the basic principles, the participants must assume and maintain the perspective, opinions, priorities, and interests of their role character. The participants are requested to perform their character's role realistically. To establish a respectful basis for discussions, the participants are also asked to let each other finish talking before speaking themselves, and to respect dissenting opinions.

3.2.2.2. Enactment phase (B). The enactment is the fundamental phase of the role-play—the phase in which the participants assume their roles and must work out various tasks both on their own and together as group. The function of the host changes from instructor to facilitator. The host moderates the flow of the interaction in the discussions.

The enactment phase is divided into two parts: "B. Info" and "B. Working" (Fig. 1). Materials that have been shared in advance are introduced to the participants (B.1 Info). These materials include two possible risk scenarios of specific climate-related risk for the year 2050. The actual role-play then starts. The participants must take on their role characters (B.2. Info), and they are introduced to the role-play situation itself (B.3. Info). In "B. Working," the participants are asked either to present their individual results or to negotiate group results as a compromise decision. A compromise in this context means a lack of dissent, meaning that consensus is not required and abstentions are valid. The following questions are to be answered in the working part of the enactment phase:

- Which actors would be affected positively and/or negatively by specific adaptation measures if they were implemented?
- Which actors are responsible for the implementation of specific adaptation measures?
- What are the risk preferences of each player with regard to two different risk scenarios for the year 2050?
- What adaptation measures are perceived by the participants as being effective for the two different hazard categories taken from the respective risk-scenarios for the year 2050?
- What strategies—comprising a prioritization of adaptation measures for two hazard categories and the actors responsible for their implementation—appear to be an effective means of protection for the whole group?

The Supplementary Material SM1 provides further details regarding the enactment phase of the RESPECT role-play simulation.

3.2.2.3. Post-enactment phase (C). Following van Ments (1996), the post-enactment phase has an important meaning in role-play. The instructor has to make sure that the participants step out of their characters when the role-play is over and have the opportunity to reflect on its outcomes. Misconceptions and factual mistakes can then be discussed and rectified. In leading the participants away from what happened in the role-play, the instructor is, in fact, encouraging them to analyze it, and this brings the discussion to a meta level.

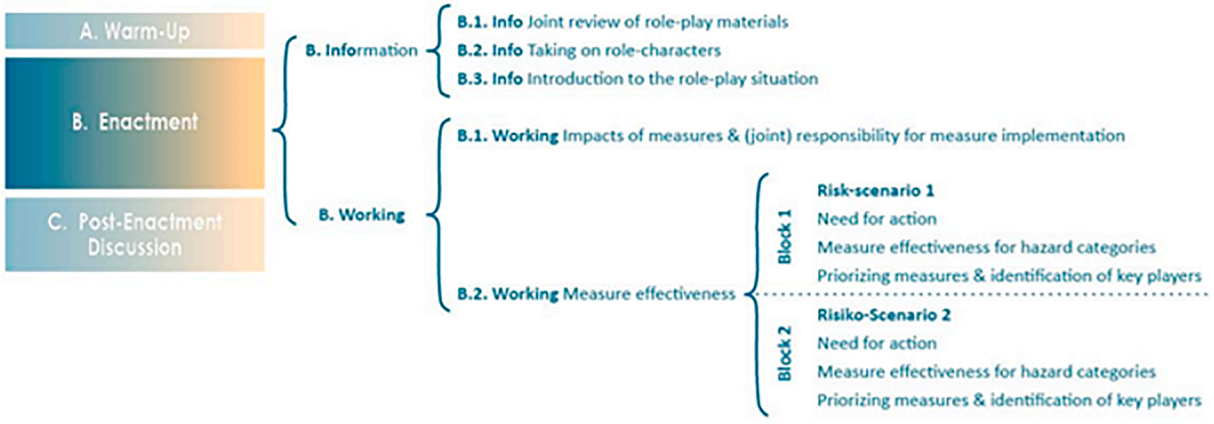

Fig. 1. Overview of the role-play workshop concept and procedure in the enactment phase. Source: Lintschnig et al. (2019).

First, the results of the role-play simulation are reviewed individually by participants from their personal point of view. There is then an open discussion, which allows individual insights to be brought into the larger group for joint reflection. During this, a set of results from the role-play can be compiled and the interconnections between those results can be discussed. It is also important for the participants to be able to exchange the experiences and insights gained during the role-play simulation.

3.2.3. The experimental set-up

3.2.3.1. Participants. In general, it is well and increasingly understood that joint action in terms of building multi-stakeholder partnerships between private and public actors is essential to meet potential climate-related risks in the future. That is why it is preferable for characters in the role-play to be designed to cover a wide range of groups involved in local CRM (Fig. 2).

To introduce the participants to their role-play characters, role cards were created according to van Ments (1996) who recommended giving fewer details about the characters themselves, and providing background facts and information about the situation at large as well as some details about how it might affect the characters taking part. Thus, participants are given open role cards rather than strict ones, so that they can use their own creativity to shape the character they are playing. This allows participants to identify more easily with their role characters.

3.2.3.2. Role-play situation and materials. Following van Ments (1996), the *situation* provides the background content of the role-play. The RESPECT role-play situation is set up to represent a meeting of interested local stakeholders from different fields of action (Fig. 2) within a virtual community. In a workshop entitled in German "*Fit für's Klima—Risiko lass' nach*!" (Fit for the climate—Reduce risk) these actors set out to develop, in collaboration with a CRM expert (=instructor), a strategy for their community to meet the challenges they are likely to face in the future regarding climate-related risks.

In the context of the RESPECT role-play situation, the players are provided with different *materials*:

- A catalog of potential CRM measures (see Supplementary Material SM2 for a portfolio of measures to tackle flood risk)
- Two possible flood risk scenarios for the year 2050
- Two different hazard categories (A and B, see below).

To compile the catalog of potential CRM measures, we used the results of the pre-project ARISE (Hama et al., 2016) and the climate adaptation strategies for Tyrol and its municipalities. The forward-looking climate risk-scenarios for the year 2050 were co-developed by researchers and key practice partners in the form of storylines for the case-study region. To incorporate the risk layering approach, the players are provided with qualitative descriptions of two hazard categories as follows:

- Hazard category (A) is characterized by a high recurrence (in intervals of some years) with minor impacts. This category entails damage due to flooding of streets and other surfaces
- Hazard category (B) is characterized by a low recurrence (in intervals of centuries) with major impacts. This category entails major damage to goods and infrastructure with endangerment to human life.

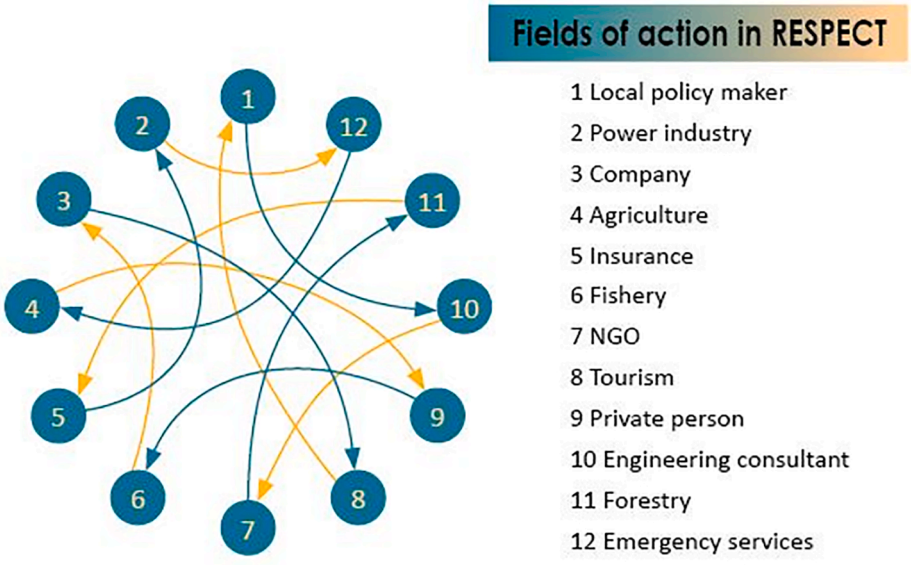

Fig. 2. Fields of action in RESPECT covering a wide range of groups of persons involved in local CRM. **Source:** The authors.

In the enactment phase "B.2. Working" (see section 3.2.2) and in the setting of the two different risk-scenarios for the year 2050, the players gauge perceptually how effective pre-identified flood risk management measures are against the two hazard categories as well as who is responsible for implementation. The role-play exercise thus integrates risk layering with a scenario approach in a participatory setting.

3.2.4. *Implementation and evaluation of the RESPECT role-play simulation*

The RESPECT role-play simulation was implemented in the city of Lienz, focusing on the climate-related risk flood and involving eight local CRM stakeholders. The participants were selected in close collaboration with a key contact person from the case study region to guarantee that the most relevant fields of action (see Fig. 2) for CRM in Lienz are represented in the role-play simulation. The participants eventually comprised a civil engineering consultant, private household representative, farmer, insurance agent, local policy maker, fire emergency service, private business representative, non-governmental organization representative. As described above, the participants were asked to step into another one of the eight roles than their own throughout the enactment phase of the

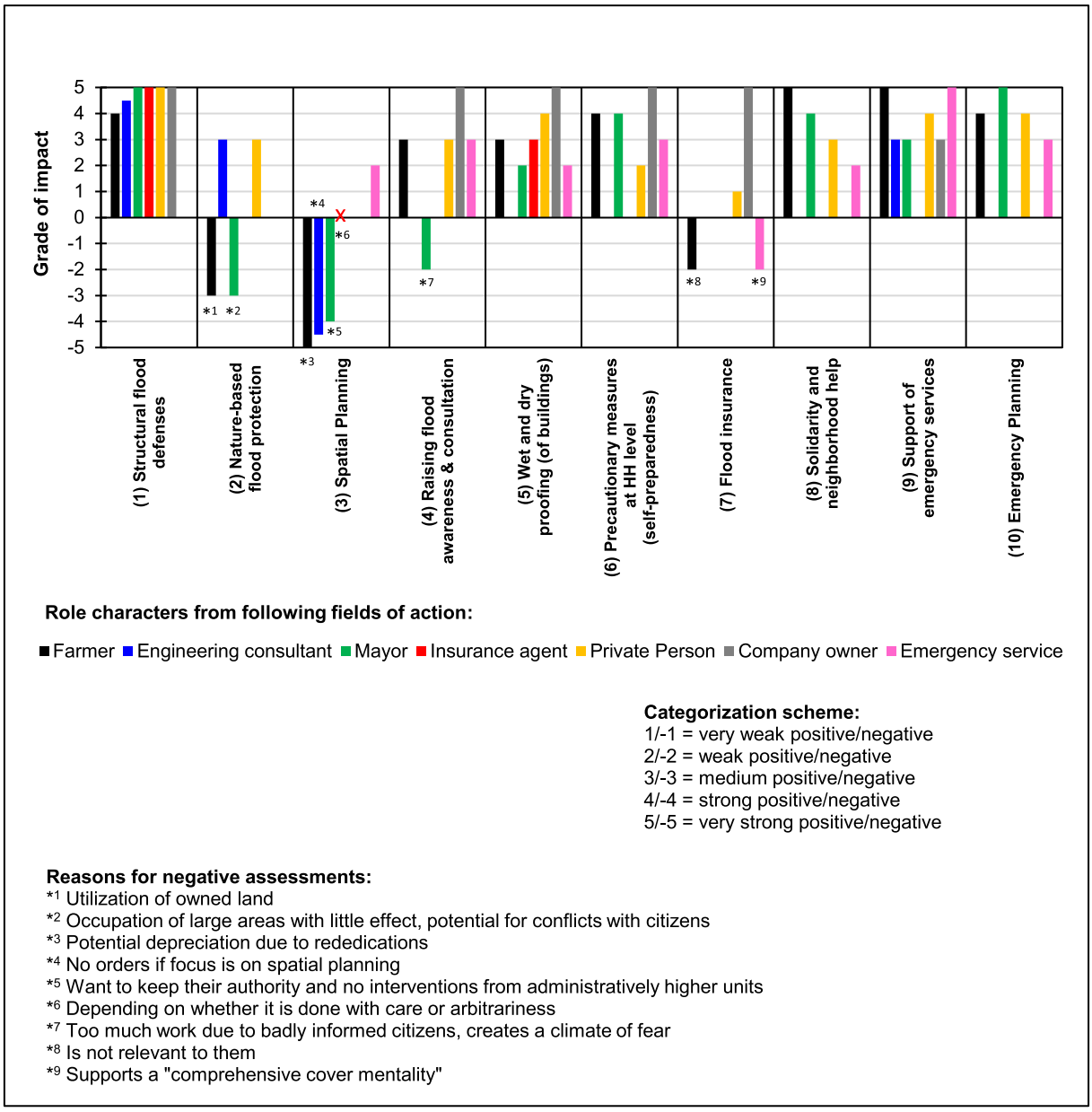

Fig. 3. Assessment of perceived potential impacts on role-play character if specific measures are implemented (on an ordinal scale from "1/-1 = very weak positive/negative" to "5/-5 = very strong positive/negative").

role-play simulation and are only allowed to bring in their personal expertise during the reflection in the post-enactment phase. All necessary role-play materials were created on the basis of the underlying real study-region setting. To ensure successful implementation, the role-play design was pre-tested in advance with researchers and students from the University of Graz. Nine participants were recruited for the pre-test, and based on their experiences and feedback, the role-play simulation design was further improved for eventual real-world implementation.

The whole workshop was documented via audio recording to ensure that discussions and arguments could be reconstructed afterwards. The results of all tasks worked out in the role-play simulations were also documented—work sheets and flip charts had been handed out before the role-play, and these were collected and their results analyzed. Three different evaluation instruments were used to systematically assess the role-play workshops:

(1) A feedback form was distributed with both open-ended and closed (rating scale) questions to assess the practical usefulness of the RESPECT role-play design in terms of fostering social learning in CRM. The questions are related to the following aspects:
   - o The role-play method itself
   - o The comprehensibility of the role-play materials and tasks
   - o The applicability of the role-play design in terms of elucidating specific aspects of CRM
   - o Personal experiences and findings from the role-play workshop
   - o The recommendation rate for use in other municipalities

(2) Oral reflection and discussion of the role-play design and components with participants and role-play personnel so that any necessary refinements could be made to the design.
(3) Pre- and post-role-play standardized questionnaires to assess if role-play has had an influence on risk attitudes and risk behavior.

4. Results of testing the RESPECT role-play simulation for flood risk in the city of Lienz

The results provide answers to the questions being tackled by "B. Enactment Phase - Working" (see section 3.2.2). The final subsection of Section 4 will present the results of the evaluation of the role-play workshop.

4.1. Comprehensive risk management measures—Impacts and responsibilities

The participants were asked to rate the potential impacts of each pre-identified flood risk management measure on their respective role-play character on an ordinal scale from "1/-1 = very weak positive/negative" to "5/-5 = very strong positive/negative." Fig. 3 summarizes the results of this exercise from the perspective of the different role-play characters.

Identifying measures with possible negative impacts on specific players is the most important insight from this exercise, given that measures perceived as being very effective may not be implemented because of a negative assessment. The players gave the reason for each negative assessment orally during this exercise (see lower part of Fig. 3). For instance, "nature-oriented flood protection" (measure no. 2) could have negative impacts on the "farmer" and the "mayor" characters in the role-play. Both, particularly the "farmer," indicated they had reservations over too much land potentially being used by this measure. The "mayor" character also saw a potential for conflicts with citizens and assessed "spatial planning" negatively, wishing to maintain mayoral authority without interventions from higher administrative units. There are some negative assessments with respect to the amount of work involved. The "mayor" fears that if the measure "flood awareness & consulting for self-provision" (measure No. 4) is implemented, too much work will be involved in building the awareness of badly informed citizens. The mayor also raised the concern that this measure might needlessly scare citizens. The "engineering consultant" feared their business would fail if there were a focus on spatial planning" (measure no. 3). The "farmer" character feared their land could depreciate if the measure "spatial planning" were to be implemented (e.g., due to being re-zoned as yellow or red). The "volunteer fire fighter (emergency service)" expressed reservations against "private insurance protection" (measure No. 7) as this would support a "comprehensive cover mentality."

Table 2 presents the results of the question about who is responsible for implementing specific measures? The most interesting insight was that the "mayor" did not feel responsible for the implementation of measure no. 4 "flood awareness & consulting for self-provision" although the "mayor" would obviously be the primarily responsible actor. After further inquiries by the workshop facilitator, the mayor argued too much work would be involved due to badly informed citizens and that the community should not be needlessly scared.

4.2. Assessing the effectiveness of flood risk management measures

Table 3 summarizes which adaptation measures are perceived as most effective by the role-play participants in terms of their respective flood risk mitigation potential for the two different flood categories. Although the players had to distinguish between the two risk layers, the results indicate that the participants perceived some measures—in particular nos. 1, 3, 6, and 7—as equally effective for tackling flood events i) with a high return period and high associated impacts and ii) with a low return period and low impacts. Structural flood protection, risk- sensitized spatial planning, self-provision, and private insurance have all been discussed for a long time regarding flood risk in Austria, without, however, considering their effectiveness for different layers of flood risk. We interpret this result as indicating that there is little knowledge among Austrian stakeholders of risk-based policy and decision making in the flood-management context. At the same time, more novel measures without a longstanding tradition in Austria, like measure no. 2

Table 2
Individually assessed (joint) responsibility for the implementation of specific measures.

Assessed (joint) responsibility for measure implementation										
Role characters from following fields of action:	**Measure No.**									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Farmer										
Engineering consultant										
Mayor										
Insurance agent										
Private person										
Company owner										
Emergency service										

Table 3
Individual assessment of measure effectiveness for two different flood categories and prioritization of measures by the whole group (framed in red).

	Assessed effectiveness of measures in contrast to Scenario X 2050 - higher risk																			
Measure No.	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)	
Flood category	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Role characters from following fields of action:																				
Farmer																				
Engineering consultant																				
Mayor																				
Insurance agent																				
Private person																				
Company owner																				
Emergency service																				
Total	7	7	3	1	2	2	1	3	3	3	4	4	3	3	4	3	4	3	2	3

Note. Red-framed measures indicate those prioritized by the group.

"nature-oriented flood protection" or measure no. 8 "networking and solidarity," were perceived as "too soft" and "not very effective" in managing high- level flood risks. Many participants thus suggested that these are effective only for flood category A (low return period, low impacts). Only in the plenary discussion, where the individual assessments were jointly evaluated by the group, supported by the moderator, could we identify and prioritize measures for each flood risk category individually (red frames in Table 3). As a result, measures 1 and 3 are still perceived as equally effective for both flood risk categories.

4.3. Collaborative ranking of measures and allocation of responsibilities to facilitate their implementation

In Table 3 the results of the group-prioritization exercise are highlighted using a red frame; and the more concrete rankings, including the main responsibilities distributed across the CRM actors involved, are given in Table 4. The group gave highest priority to measure no. 1 "structural flood protection facilities" for both flood categories. This result is not surprising and had already emerged from the exercise in section 4.1 (Fig. 3), where this measure had the highest assessment of positive impacts across all role-play characters.

Measure no. 3 "spatial planning" was not expected to receive the second-highest priority for both flood categories, as it did not emerge from the previous individual assessments. Open deliberation by the players, however, established conditions under which this measure could become highly effective without negative impacts on specific players:

- As "structural flood protection facilities" have the highest priority, the reservations of the engineering consultant concerning a weak order situation for their services was no longer valid.

Table 4
Collaborative ranking of the measures and mapping of respective responsibilities of the CRM actors involved.

Flood category	Priority 1	Priority 2	Priority 3
A - High frequency with low impacts	(1) Structural flood-protection facilities	(3) Spatial planning	(9) Support of emergency services
B - Low frequency with high impacts	(1) Structural flood- protection facilities	(3) Spatial planning	(10) Plans for emergency and crisis intervention
Character responsible for implementation	(1) Structural flood- protection facilities: • *Farmer* - provide land if needed • *Engineering consultant* - project planning • *Mayor* - primary responsibility • *Company* - provide land if needed	(3) Spatial planning: • *Engineering consultant* - provide results from flood modeling • *Mayor* - primary responsibility	(9) Support of emergency services: • *Farmer* - is a member of the voluntary fire brigade • *Emergency service* - primary responsible • *Mayor* - financial support (10) Plans for emergency and crisis intervention: • *Farmer* - is a member of the voluntary fire brigade • *Engineering consultant* – provides results from flood modeling • *Mayor* – primary responsibility • *Emergency service* –participation in planning and tutorials

- The farmer still does not want their land value to depreciate, but at least acknowledged that financial compensation would be a satisfactory outcome.
- The insurance agent argued that this measure could have positive or negative impacts depending on the quality of execution and pleaded for a participatory process towards implementation.

After evaluating these two measures as being most effective for both flood risk categories, the group also set out to identify specific measures for each category in the spirit of the risk-layering approach. In third place, came measure no. 9 "support of emergency services" for flood category A, and measure no. 10 "plans for emergency and crisis intervention" for flood category B.

After jointly prioritizing the available flood risk management measures, the final step in the role-play simulation was the joint allocation of respective responsibilities for implementing the measures. While remaining in their respective roles, the participants collectively identified an actor responsible for each measure to kick off the implementation process (see Table 4).

4.4. Evaluation of the role-play simulation

A feedback form with open-ended and closed (rating scale) questions was filled out by the role-play participants directly after the workshop so that feedback could be collected on the usefulness of the role-play simulation method. The specific questions are listed in the Supplementary Material (SM3) and can be clustered into the following five categories:

- The role-play method itself (3 questions)
- The comprehensibility of the role-play materials and tasks (8 questions)
- The applicability of the role-play design to working out aspects of CRM in specific points (4 questions)
- Personal experiences and findings due to the role-play workshop (1 question)
- The rate of recommendation for other municipalities (1 question)

Overall, more than 80% of the participants returned the feedback form[1]. The results (visualized in Fig. S1 in SM2) indicate that the role-play materials and tasks were mostly assessed as "understandable" or "quite understandable" (5-graded ordinal rating scale: 1 = "understandable," 2 = "quite understandable," 3 = "neither/nor," 4 = "not quite understandable," 5 = "not understandable"). The applicability of the role-play concept to elaborate different fields of stakeholder responsibility, risk management measures, and their potential effects was also mainly assessed as "appropriate" or "quite appropriate" (5-graded ordinal rating scale from 1 = "appropriate" to 5 = "not appropriate"). The role-play methodology was regarded as particularly appropriate for developing a better understanding of other stakeholders' viewpoints. Thirteen participants (of the 14 returning their feedback form) indicated they would recommend this workshop to stakeholders in other communities. The most diverse feedback was given regarding the assumption of specific role characters during the role-play simulation and thus having the opportunity to assess things from a different perspective from their own.

[1] In section 4.4 we use a larger sample size (n=14), covering not only the role-play simulation workshop on flood risk but also a second one on drought risk in the city of Lienz, in order to evaluate the participants' feedback on the RESPECT role-play more robustly. The methodological approach was exactly the same, we only adjusted the role-play materials and the list of participating stakeholders to reflect the focus on drought risk instead of flood risk.

Four respondents chose "I found it easy," four "I found it quite easy," two "neither/nor," and four "I found it quite hard." Different reasons were given by participants who had difficulties (e.g., the role was a controversial one or too little background information was provided on it).

5. Discussion and conclusions

5.1. Assessing the effectiveness of the RESPECT role-play simulation

In the field of participatory research, assessment of the effectiveness of the interventions and evaluation of the process itself (see section 4.4) are important but often overlooked issues. In the research activity presented in this paper, we hypothesized that applying the role-play simulation method leads not only to a better understanding of the diverse roles and responsibilities in flood risk management but also to increased risk literacy among participants. Using a pre- and post-role-play inquiry with a standardized questionnaire, we assessed if the role-play workshop did indeed affect the risk attitude and behavior of the participants. The participants were asked to fill in the pre-questionnaire at the workshop before it began and the post-questionnaire one to two weeks afterwards (returning it either by mail or email). The questions are listed in Table 5. They all had to be answered on a 5-graded ordinal rating scale (1 = "does not apply at all", 2 = "does not quite apply", 3 = "neither/nor", 4 = "does somewhat apply," 5 = "does apply completely"). Ratings that differ by at least two scales between pre- and post-inquiry are taken as indicators of change of risk attitude and risk behavior. Overall, 10 participants returned the post-questionnaire.

The most sizable effects relate to question (14) addressing the responsibility for ex post compensation after a natural disaster. The role-play workshops communicated that in Austria the national disaster fund pays compensation for damage due to catastrophic events, a fact apparently not known by some participants.

After the workshops, two participants changed their mind regarding their ability to cope with flood/drought protection on their own (question ([13]). Before the workshops these participants were sure they could manage climate-related risk management on their own. They subsequently changed to a rating of 2.

The role-play concept developed here underlines the necessity of involving all stakeholders concerned with the possible impacts of a given climate-related risk. It illustrated that the challenges can be tackled effectively only by the combined efforts of the whole community. This is further confirmed by a considerable change in the rating of question (6). Being asked whether the participants have higher personal concerns regarding protection against flood/drought (Question ([8]) two participants, changed their pre-rating of, respectively, 4 to 5 and 2 to 3 in the post-rating, showing a decrease in concern after the role-play workshops, which presented ways of co-designing effective risk management strategies. Moreover, two participants considerably changed their opinion that floods and droughts are simply uncontrollable natural phenomenon (question [9]) and two participants changed their opinion regarding question (4), meaning that if the right risk management processes and measures are in place, climate-related risks might not be as unmanageable as participants had thought pre-role-play.

Question (15) shows a decrease in trust in public flood protection by two participants. The role-play workshop on flood risk pointed out the importance of flood protection at household levels, and proactive planning of buildings as structural flood protection facilities, although even this can never provide 100% safety. This information also led to a considerable change in the rating of question (1) by one participant, who will now be better self-informed about climate-related risks, and in the context of question (11) by another who

Table 5
Pre- and post-inquiry questionnaire for assessing the effectiveness of the role-play simulation for increasing risk literacy, namely, by changing individual risk attitudes. Column 2 shows the number of participants with considerable differences (at least two scales) in risk attitude before and after the workshops at an individual level for each survey question (n = 10).

Questions	Number of participants with significant changes
(1) I try to stay informed regarding developments related to the flood/drought issue and regularly search for up-to-date information.	2
(2) Climate-related risks derive not only from human causes but also from a higher power.	/
(3) I fully trust the risk-management measures of my municipality.	/
(4) Most people make climate-related risks out to be a bigger problem than they are.	2
(5) I worry about a disaster event (e.g., flood) taking place.	/
(6) I want to improve my protection against climate-related risks using my own efforts.	1
(7) Ultimately fate decrees if or not you are hit by a disaster (e.g., flood).	/
(8) I am very concerned personally regarding my protection against climate-related risks.	2
(9) A disaster (e.g., flood) is simply an uncontrollable natural phenomenon.	2
(10) The next disaster (e.g., flood) event will certainly not occur as soon as currently expected.	/
(11) I have plans to implement further protection measures against climate-related risks at my own cost.	1
(12) My insurance, public institutions, and donations will pay for any major damage I have after a disaster event (e.g., flood).	/
(13) I can cope on my own with any problems regarding my protection against climate-related risks	2
(14) I would have to pay for my major damage myself after a disaster (e.g., flood) event.	5
(15) Public disaster protection gives me a feeling of security.	2

will now pay privately to take action against risk.

5.2. Fostering social learning through transdisciplinary research in CRM

Based on these experiences and lessons learned from developing and testing role-play simulations in the context of managing climate-related risks in Austria, we conclude that this particular participatory methodology can be useful for identifying and allocating often unclear roles and responsibilities in CRM, and it also promotes a better understanding of other stakeholders' viewpoints. It does this by integrating all three modes of decision-making practice—*thinking, seeing,* and *doing*—described by Mintzberg and Westley (2001). Following the definition by Reed et al. (2010), our results show that role-play simulations can be regarded as an effective participatory social learning process. First, the pre- and post-intervention survey results demonstrate that a change in understanding (here in terms of risk literacy) has taken place in the individuals involved. Second, the participants' feedback on the intervention (see section 4.3) highlights the strong potential of role-play simulations to develop a better understanding of other stakeholders' perspectives, needs, and concerns, and hence to overcome potential conflicts and misunderstandings in CRM policy and practice. This may lead to changes beyond the individual level: changes that may become situated within wider social units or communities of practice. Third, we conclude, based on the previous two insights, that the role-play simulation process is characterized by social interactions and processes among actors within a social network, fostering a better understanding of other stakeholders' points of view.

5.3. Enabling transdisciplinary CRM research

As transdisciplinary research, implemented through different collaborative approaches such as the role-play simulation presented in this paper, is becoming increasingly important for supporting effective and inclusive CRM in practice through fostering social learning, we regard it is as essential to better align research project–funding cycles with the increasing demands on research projects. In particular, if a quality and impact assessment of participatory processes going beyond a pre- and post-intervention survey (see e.g., UNDP-UNDESA, 2021) should become a requirement for transdisciplinary research projects—which we believe it should—then, substantially longer project time-horizons and/or fast-track follow-up funding streams are required.

6. Conclusions

The development and implementation of the RESPECT role-play simulation for managing flood risk in the city of Lienz, Austria, shows the merit of collaborative research approaches as follows: i) they enable diverse societal stakeholders (policy makers, decision-makers, civil society, private sector, households, researchers) to better understand the interacting dimensions of flood risk as well as each other's risk perceptions, interests, and needs in addressing this climate-related risk; ii) they engage societal stakeholders beyond traditional policy and decision-making communities in informed and inclusive public discussion and debate around challenges of, and solutions to, managing flood risk; and iii) they have the potential to support the breaking down of cultural, political, and institutional barriers to collaboration beyond the level of individuals, enabling more inclusive, reflexive, and transformative stakeholder processes. Taken together, we conclude, based on our findings from this Austrian case study, that role-play simulations are effective participatory processes in terms of fostering social learning, including cognitive, relational, and normative aspects of it, and that they embrace all relevant stakeholders' requirements. This can, in turn, lead to more effective and fairer climate-related risk management practice in Austria and beyond.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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