Tailored Flood Risk Communication

Residents' Perspectives as a Starting Point

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Abstract: Flood risk is increasing, and residents are expected to undertake adaptation measures to minimize flood damage. This requires them to be aware of the risk they face and how they can adapt, but this is often not the case. Through risk communication, residents' relation to their flood-prone environment could be strengthened, but the effect remains limited. This article aims to understand how residents across countries prefer flood risk communication and provides a basis for developing communication strategies that manage to raise awareness on risk and adaptation. Residents living in flood risk areas in England and the Netherlands were interviewed on their preferences for flood risk communication. The Q-methodology, consisting of 34 Q-sorts, resulted in four significantly different sets of preferences: (1) localist; (2) sufficientist; (3) imperfectionist; and (4) conventionalist. Moreover, cultural and individual factors, such as country of residence, flood experience, and responsibility division, prove potential determiners for these distinctly different perspectives.

Keywords: England, flood risk communication, flood risk management, methodology, residents' perspectives, the Netherlands, Q-methodology

Flood risk is increasing in intensity and frequency and is therewith threatening the way of life in living areas (Bradford et al. 2012; Burningham et al. 2008). Inundation of private properties can have severe impacts on residents' living conditions, such as health, finances, and safety (Kuhlicke et al. 2020; Rufat et al. 2020). Reducing flood risk is thus in the interest of residents living in flood risk areas. Residents can undertake many measures to increase the protection and resilience of their homes (see, e.g., Attems et al. 2020). Accordingly, academic studies and policy both agree that a viable option for minimizing damages and increasing community resilience is for residents to adopt flood risk adaptation measures for their homes independently (Holub and Fuchs 2009; Mees et al. 2012; Osberghaus 2015).

Greater reliance on individual actions has implications for the distribution of responsibilities in flood risk governance. In traditional

flood risk management, implementing measures for flood protection is mainly a governmental responsibility, and residents are considered mere recipients of flood protection (Kuhlicke et al. 2020). By expecting residents to implement property-level flood risk adaptation (PLFRA) measures, their role changes. Ultimately, residents are becoming key stakeholders (Snel et al. 2020). This shift in responsibility requires that residents be aware of the risk they face, their responsibility in minimizing it, and how they can do so (Rollason et al. 2018). Through risk communication, it is feasible to strengthen the relationship between residents and the flood risk area they live in, and specifically to increase risk awareness, responsibility, and potential adaptive actions such as PLFRA (Charrière et al. 2012). However, the process of flood risk communication is subject to ambiguous interpretations, as are the concepts of risk and responsibility. This creates two key challenges for communicating flood risk: the first challenge relates to raising risk awareness and encouraging PLFRA, and the second relates to the division of responsibility.

First, the academic debate has been focused on residents' flood risk awareness and how to increase it. Still, residents are not commonly aware of the flood risk they face. For instance, in the United Kingdom up to 40 percent of the residents in flood risk areas have been unaware (Burningham et al. 2008), and a more recent study suggests that 31 percent of at-risk residents would not know what to do in the event of a flood (Davies 2015; Rollason et al. 2018). Moreover, in the Netherlands residents have a low perception of flood risk. Research shows that 35 percent of at-risk residents have never considered the possibility of experiencing a flood where they live (Gutteling et al. 2010). England and the Netherlands were chosen as case countries because both of them are undergoing a similar shift in flood risk governance—that is, one emphasizing local flood risk management strategies and encouraging individuals to take more responsibility. Yet, experiences of flood events in these countries are quite different. In the Netherlands, flooding is relatively rare. In England, the country experiences floods almost on a yearly basis (Environment Agency 2020). This makes for a relevant analysis the communication preferences of residents in risk areas with such diverging levels of exposure to floods.

Raising awareness has been one of the main objectives of flood risk communication, in addition to transferring knowledge and providing (behavioral) advice on adaptive actions that may be taken to reduce risk (Höppner et al. 2012). However, risk awareness is hampered by residents' distinct understandings of risk (Douglas and Wildavsky 1992;

Hartmann 2011) and the fact that communication strategies are not often tailored to the preferences of residents (Snel et al. 2019).

Second, the concept of responsibility is ambiguous. What it means to be responsible has many different connotations, and every actor pieces together their own and others' responsibility based on their own perception and experience. Additionally, there are various forms of responsibility that are often not clearly distinguished, such as moral responsibility and accountability (Snel et al. 2022). This leads to miscommunication and scholarly confusion (Doorn 2012; Giddens 1999; Pellizzoni 2004) and can hamper risk communication efforts to encourage adaptive actions.

Awareness of flood risk and responsibilities are the starting point for mobilizing residents to take an active role in flood risk management processes (Charrière et al. 2012; Höppner et al. 2012; Kievik and Gutteling 2011). However, we argue that the envisioned shift to residents becoming key stakeholders is hindered due to their limited risk awareness and ambiguous understanding of responsibility. Even though flood risk communication is not the sole solution for this hindrance, it is a promising way forward (Kievik and Gutteling 2011). Predominantly, information on risk can be shared, and behavior can be altered (O'Sullivan et al. 2012; Ping et al. 2016; Rollason et al. 2018).

This article uses residents' perspectives as the starting point for an empirical analysis of what risk communication should encompass to make a difference. It is crucial to determine what the communication preferences of residents are in order to tailor communication strategies. Following a social constructivist approach, this article aims to better understand residents' communication preferences across different localities in two distinct national contexts (England and the Netherlands). This provides the basis for developing flood risk communication (i.e., recognizing residents' preferences and interpretations) that is able to raise awareness of risk and responsibility among residents.

Plurality in Flood Risk Communication

Risk communication is subjected to plurality, as residents' preferences regarding flood risk communication are diverse (Snel et al. 2019). This section summarizes the key insights from the academic literature regarding risk communication in flood risk governance.

The main aim of flood risk communication has generally been to raise awareness by transferring knowledge and providing adaptation

advice (Charrière et al. 2012; Höppner et al. 2012). Despite this fact, difficulties in reaching these objectives still remain (Rollason et al. 2018) and result in different insights into how to improve (flood) risk communication. It has been argued that the ineffectiveness of communication is primarily due to the one-way transmission of risk information in which the public merely receives information, instead of a preferred interactive two-way approach (Árvai 2014; Höppner et al. 2012; Ping et al. 2016). In addition, residents prefer to be informed regarding the likely impact and consequences of floods on their well-being and property (Bichard and Kazmierczak 2012; Renn 2009), instead of about probabilities of flooding, as these are difficult to understand and their significance is even more difficult to interpret (Snel et al. 2019). Furthermore, it is important that the information provided is actionable, because being informed about risks that are beyond your individual control raises anxiety rather than prompting adaptation (Bubeck et al. 2012; Everett and Lamond 2013; Grothmann and Reusswig 2006; Meyer et al. 2012). In the past, flood risk communication has often been developed from an expert point of view without taking the preferences of the intended target group into account (Patt and Jüpner 2013). This expert point of view refers to professionals working in the water sector (e.g., regional water authorities). It is often considered to be a top-down matter, whereas the impact of communication strategies could be improved by adopting a more resident-centric focus (Ping et al. 2016). Yet, residents are rarely included in the development of such communication strategies and campaigns (Rollason et al. 2018). Effective flood risk communication strategies would thus need to be specifically tailored to residents' preferences (i.e., target groups) (Snel et al. 2019).

Tailoring flood risk communication to the preferences and needs of residents is, however, not as easy as it might seem. A key challenge is that residents prefer flood risk to be communicated in different ways (Martens et al. 2009; Ping et al. 2016). Specifically, Karin Snel and colleagues (2019) have identified four distinct preferences for flood risk communication through empirical data-analysis of structured interviews and Q-methodology in the Netherlands. They show that these four distinct preferences concur with the four rationalities of the cultural theory of risk developed by Mary Douglas and Aaron Wildavsky (1992). This theory takes as a starting point four distinct rationalities (or cultures), according to which people perceive the world and from which their actions are derived: egalitarianism, individualism, hierarchism, and fatalism (Hartmann 2012; Schwarz and Thompson 1990). The first group identified by Snel and colleagues (2019) is named the "Self-assured

Omniscients" (i.e., hierarchists) because of their confidence in their existing knowledge of flood risk and the trust they put in public authorities. They expect the government to inform them when it is necessary to undertake PLFRA, and until then they put trust in other protection measures in place. The second group prefers flood risk communication to be tailored to their local risk. They acknowledge that they are not as informed as they would like to be, as they perceive their properties as being not well protected against floods. Therefore, this second group characterizes as individualists and is called the "Acknowledged Inexperts." The third group is considered to contain fatalists. They assume themselves to be well-informed, aware of the flood risk they face, and they state that there is nothing they can do to prevent a flood event. They are labeled the "Insusceptible Confident." The fourth group is called the "Insufficiently Connected" and connected to the rationality of egalitarianism. They believe that they are not sufficiently aware of flood risk and would like more information, from general to individual risk and PLFRA.

Building on these insights, one could design flood risk communication strategies to meet all the different preferences. Yet, building on the analytical framework that the cultural theory of risk provides, these four rationalities are determined to be mutually exclusive and they represent contradicting preferences for flood risk communication (Snel et al. 2019). The difficulty of such plurality of needs is that any communication strategy that addresses only one of the groups will be ineffective for the other groups and possibly entirely disregarded by them. Moreover, a solution that deliberately considers all four rationalities has disadvantages as well, because it will never be fully tailored to the preferences of the specific groups (Hartmann 2012; Snel et al. 2019).

In short, existing research shows plurality in how residents prefer flood risk to be communicated (e.g., Höppner et al. 2010; Ping et al. 2016). Yet, in contrast to previous studies that take one country as their focal point (e.g., Martens et al. 2009; Ping et al. 2016; Rollason et al. 2018; Snel et al. 2019), this study conducts a cross-country analysis of residents' perspectives in order to identify factors (e.g., country of residence) that affect potential differences in preferences to better understand what explains this plurality.

Methodology

To study the plurality of residents' preferences for flood risk communication, an in-depth, predominantly qualitative research design is imperative. We aimed for a cross-country analysis that is not limited to a specific type of flood risk (e.g., river, sea, or surface water flooding), because experiences with victims of flood events show that they hardly differentiate between the type of flooding. They tend to focus on the fact that they have been flooded instead. In addition, often the types of floods overlap in one event, which makes it difficult for affected people to differentiate between them. Therefore, from the viewpoint of residents the distinction between the specific type of flood does not carry as much weight as it does for experts. The Netherlands and England were selected as case countries because of their mix of flood risk management strategies (e.g., flood protection and mitigation, flood warning and response, spatial planning) and because (at the time of data collection) both were subject to the EU Floods Directive. Furthermore, both countries are undergoing similar shifts in flood risk governance directing increased attention toward flood risk management at the local level and encouraging individuals to take more responsibility for their flood risk, including the adoption of PLFRA (Johnson and Priest 2008; Mees et al. 2019; Mehring et al. 2018).

In contrast, both countries are at different points along this journey and coming from very different starting points, which makes a cross-country analysis of residents' preferences relevant. The Netherlands is starting from a system with a high protectionist approach with strong governmental responsibilities, whereas England has long had a more diverse approach, acknowledging that not all flooding is avoidable and with legal responsibilities resting with individual property-owners (Hegger et al. 2016). As such, experiences of flood events in these countries are quite different. In the Netherlands, flooding is relatively rare, although pluvial and fluvial flood events are increasing. At the time of data collection, the most recent flood event occurred in the Meuse basin in 1995, but actual flooding was limited to local events (Van Meijgaard and Jilderda 1996). In England, floods are much more common. Large-scale flood events have been occurring somewhere in the country almost on a yearly basis.[1]

In both countries, three locations were chosen in relation to varying types of flooding—sea, river, and rain-induced flooding—and flood risk. This allowed us to be able to analyze the perceptions of residents to flood risk communication in general. Great Yarmouth (England),

Aldeburgh (England), and Dordrecht (Netherlands) are susceptible to sea flooding. Zwolle (Netherlands), Venlo (Netherlands), Dordrecht (Netherlands), Oxford (England), and Aldeburgh (England) are susceptible to river flooding (see Figs. 1 and 2). All of these locations are susceptible to rain-induced flooding.

Respondents were selected by snowball sampling. The main selection criterion comprised residents of flood risk areas. All locations in England and the Netherlands have residential areas at flood risk from which respondents were selected, but only some respondents had experienced flooding before. This permitted us to perform an analysis on which cultural and individual factors might influence residents' preferences for flood risk communication. In both countries, the selection process started with establishing initial contacts with local actors who were involved in local flood risk management or governance processes. These initial contacts connected us with their local network for approaching respondents. Examples of such networks are members of Flood Action Groups or town council members. We reached out to any of the people in those networks and conducted interviews based on availability. Efforts were made to include residents who were flood experienced/inexperienced, as well as those who belonged to different age groups and genders. We considered a respondent to have flood experience if they had experienced a flood event in the proximity of their living location (see Figs. 1 and 2). However, flood risk communication addresses residents of flood risk areas in general, regardless of their flood experience; it is therefore also important to take both groups into account in this study.

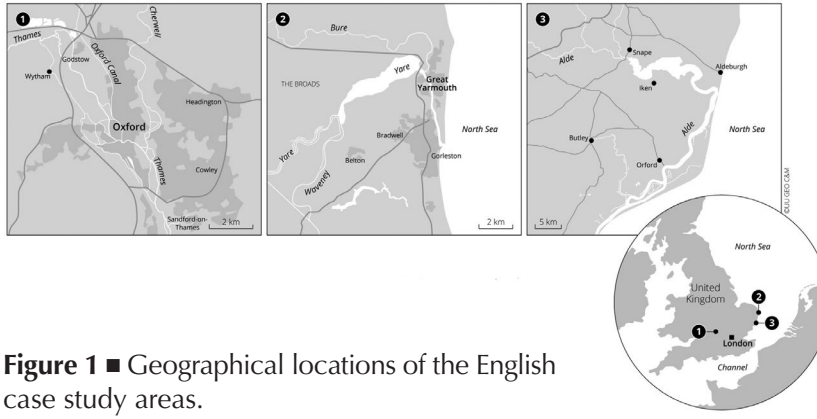

Figure 1 ■ Geographical locations of the English case study areas.

Figure 2 ■ Geographical locations of the Dutch case study areas.

To acquire more in-depth insight into residents' perspectives on flood risk communication, 16 English and 18 Dutch residents were interviewed using Q-methodology distributed across the six study locations. Q-methodology systematically reveals individual perspectives and groups them into shared perspectives using quantitative factor analysis (Raadgever et al. 2008). The factor analysis identifies the basic principal dimensions of respondents' perspectives (Kerr and Bjornlund 2018). By using Q-methodology, this study combines quantitative and qualitative research methods (McKeown and Thomas 2013). Q-methodology can highlight the various perspectives coexisting among English and Dutch residents, as well as pinpoint any differences. It is a fitting methodology for the aim of this study, which is to explore in depth individual preferences for flood risk communication (embracing plurality) in multiple risk contexts to improve flood risk communication strategies.

The Q-methodology performed for this study consisted of four steps. First, a Q-set (or Q-sample) was created. The sample is composed of 31 statements (see Table 1) extracted from the literature on flood risk communication, flood risk awareness, and flood risk perception; interviews with policymakers; and the media (e.g., Árvai 2014; Bier 2001; Bradford et al. 2012; Burningham et al. 2008; Höppner et al. 2012; Kasperson 2014; Terpstra 2011). The statements have been formulated based on the international state of the art regarding (flood) risk communication in academic and practice literature. The same Q-set has been applied in all locations, because we aim to analyze communication preferences of residents in flood risk areas in general,

Table 1 ■ The 31 statements that were used as the Q-set in this study.

Statements: Q-Methodology
I prefer face-to-face information-sharing to an online information platform.
A website with information on protection measures is only complete when I can get specific information on the benefits of implementing protection measures.
I think that a website or mobile application should be available to inform me about different flood risks in the region.
I have the need for real-time information on flood risk.
I am willing to pay for the advice of experts on how I can best protect my house against flooding.
I am only interested in information on my flood risk if it is free.
My home is well protected against flooding.
I think it is problematic that information about the flood risk of my home is freely accessible online.
Now, I know I live in a flood-prone area. I am going to gather more information on flood risks and protection measures.
The government informs me sufficiently about the flood risk in my region.
I am willing to use my address details to determine via a website or mobile application what flood risks I am facing.
I understand what it means when my home is protected against floods of 1-in-100 years.
I would use a website or mobile application that informs me on flood risk.
In my opinion, there is already enough information on my personal flood risk available.
I think flood probabilities are the best way of informing me about flood risks.
Only a government has the necessary credibility to inform me about flood risk.
I want more information on flooding than just a calculation of the chance that my home will flood.
I have the need for more information on flood risk.
A website or mobile application would be useful for gathering information on my personal flood risk.
I am willing to pay money for a detailed report on the flood risks of my home.
Flyers that are sent to my home address to inform me on my personal flood risk are a suitable form of risk communication.
Existing flood maps showing risk in the region are easy for me to understand.
Information on flood risk needs to be repeated regularly before I realize what the possible consequences are.
I think a website or mobile application with information about my flood risk provided by an insurance company is trustworthy.
On a website or mobile application, I want to be able to ask my questions about flood risk, the consequences, and prevention.
In my opinion, websites or mobile applications improve the communication between flood experts and citizens.
I think a website or mobile application should be available to inform me about technical flood protection measures regarding my home.
I would only use a website or mobile application on flood risk if it is free.
Information about my personal flood risk provided by experts is more reliable than that provided by a website or mobile application.
I am aware of the flood risk to my property.
I have the need for a national campaign on flood risks to raise my awareness of possible consequences.

in order to determine what factors might explain potential differences in preferences, such as country of residence. Next, respondents were selected in the flood risk areas of the study locations.

In the second step, Q-sorts were collected. In total, 34 respondents ranked the 31 statements by assigning a value to each statement (Uittenbroek et al. 2014). They assigned each statement to one of 31 boxes in the Q-sort pyramid, which consisted of a 9-point scale from strongly agree (+4) to strongly disagree (–4) (see Fig. 3).

The third step consisted of a statistical factor analysis of the Q-sorts. PQmethod software was used to run a principal component analysis (Schmolck 2002). The statistical analyses run by PQMethod manually and automatically rotate the initial factors to provide the necessary outputs (McKeown and Thomas 2013). Four factors were selected based on their eigenvalues and cumulative explained variance. Factors with an eigenvalue greater than 1.00 are considered significant, and cumulative explained variance is ideally above 50 percent (McKeown and Thomas 2013). Since all initial factors had eigenvalues greater than 1.00, four factors were selected based on their cumulative explained variance of 54 percent. The varimax rotation method was applied. Next a proportional distribution of respondents across the factors was established.

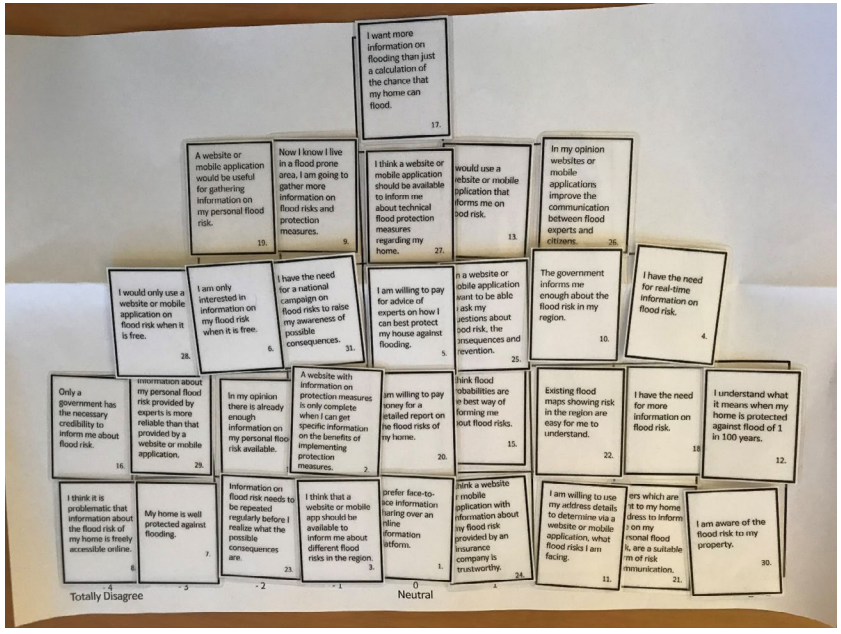

Figure 3 ■ Example of a Q-sort by one of the respondents.

Step four was to interpret the factors. Bruce McKeown and Dan Thomas (2013) refer to this as the task of distilling the core meanings hidden within the factors. This process is mostly based upon the factor loadings, the Z-scores, and distinguishing statements per factor. Additionally, the reasoning that respondents provided for their (dis)agreement with certain statements during the interviews was used to distill the core meaning of the factors. This is a fundamentally interpretative step.

Limitations to this research method are related to the required focus to sort statements and the interpretative nature of the results. Q-methodology is time-consuming and demanding (Lundberg et al. 2020). The amount of time and effort that is needed (e.g., explanation of the method, sorting the statements, explaining sorting choices) could influence the way in which respondents sort the statements. However, this impact is limited because in our experience respondents sort the statements that they feel strongly about most easily. Regarding the generalizability of the results, Q-methodology is here used to identify residents' preferences in flood risk communication, but does not allow for conclusions on how many people share these perspectives beyond the sample (McKeown and Thomas 2013). Generalizability might also be hampered by a potential sample bias. It is possible that the people who were motivated to be part of this study were more interested in flood risk and, therefore, potentially more knowledgeable on the topic than an average resident of a flood risk area.

The Q-sorts were collected as part of semi-structured interviews conducted with each of the English and Dutch respondents; each interview lasted between 60 and 90 minutes. These interviews were transcribed and coded using MAXQDA. In other words, in addition to the Q-methodology, respondents were also interviewed for in-depth information on, for example, their experience with floods and perception of responsibility division and about whether they had taken PLFRA measures. For instance, respondents were asked how they divided responsibility for reducing flood risk to their homes on an 11-point scale with "100 percent residents' responsibility" on one side and 100 percent "public authorities' responsibility" on the other. This additional data provided insight into which cultural and individual factors might influence how respondents sorted the Q-statements.

All in all, the Q-methodology has led to four significant "factors" that represent groups of residents who share similar preferences for flood risk communication (see Table 2). The factors are in this study referred to as "perspectives." In the analysis presented in the following section, findings concentrate on a combined dataset including both Dutch and

Table 2 ■ Overview respondents per perspective.

	Respon-dent	Correlation Perspective	Country of Residence	Flood Experi-ence?	Responsibility Resident/Public Authorities
"Localist" Perspective 1 **Explained Variance: 13%**	1	0.5892	England	N	50/50
	6	0.7462	England	N	50/50
	9	0.5199	England	N	20/80
	10	0.8421	England	N	50/50
	11	0.6691	England	Y	50/50
	12	0.5397	England	Y	100/0
	13	0.5664	England	Y	50/50
	16	0.5224	England	Y	50/50
"Sufficientist" Perspective 2 **Explained Variance: 16%**	2	0.5786	England	N	20/80
	3	0.4827	England	N	30/70
	14	0.8529	England	N	50/50
	20	0.7047	Netherlands	Y	0/100
	25	0.5426	Netherlands	N	20/80
	26	0.5894	Netherlands	Y	0/100
	27	0.5556	Netherlands	Y	10/90
	29	0.5108	Netherlands	Y	0/100
	30	0.5301	Netherlands	N	0/100
	31	0.6362	Netherlands	N	20/80
	33	0.7974	Netherlands	Y	0/100
	34	0.4553	Netherlands	Y	40/60
"Imperfectionist" Perspective 3 **Explained Variance: 11%**	4	0.6831	England	N	25/75
	5	0.6087	England	N	50/50
	7	0.7049	England	N	0/100
	8	0.7585	England	N	30/70
	19	0.6456	Netherlands	N	50/50
"Conventionalist" Perspective 4 **Explained Variance: 14%**	15	0.6533	England	Y	60/40
	17	0.4968	Netherlands	N	50/50
	18	0.4706	Netherlands	N	50/50
	21	0.7244	Netherlands	N	0/100
	22	0.5422	Netherlands	Y	0/100
	23	0.5437	Netherlands	N	30/70
	24	0.7013	Netherlands	N	20/80
	28	0.6621	Netherlands	Y	50/50
	32	0.5893	Netherlands	N	20/80

English respondents. We started this study with the intention to conduct a cross-country comparison of the separate Dutch and English Q-sorts; however, that analysis showed no significant differences or similarities between the two countries. Therefore, we ran the Q-methodology for the whole set of both the English and Dutch Q-sorts, and this led to interesting results when we cross-checked the four selected factors with additionally collected data on flood experience and perceived responsibility division on top of country of residence. Consequently, these results are discussed in the following section, as they illustrate why respondents shared certain preferences.

Different Perspectives on Flood Risk Communication: Findings from the Q-Methodology

Four significantly different perspectives on flood risk communication resulted from the Q-methodology. Each perspective represents a distinct set of preferences. Before we emphasize the specific characteristics of the four perspectives, statements that constitute consensus among all four groups are highlighted. First, all perspectives showed some disagreement with the statement that their home is well protected against floods. Additionally, all emphasized that they want more information on flooding other than the calculation of the chance that their homes can flood. Regarding the method of risk communication, all perspectives acknowledged that they would use a website or mobile application that informs them on flood risk. None of the perspectives deemed it problematic if information about the flood risk of their homes would be freely accessible online. Respondent 4 explained that there is "definitely no reason why it should be a problem. If it implies that other people would be able to tell and then they might not want to buy my house, then again, I totally disagree that one should be trying to hide the fact [that your property is at flood risk]. I think that is an ethical thing."

Beyond this consensus, the factor analysis presented four significant perspectives on flood risk communication: these respective perspectives are hereafter labeled as (1) localist; (2) sufficientist; (3) imperfectionist; and (4) conventionalist. We named these perspectives based on the distinctive aspects of their communication preferences. The interpretation of these perspectives is mostly based on distinguishing statements of the group (see Table 3). Those are statements that are unique to a factor, because they scored significantly different compared to the other perspectives on that statement. These statements distinguish

Table 3 ■ Distinguishing statements for each perspective.

No.	Statement	Q-Sort Value	Z-SCR
	Perspective 1 – "Localist"		
21	Flyers that are sent to my home address to inform me on my personal flood risk are a suitable form of risk communication.	3	0.90*
1	I prefer face-to-face information-sharing to an online information platform.	0	–0.02
24	I think a website or mobile application with information about my flood risk provided by an insurance company is trustworthy.	0	–0.03*
19	A website or mobile application would be useful for gathering information on my personal flood risk.	–1	–0.38*
2	A website with information on protection measures is only complete when I can get specific information on the benefits of implementing protection measures.	–1	–0.38
31	I have the need for a national campaign on flood risks to raise my awareness of possible consequences.	–2	–0.51*
6	I am only interested in information on my flood risk if it is free.	–2	–0.94*
29	Information about my personal flood risk provided by experts is more reliable than that provided by a website or mobile application.	–2	–1.00
16	Only a government has the necessary credibility to inform me about flood risk.	–4	–2.04*
	Perspective 2 – "Sufficientist"		
11	I am willing to use my address details to determine via a website or mobile application what flood risks I am facing.	4	1.96*
14	In my opinion, there is already enough information on my personal flood risk available.	3	1.29*
28	I would only use a website or mobile application on flood risk if it is free.	2	0.67*
10	The government informs me enough about the flood risk in my region.	1	0.61*
16	Only a government has the necessary credibility to inform me about flood risk.	0	0.34*
18	I have the need for more information on flood risk.	–3	–1.18*
9	Now, I know I live in a flood-prone area. I am going to gather more information on flood risks and protection measures.	–3	–1.33*

($p < .05$; Asterisk [*] indicates significance at $p < .01$)

Table 3 ■ Continued.

No.	Statement	Q-Sort Value	Z-SCR
	Perspective 3 – "Imperfectionist"		
23	Information on flood risk needs to be repeated regularly before I realize what the possible consequences are.	2	1.09*
31	I have the need for a national campaign on flood risks to raise my awareness of possible consequences.	1	0.66*
30	I am aware of the flood risk to my property.	1	0.62*
4	I have the need for real-time information on flood risk.	0	–0.17*
28	I would only use a website or mobile application on flood risk if it is free.	0	–0.22*
16	Only a government has the necessary credibility to inform me about flood risk.	–2	–1.05*
12	I understand what it means when my home is protected against floods of 1-in-100 years.	–4	–1.58*
10	The government informs me sufficiently about the flood risk in my region.	–4	–1.60*
	Perspective 4 – "Conventionalist"		
1	I prefer face-to-face information-sharing to an online information platform.	4	1.29*
16	Only a government has the necessary credibility to inform me about flood risk.	3	1.12*
29	Information about my personal flood risk provided by experts is more reliable than that provided by a website or mobile application.	2	0.72*
11	I am willing to use my address details to determine via a website or mobile application what flood risks I am facing.	0	–0.05*
14	In my opinion, there is already enough information on my personal flood risk available.	0	–0.09*
26	In my opinion, websites or mobile applications improve the communication between flood experts and citizens.	–1	–0.17*
18	I have the need for more information on flood risk.	–1	–0.55*
22	Existing flood maps showing risk in the region are easy for me to understand.	–2	–0.75*
21	Flyers that are sent to my home address to inform me on my personal flood risk are a suitable form of risk communication.	–2	–0.94
15	I think flood probabilities are the best way of informing me about flood risks.	–2	–1.10
6	I am only interested in information on my flood risk if it is free.	–4	–2.11*
24	I think a website or mobile application with information about my flood risk provided by an insurance company is trustworthy.	–4	–2.15*

($p < .05$; Asterisk [*] indicates significance at $p < .01$)

between the core and secondary preferences of respondents (Webler et al. 2009).

The respondents adhered to one of these four perspectives, and each perspective has a common preference on how flood risk ought to be communicated. In the following section, these sets of preferences are explained based on their typical components and their similarities to and differences from the other perspectives. On top of the factor analysis, we have enriched the results with data on cultural and individual factors, such as respondents' flood experience and how they divided responsibilities in flood risk management (see Table 2).

Perspective 1: "Localist"—Preferring Locally Provided Information

These respondents can be characterized as "localists" because they articulated a clear need for more locally provided flood risk information, which applies both to their recognition of local sources as reliable providers of information, as well as to their preference for home-delivered flyers on flood risk. Moreover, they preferred getting information specified to the local level, such as real-time information.

Using flood probabilities as a form of flood risk communication, such as protection against a 1-in-a-100-year flood, is understandable for this group of respondents, although they do tend to explain it in different ways. Respondent 12 understood it as "a disastrous event where you have to leave your home and have it completely refurbished. . . . You see them on the television—people sitting on the tops of their roofs waiting to be rescued, that sort of thing." Respondent 9 explained that "it might happen tomorrow. I get it, but it is kind of meaningless, isn't it?" And Respondent 6 stated that "it means that on the big average they expect us to go through this experience once every hundred years. [But] everybody knows that 1-in-a-100 doesn't mean that at all. We're talking mathematics, not flood risks." This group strongly agrees with the statement that they understand what a return period of 1-in-a-100-year means, but they are ambiguous in their explanations. This raises questions of whether there is a common, and correct, understanding. Yet, whether the statement was fully understood or not, these respondents stated strongly that their homes were not well protected against floods.

Moreover, they stated that websites with flood risk information do not have to be free in order for them to use them: "If it was there and if it was useful, it would help me keep safe. Why would I not want to pay for it?" (Respondent 12). This aligns with the statement that they are not

only interested in flood risk information when it's free. Respondent 12 stated: "I think it's far too important to be worrying about the odd fee. If there's a bit of a fee, so what? If it's free, fine, but I certainly wouldn't be only interested in it if it's free: definitely not. . . . I think it would be ludicrous to demand that it has to be free, because it's too important to keep your home safe." Respondents 9 and 17 expressed that they had already paid for flood risk information, and so they had no issue with having to pay for such information.

Additionally, the respondents who shared this localist perspective stand out from those who shared the other perspectives through (1) their need for real-time information; and (2) their acknowledgment of the importance of local knowledge in communicating flood risk. The first was brought up with regard to current river measurements on water levels and velocity (Respondent 17) and regular updates by phone or text (Respondent 11). The second relates to the statement on whether they perceive governmental actors to be the only credible source of flood risk information. Respondents 13, 12, and 17, for instance, also rely on local knowledge from fishermen and farmers: "The farmers who live in this area probably know as much about it than somebody in government" (Respondent 12). Respondent 1 additionally mentioned local flood action groups as an example of a reliable source of flood risk information. Therefore, the respondents who share these preferences do not consider public authorities to be the sole providers of credible flood risk information.

The above-mentioned cultural and individual factors show that this localist perspective consists of only English respondents. So, besides their shared preferences on flood risk communication, based on the use of the Q-methodology, they are also connected based on their country of residence. Moreover, six out of eight respondents divided the responsibility for reducing flood risk to their properties "50/50" between residents (themselves) and public authorities. In addition, half of the respondents had been flooded before.

To summarize, the localists prefer more information on flood risk, which would ideally build on local knowledge and be shared with them through flyers, text messages, or a phone call.

Perspective 2: "Sufficientist"—Trusting Accessibility of Sufficient Information

We have characterized this group as "sufficientist," because its members were not interested in additional information on flood risk, and

if they, in the future, might need more information, they argued, they would find it on the Internet. They claimed to be aware of the flood risk that they face and acknowledged that their homes are not well protected. Yet, some of them put their awareness in perspective by emphasizing that, while they themselves were aware, their neighbors might not be sufficiently aware. One said: "I have an above-average understanding on the topic of flood risk" (Respondent 26).

The respondents adhering to this perspective explicitly stated that they did not have a need for more flood risk information and that they were not willing to pay for flood risk information. Respondent 35 explained: "In my opinion, information on floods should be free of charge. That is the way it is supposed to be, considering I already pay taxes to the regional water authority." Respondent 15 said: "Personally, there's enough information [available] that you can research." Moreover, Respondent 29 stated: "Even though I am aware of the high flood risk I am facing, I am not going to invest money to prevent a flood that could occur once every 100 years; I will worry about it then." This implies that respondents who held a sufficientist perspective had no need for more information.

Using flood probabilities, like 1-in-a-100-year phrases, to communicate the risk of flooding does not align with the preferences of this perspective. Respondents emphasized that formulations of 1-in-a-100-year risk of flooding do not work. Respondent 29 said: "I'll worry about it when there is an actual threat." Respondent 3 explained that "[1-in-a-100-year] means nothing to me, absolutely nothing. I work in this field, and I still don't understand it. How can you have three 100-year floods in a short period of time? It does not make any sense to me at all." Respondents 32 and 35 agreed that flood probabilities are too abstract to grasp and give the impression that a flood will only happen once.

Members of this group were the only ones who explicitly stated that they did not have a need for more flood risk information. They claimed that enough information was already available. Accordingly, flyers are not a suitable form of flood risk communication in their eyes, and neither is a national campaign. The only form of communication that this group is willing to use is a website that informs its members on flood risk in general and on the individual risk they face. Also, this form of information needs to be free of charge.

This sufficientist perspective on flood risk communication was shared by respondents from both England and the Netherlands, and they have had mixed experiences with floods. Yet, the additional analyses also showed that all respondents perceived public authorities

to have nearly full responsibility for protecting properties from flood damage. This might put their communication preferences in perspective in relation to the other three sets that are presented in this results section. To summarize, sufficientists are not interested in more information on flood risk because they believe that enough information is already available.

Perspective 3: "Imperfectionists"—Acknowledging Their Limited Experience

We characterized this perspective as "imperfectionist" because those who held it acknowledged that their awareness of flood risk and understanding of flood probabilities were not perfect. Also, these respondents were the only ones who stated that flood risk information needs to be repeated regularly and that "messaging has to be varied enough to have impact" (Respondent 7). In addition, they are the only group that voiced slightly positive opinions about the added value of a national campaign on flood risk.

These respondents emphasized that they wanted to gain more information on the flood risk of their property, as they acknowledged that they were fully aware of the risk they face. They argued that public authorities do not inform them sufficiently. They suggested that public authorities should play a bigger role in dispersing information, which, from their perspective, was currently not the case (Respondent 21). Also, they did not perceive public authorities to be the only credible provider of flood risk information and stated that they do not necessarily see information provided by insurance companies as untrustworthy.

These respondents agreed that there is not enough flood risk information, and although it might be available, "it might not necessarily be very visible" (Respondent 4). Flood risk communication should in their opinion be free of charge, and it needs to be repeated regularly. Additionally, they explicitly stated that they do not understand what it means to be protected against a 1-in-a-100-year flood. Whereas the other groups in this analysis also addressed the shortcomings of these probabilities, this group completely disagreed with the use of such probabilities. Respondent 21 emphasized that flood probabilities "are actual nonsense."

Compared to the size of the other groups, fewer respondents adhered to the imperfectionist perspective, but what unites them besides their shared preferences for flood risk communication is their inexperience with floods. None of them had been flooded before, which was

likely to have influenced their preferences for flood risk communication. The respondents did diverge in their answers regarding where responsibility lies for protecting properties. Moreover, since this group consisted of both English and Dutch respondents, country of residence does not seem to have been an indicating individual factor.

To summarize, the imperfectionists acknowledged their limited awareness of flood risk and therefore need flood risk information to be regularly repeated, free of charge, and go beyond mere flood probabilities.

Perspective 4: "Conventionalist"—Preferring Offline Information by Public Authorities

This perspective is characterized as "conventionalist" because it is held by the only group whose members prefer the more conventional forms of communication. Also, they only perceived public authorities as reliable and would not accept information provided by other actors, such as insurance companies.

Respondents that are part of this group expressed a clear need for more information. Even though they stated they are aware of the flood risk to their property, they did acknowledge that there is more to learn. Respondents questioned, for instance, whether their knowledge is adequate (Respondent 30). Additionally, Respondents 25 and 19 addressed the fact that their friends or neighbors might not be aware enough. One stated: "I am not the average Dutch resident on this topic" (Respondent 19). This aligns with their responses to the statement about whether they understand what a 1-in-a-100-year flood means. Respondent 26 acknowledged that communicating a flood probability of 1-in-100-years or even 1-in-1000-years causes people to wait and see what will happen. And Respondent 19 claimed that the mention of a 1-in-1000-year probability causes people to assume that they will not experience such an event. While a flood of that magnitude is possible, the question remained whether it would actually happen in their lifetime.

This perspective prefers face-to-face information-sharing to an online information platform. Accordingly, the conventionalists stated that information provided by experts is more reliable than information on a website or mobile application. They acknowledged that flood maps are not easy to understand. This might also have to do with the reason why they prefer face-to-face information-sharing, because websites or mobile applications on flood risk are often built around flood maps (such as "Risicokaart" and "Check Flooding"). The respondents

were willing to pay for flood risk information. For this group, only public authorities are providers of credible flood risk information, and information provided by insurance companies is perceived as untrustworthy. Yet, they are not interested in a national campaign on flood risk, which relates to the preference for face-to-face information-sharing.

Besides their shared preferences for flood risk communication, the respondents also shared the same country of residence: eight of out nine respondents lived in the Netherlands. They were divided regarding their flood experience and on whether they perceived the main responsibility for protecting properties from floods to be with public authorities or with residents. Yet, they all perceived at least 50 percent of the responsibility for minimizing flood damage at the property level to lie with public authorities.

To summarize, the conventionalists prefer face-to-face flood risk communication that is provided by public authorities and do not include flood maps in said communication, as they are difficult to understand.

Discussion

The Q-methodology has resulted in four significantly different sets of preferences on how flood risk should be communicated according to residents of flood risk areas in England and the Netherlands. The residents who adhered to these perspectives are named (1) localists; (2) sufficientists; (3) imperfectionists; and (4) conventionalists. In addition to the risk communication preferences, relevant cultural and individual data (flood experience, country of residence, and responsibility division) is presented for each perspective in order to interpret the significant difference between the four perspectives. In this section, the results are discussed and suggestions for future research are made.

Insights on Communication Preferences of Residents

This empirical study emphasizes the plurality of residents' preferences for flood risk communication as corresponds with previous studies on risk communication by Thomas Martens and colleagues (2009) and Neoh Ping and colleagues (2016). The Q-methodology resulted in four distinct perspectives, which is a result similar to that arrived at by Karin Snel and colleagues (2019). Although the four sets of communication preferences they presented are not identical to those in this study, we share their conclusion that a generalized communication strategy to

address residents of flood risk areas as whole will most likely fail to meet the intended objective, since it will not be able to meet all (contradicting) preferences in one strategy. For flood risk professionals wanting to focus on improving communication, these insights imply that a decision on audience is imperative. Namely, they must first determine whether they aim to target the whole population, or tailor a strategy specifically for a target audience based on the preferences presented in this study. What the results do show is that residents of flood risk areas in the Netherlands and England would use websites or mobile applications for gathering information on flood risk. They, overall, do not mind if flood risk information about their property is publicly available. Moreover, they agree that flood risk should be communicated in another matter than the chance or probability of flooding. Their perspectives differ, however, regarding their understanding of what it means to be protected against 1-in-100-year floods, whether public authorities are the only credible providers of flood risk information, and whether enough information is already available. These insights could shape future flood risk communication strategies.

Cultural and Individual Factors

The outcome of the Q-methodology raises the question of what makes residents have such significantly different preferences for flood risk communication. The cultural and individual data in this study present some preliminary insights into what might influence residents' preferences for flood risk communication. Therefore, we discuss here how cultural and individual factors such as flood experience, country of residence, and perceived responsibility might determine residents' communication preferences. This is a fruitful next step toward better tailoring flood risk communication to residents' preferences to increase their awareness on risk and PLFRA measures.

Country of Residence

How residents prefer flood risk to be communicated might be influenced by their country of residence, as every country has various approaches to and experiences with floods. Based on some of the country-specific results that were outlined in the previous section, we can assume that path-dependently developed institutional aspects (e.g., cultural traditions and governance approaches to managing flood

risk) to some extent influence residents' communication preferences (Kaufmann and Wiering 2017). This corresponds with expectations indicated in previous studies (e.g., Bubeck et al. 2012; Burningham et al. 2008; Terpstra and Gutteling 2008). In recent years in England, residents have more frequently faced the threat of a flood event (or seen it on the news) than residents of the Netherlands. English residents might, therefore, have a stronger opinion on how they would want flood risk to be communicated. The localists are interested in more information on flood risk, which ideally builds on local knowledge. This group consists solely of English respondents. Therefore, this might indicate that the localists have received flood risk information more often and from various sources; as such, this group might attach more value to local knowledge than the others.

The Netherlands has a longstanding tradition where public authorities are the main actors in flood risk management. The conventionalists consist of all-Dutch respondents, except one. This group prefers face-to-face flood risk communication that is ideally provided by public authorities. Their country of residence might influence the conventionalists' specific preference for governmental information on flood risk, as that is what they are used to.

Flood Experience

The imperfectionists acknowledge their limited awareness of flood risk and therefore state a clear need for flood risk information that is free of charge, repeated regularly, and not solely focused on flood probabilities. The cultural and individual data show that none of the respondents adhering to this group have experience with floods. These residents acknowledge in the interviews that since they have not been flooded before they lack a sense of urgency for increasing awareness and taking PLFRA measures. Therefore, they prefer flood risk information to be repeated regularly (so that they are reminded often), freely available (which increases accessibility), and consist of more than just flood probabilities (as they are difficult to understand *and* do not raise the sense of urgency they would like). That the experience of having been flooded has an impact on the risk perception of residents has been concluded by varying authors, as outlined by Jonathan Hopkins and Jeff Warburton (2015). It is thus fair to assume that flood experience also influences how residents prefer flood risk to be communicated as well.

Responsibility Division

Communication preferences of residents might be influenced by their perception of responsibility. In this case, we asked respondents how they would divide responsibility for protecting private properties against flood risk between residents and public authorities. The sufficientists, who are not interested in more flood risk information as they trust enough is already available, all placed a strong emphasis on governmental responsibility. This might indicate that respondents did not perceive it as their own responsibility and thus as unnecessary for them, as residents, to have more knowledge on the risk of flooding and PLFRA. In their opinion, public authorities are responsible for flood risk management, and they expect to be informed when a flood is imminent. It is increasingly acknowledged that perception of responsibility's influence on residents' preferences of flood risk communication is an important factor: how residents divide flood-related responsibilities influences their risk perception and motivation to take PLFRA measures (e.g., Hopkins and Warburton 2015; Snel et al. 2021; Wachinger et al. 2013). However, responsibility as an indication of communication preferences is a new insight. This therefore calls for a better understanding of how residents perceive responsibilities to be divided and how flood risk communication can be tailored to these perceptions. Furthermore, which actor is responsible for what in case of a flood event should be considered as a main topic for communication strategies in order to minimize potential discrepancies.

These three cultural and individual characteristics provide insight into what might be behind these four significant perspectives on flood risk communication. We suggest that future research should shed more light on what influences residents' preferences for flood risk communication, as the cultural and individual factors presented here are not the sole determining factors. For instance, some English and Dutch respondents are dispersed across the perspectives, so country of residence is not solely decisive in their communication preferences. This, then, calls for future research on which factors determine residents' communication preferences.

Conclusion

Residents' relation to their flood-prone environment can be strengthened through risk communication (Charrière et al. 2012). Existing communication strategies generally provide information on the risk of flooding (e.g., water depth, probabilities of occurrence, and flood maps). Increasingly, also information on PLFRA measures are included in flood risk communication strategies, with the intended impact of raising awareness of flood risk and PLFRA measures among residents of flood-prone areas (Attems et al. 2020). However, the effect remains limited due to, for instance, top-down and one-way communication methods, use of expert knowledge, and a disconnect with the needs of the target audience (i.e., residents) (Rollason et al. 2018; Ping et al. 2016). In this study, the target audience formed the starting point, as we analyzed their perspectives on strategies of flood risk communication and their preferences for it. The results show four significantly different sets of preferences for flood risk communication. This led us to the conclusion that generalized flood risk communication strategies will most likely fail to meet the intended objectives for all residents, since they will not be able to meet all (contradicting) preferences in one approach (Snel et al. 2019). Through the use of the Q-methodology, strategies can be tailored to the specific preferences of a subgroup, for example, face-to-face contact or online information, desired level of detail, preference for flood maps, or public authorities as sole information-providers. Overall, flood probabilities are unwanted as a means to communicate flood risk. Moreover, the importance of cultural and individual factors was examined to demonstrate potential determinants for the residents' distinctly different perspectives on flood risk communication. Three potentially determining factors were identified: country of residence, flood experience, and responsibility division. The cross-country analysis allowed us to gain insight into the role that such factors play. Responsibility division is emphasized as a reasonable determiner for communication preferences, as this study highlights that residents perceive in varying manners how responsibilities between public authorities and themselves are divided. Accordingly, both in research and policy the plurality of residents' communication preferences and their division of responsibility should be taken into account when analyzing and designing flood risk communication strategies.

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Note

1. Large-scale flood events are, for instance, 2013–2014: Southeast and coastal flooding on East Coast; 2015–2016: Cumbria and Yorkshire (Environment Agency 2020); and 2023: Storms Babet and Ciaran caused over 2,000 properties to flood (House of Commons 2024).

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