FLOOD PREPAREDNESS

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THOUGHTS, FEELINGS AND INTENTIONS OF THE DUTCH PUBLIC

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ABSTRACT

Background, objective, and methods

Despite the high levels of flood protection in the Netherlands, absolute safety is not guaranteed. Preparing Dutch society for potential flood disasters, including the preparedness of individual citizens, is one of the great challenges in future flood risk management. This thesis is aimed at increasing the understanding of citizens' intentions in flood preparation. Knowledge of the determinants of citizens' behavioural intentions is indispensable for developing well-founded, effective risk communication that is aimed at facilitating citizens' flood preparedness decisions.

To study those behavioural intentions, we have adopted the Protective Action Decision Model (PADM, Lindell & Perry, 2000, 2004) which provides a social-psychological perspective on how people decide whether or not to prepare for disasters. This thesis contains four studies. These studies draw from the data that have been collected in three questionnaire surveys that were performed in flood risk areas along the Dutch coast, branches of the rivers Rhine and Meuse, and Lake Marken.

Main findings

From the responses of 3,559 Dutch citizens it is clear that few citizens intend to prepare for floods in the near future. However, intentions of adopting flood emergency preparations (e.g., knowing evacuation routes) are higher than intentions of adopting damage mitigation actions (e.g., buying sand bags). Of course, the key question is: why are the intentions of the public in flood preparedness generally low? To explain these preparedness intentions, this research focuses on three mechanisms: 1) citizens' perceptions of flooding risk, 2) their perceptions of responsibility in flood preparedness, and 3) their perceptions of flood preparations. Insight in these perceptions is essential for the improvement of flood risk communications.

First, the current high level of flood protection and the absence of any large floods in the Netherlands, as well as the communication efforts that have stressed the strength of the Dutch flood defences over the past 60 years, have turned the possibility of potential flood disasters into a blind spot. The public greatly trusts in the authorities' abilities to build and maintain the collective flood defences. Only a minority (13%) of all 3,559 respondents regards flooding as a likely event within the next ten years. In addition, people experience little dread (fear-related feelings) when considering their exposure to a flood risk. Together these variables explain up to 26% of the variance in citizens' flood preparedness intentions (see Chapter 2). Although 67% of all 3,559 respondents believe they will suffer large consequences if flooding were to occur in their dike ring, their perceptions of flood consequences play an inferior role in their flood preparedness decisions.

Second, 75% of the public regards the government as mainly responsible for potential flood damage to their possessions (see Chapters 3 and 5). Remarkably, however, a majority of the people (about 68%) accept a personal responsibility in preparing for flood emergency situations, such as evacuation. This is an important finding because it indicates that large parts of the population are open to the suggestion that they should undertake some personal action to prepare for a flood disaster. However, in this research perceived responsibility was uncorrelated with citizens' behavioural intentions toward taking flood preparations. Possibly, Dutch citizens regard collective flood protection as a 'moral obligation' of the government, reflecting moral intuitions about right and wrong. Moral intuitions are often unrelated to one's own behavioural context. Alternatively, the extent to which people accept responsibility may also be related to whether they perceive opportunities for taking action personally ('actionable responsibility'). Citizens who perceive little opportunities to prepare for floods may decline a personal responsibility in flood preparedness (defensive attribution).

Third, the most influential determinant of the intentions of the public to prepare for floods is the extent to which they perceive that flood preparations increase their own and their family's safety in the case of flooding. In addition, people are more likely to consider flood preparations that are also effective in protecting their property from flood damage, or when flood preparations are regarded as useful for other purposes. Together, these three 'efficacy attributes' explain between 32% and 41% in people's intentions of taking various flood preparations. However, few flood preparations are regarded as effective for coping with a flood's consequences. Clearly, having emergency information concerning flood consequences, such as expected flood depths, evacuation routes, and safe/high places in the neighbourhood, is regarded as the most effective flood preparation. Still, only 30% of the citizens intend to search for such information in the near future. Psychological theory also predicts that people's behavioural intentions may be lowered if people perceive themselves as having insufficient resources (such as money, time, knowledge/skills, and cooperation from other persons) to take preparations. However, our findings failed to support that perceived resources requirements are correlated with behavioural intentions (see Chapter 4).

Implications for performing risk communication

1 People will only prepare for floods, if they perceive that flood preparedness is personally relevant. It is therefore most important that risk communication is tailored to the local needs of the people at risk. In addition, people's flood preparedness decisions should be regarded as the ultimate outcome of a process that consists of several stages (e.g., as conceptualised in the PADM; see the Introduction of this thesis). Current risk communication practice follows a generic approach for different types of risk and fails to address each of the decision stages properly.

2 Stimulating flood awareness is imperative. Risk communication should emphasize, much more than in current practice, that flooding is and remains a possibility.

3 Citizens are unfamiliar with having a personal responsibility in flood preparedness. Risk communication messages should explain that flood preparedness requires citizen participation. To establish a protection motivation, risk communication should use a combination of fear appeal, information about local flood consequences, and locally effective flood preparations that require few individual resources.

- a. Communication messages should at least explain that flood risk management authorities will keep working to maintain flood safety, but that, in addition to flood prevention, there will also be investments in better disaster preparedness that will require citizen participation.
- b. Although citizens generally expect large flood consequences, thinking about floods arouses little fear in people. Some emotional reaction when thinking of floods is instrumental in catalysing motivation toward preparing for floods. Risk communication should not avoid fear appeal if its potential side effects can be minimised.
- c. If communications arouse fear but fail to recommend multiple protective actions that are perceived as effective, people may become disappointed and deny their personal responsibility. Fear-arousing messages should be developed such that they motivate people to reduce their emotional reaction by taking locally effective flood preparations.
- d. Citizens will only take flood preparations if they perceive those preparations as effective means to deal with the local consequences of floods. People are most interested in flood preparations that increase their safety during evacuation and floods, but largely decline to take responsibility for flood damage.
- e. When flood preparations are perceived as requiring many resources individuals are likely to postpone their decisions. It would be wise to study how information about flood risk and flood preparedness (e.g., maps showing flood depths and evacuation routes) can be designed, such that it is easy to comprehend.

4 The majority of Dutch citizens hold a negative attitude towards the introduction of a private flood insurance arrangement. If the government decides to introduce flood insurance, but does not reckon with the mechanisms that involve how people perceive the division of responsibilities in flood risk management, they may do so at the expense of losing credibility.

Implications for further research

1 The results of Chapter 2 indicated that people associated their prior flood hazard experiences with negative (e.g., feelings of fear and uncertainty) and positive emotions (e.g., feelings of solidarity and unity). The negative emotions correlated with higher levels of self-reported fear when considering floods, while positive emotions correlated with lower self-reported fear. An important extension of these findings would be to investigate how risk communication can be employed to simulate the vividness of local flood consequences resulting in affective reactions that create a sense of urgency for self-protection against floods (fear-appeal).

2 Currently there is a great lack of knowledge about the true efficacy of flood preparedness actions. There are complex interdependencies between collective disaster response plans and people's individual opportunities to prepare for flood disasters. This has great implications for the content of both risk and crisis communications. Research on the true efficacy of flood preparations should be conducted.

3 Flood risk communication currently recommends the same flood preparations (e.g., an emergency kit) for different populations in different flood risk areas. This method fails to meet with people's local needs in the case of an imminent flood disaster and is unlikely to increase flood preparedness behaviour. The causal effects of communication messages should be tested in a laboratory setting. Ultimately, these messages should be tested in the field, taking into account the differences between flood risk areas and the implications of these differences for individual preparedness opportunities.

SAMENVATTING

Achtergrond, doelstelling, en methoden

Ondanks de hoge beschermingsniveaus van waterkeringen, kan de absolute veiligheid tegen overstromingen in Nederland niet worden gegarandeerd. Het voorbereiden van de maatschappij op mogelijke overstromingsrampen, inclusief de voorbereiding van individuele burgers, is één van de grote uitdagingen in het overstromingenbeleid van de toekomst. Dit proefschrift heeft tot doel om onze kennis te vergroten ten aanzien van de intenties van burgers om zich voor te bereiden op overstromingen. Kennis van de determinanten van deze gedragsintenties is onmisbaar bij het opzetten van goed gefundeerde, effectieve risicocommunicatie die zich richt op het faciliteren van de voorbereidingsbeslissingen die mensen nemen.

Gedragsintenties zijn onderzocht door toepassing van het Protective Action Decision Model (Lindell & Perry, 2000, 2004). Dit model biedt een sociaal-psychologisch perspectief op de manier waarop mensen besluiten zich al dan niet voor te bereiden op rampen. Dit proefschrift bevat vier studies. Deze studies steunen op de onderzoeksdata die zijn verzameld in drie vragenlijstensurveys die zijn uitgevoerd in dijkringgebieden langs de Nederlandse kust, in het rivierengebied, en langs het Markermeer.

Voornaamste bevindingen

Uit de antwoorden van 3.559 Nederlanders is duidelijk geworden dat slechts een enkeling van plan is zich in de nabije toekomst op overstromingen voor te bereiden. Echter, mensen zijn in sterkere mate geneigd om voorbereidingen te treffen gericht op noodsituaties (bijvoorbeeld, het kennen van evacuatieroutes) dan om schadebeperkende maatregelen te nemen (bijvoorbeeld, zandzakken kopen). Uiteraard, de hamvraag is: waarom zijn de voorbereidingsintenties onder het Nederlandse publiek over het algemeen laag? Om deze gedragsintenties te kunnen verklaren, richt dit onderzoek zich op drie mechanismen: 1) percepties van het risico op overstromingen, 2) percepties ten aanzien van de eigen verantwoordelijk in het voorbereiden op overstromingen, en 3) percepties van mogelijke voorbereidingsmaatregelen.

Ten eerste, het huidige hoge beschermingsniveau en de afwezigheid van grote overstromingen in Nederland, alsmede de communicatie inspanningen die bovenal de sterkte van de waterkeringen hebben benadrukt in de voorbije 60 jaar, hebben ervoor gezorgd dat de mogelijkheid op overstromingsrampen een blinde vlek is geworden. De bevolking heeft een groot vertrouwen in de kwaliteiten van de waterbeheerders om waterkeringen te bouwen en te onderhouden. Slechts een minderheid (13%) van alle 3.559 respondenten acht een overstroming in de komende 10 jaar als een waarschijnlijke gebeurtenis. Bovendien, mensen ervaren weinig angstgerelateerde gevoelens wanneer zij denken aan hun blootstelling aan het risico op overstromingen. Samen verklaren deze variabelen tot 26% van variantie in de (lage) gedragsintentie (zie Hoofdstuk 2).

Hoewel 67% van alle 3.559 respondenten gelooft dat zij zijn blootgesteld aan grote gevolgen in geval van een overstroming, speelt deze perceptie een ondergeschikte rol in het besluit zich al dan niet voor te bereiden.

Ten tweede, 75% van het publiek vindt dat de overheid hoofdzakelijk verantwoordelijk is voor schade aan hun bezittingen als gevolg van overstromingen (zie de Hoofdstukken 3 en 5). Het is opmerkelijk echter, dat een meerderheid (ongeveer 68%) de verantwoordelijkheid accepteert om zich persoonlijk voor te bereiden op mogelijke noodsituaties, zoals evacuaties. Dit is van belang omdat het aangeeft dat een groot deel van de bevolking open staat voor de suggestie dat men zelf actie zal moeten nemen om zich voor te bereiden op overstromingen. Echter, het gepercipieerde verantwoordelijkheidsgevoel correleert in dit onderzoek niet met de gedragsintentie om zich voor te bereiden op overstromingen. Een mogelijke verklaring is dat Nederlanders de collectieve bescherming tegen overstromingen als de morele plicht van de overheid zien, een overweging die te maken heeft met morele intuïties als 'goed' en 'fout'. Morele intuïties zijn vaak niet gerelateerd aan de eigen gedragscontext. Anderzijds, de mate waarin iemand verantwoordelijkheid accepteert kan eveneens te maken hebben met de vraag of iemand mogelijkheden ziet om zelf actie te ondernemen ('actie verantwoordelijkheid'). Indien weinig mogelijkheden worden gezien om zich voor te bereiden op overstromingen, is de kans groot dat deze verantwoordelijkheid niet wordt geaccepteerd (defensieve attributie).

Ten derde, de meest invloedrijke determinant van de gedragsintentie is de mate waarin men het idee heeft dat voorbereidingsmaatregelen ook daadwerkelijk effectief zijn om de eigen veiligheid en die van het gezin te vergroten, in het geval van een overstroming. Daarnaast zijn mensen sterker geneigd om voorbereidingen te treffen wanneer die ook de mogelijkheid bieden om hun bezitingen te beschermen, of wanneer voorbereidingen als nuttig worden ervaren voor andere situaties dan overstromingen. Deze drie 'effectiviteits-attributen' verklaren samen tussen de 32% en 41% van de variantie in de gedragsintentie. Echter, om zich te wapenen tegen de gepercipieerde gevolgen van overstromingen, acht men weinig voorbereidingsmaatregelen echt effectief. Het is zeer duidelijk dat het hebben van informatie over de gevolgen van een overstroming, zoals het kennen van mogelijke waterdiepten, evacuatieroutes, en mogelijke veilige vluchtplaatsen in de eigen buurt/regio, als de meest effectieve vorm van voorbereiden wordt gezien. Toch geeft slechts 30% van de mensen aan dat zij in de nabije toekomst zelf op zoek zal gaan naar dergelijke informatie.
De psychologische theorie voorspelt eveneens dat gedragsintenties kunnen inzakken wanneer mensen de indruk hebben dat zij over onvoldoende middelen (zoals geld, tijd, kennis en vaardigheden, of hulp van anderen) beschikken om voorbereidingen te treffen. Echter, de onderzoeksresultaten bieden geen duidelijke ondersteuning voor een verband tussen percepties van de benodigde middelen en de gedragsintentie (zie Hoofdstuk 4).

Implicaties voor risicocommunicatie

1 Mensen zullen alleen overwegen zich op overstromingen voor te bereiden, wanneer ze daarvan zelf de relevantie inzien. Het is daarom van het grootste belang dat de communicatie wordt afgestemd op de lokale behoeften van mensen die staan blootgesteld aan overstromingsrisico's. Daarnaast, het besluit van mensen om zich voor te bereiden op overstromingen moet worden gezien als de ultieme uitkomst van een proces dat bestaat uit meerdere stappen (bijvoorbeeld, zoals onderkend wordt in het PADM model; zie de Introductie van dit proefschrift). De huidige manier van communiceren volgt een generieke aanpak voor verschillende risico's en slaagt er niet in om deze stappen in de besluitvorming van mensen op de juiste wijze te adresseren.

2 Het stimuleren van het bewustzijn ten aanzien van overstromingsrisico's is hoogst noodzakelijk. Risicocommunicatie moet veel duidelijker, dan nu wordt gedaan, de mogelijkheid op overstromingen benadrukken.

3 Nederlanders zijn niet vertrouwd met het hebben van een eigen verantwoordelijkheid in het voorbereiden op overstromingen. Om mensen te motiveren tot het nemen van voorbereidende maatregelen, dient risicocommunicatie gebruik te maken van 'fear-appeal', gecombineerd met informatie over de lokale gevolgen van overstromingen en aanbevelingen ten aanzien van lokaal effectieve voorbereidingshandelingen die weinig eisen stellen aan de middelen die mensen tot hun beschikking hebben.

   a. In de communicatie moet duidelijk gemaakt worden dat de waterbeheerders zich onverminderd zullen blijven inspannen voor de preventie van overstromingen, maar dat er in aanvulling daarop zal worden gewerkt aan de rampenbestrijding waarbij de participatie van individuele burgers van groot belang is.
   b. Hoewel mensen over het algemeen denken dat de gevolgen van een overstroming voor henzelf groot zullen zijn, blijven mensen onbevreesd. Het opwekken van een emotionele respons bij de gedachte aan overstromingen is instrumenteel in het katalyseren van het voorbereidingsproces. Risicocommunicatie zou het gebruik van 'angstaanjagende' boodschappen niet uit de weg moeten gaan als de nadelige bijeffecten daarvan kunnen worden geminimaliseerd.
   c. Indien de communicatie er in slaagt om angstgerelateerde emoties op te wekken, maar er niet in slaagt voorbereidingshandelingen aan te bevelen die als effectief worden ervaren, dan zullen mensen mogelijk teleurgesteld raken en hun verantwoordelijk in het voorbereiden op overstromingen afwijzen. De communicatie moet zodanig worden vormgegeven dat de angstaanjagende boodschap ervoor zorgt dat mensen gemotiveerd raken om hun angstgevoelens teniet te doen door lokaal effectieve voorbereidingen te treffen.

d. Mensen zullen alleen voorbereidingen treffen wanneer zij de indruk hebben dat die voorbereidingen hen helpen in het geval van een overstroming. Mensen zijn daarbij het meest geïnteresseerd in voorbereidingen die de veiligheid van henzelf en hun familie vergroot. Mensen weigeren verantwoordelijk te zijn voor schade als gevolg van overstromingen.
e. Wanneer mensen de indruk hebben dat voorbereidingen veel eisen van de middelen die zij tot hun beschikking hebben, zullen ze geneigd zijn hun besluit uit te stellen. Er moet onderzoek worden gedaan naar de wijze waarop informatie vormgegeven kan worden, vooral wanneer het gaat om risicokaarten, zodat zij voor leken (burgers) eenvoudig te begrijpen zijn.

4 De meerderheid van het Nederlandse publiek is tegen de invoering van een particuliere verzekering voor schade als gevolg van overstromingen. Indien de overheid besluit tot de invoering van een dergelijke verzekering, maar geen rekening houdt met de wijze waarop mensen aankijken tegen de verantwoordelijkheidsverdeling tussen burger en overheid op het terrein van overstromingsrisico's, dan kan dat ten koste gaan van het vertrouwen dat de bevolking stelt in de overheid.

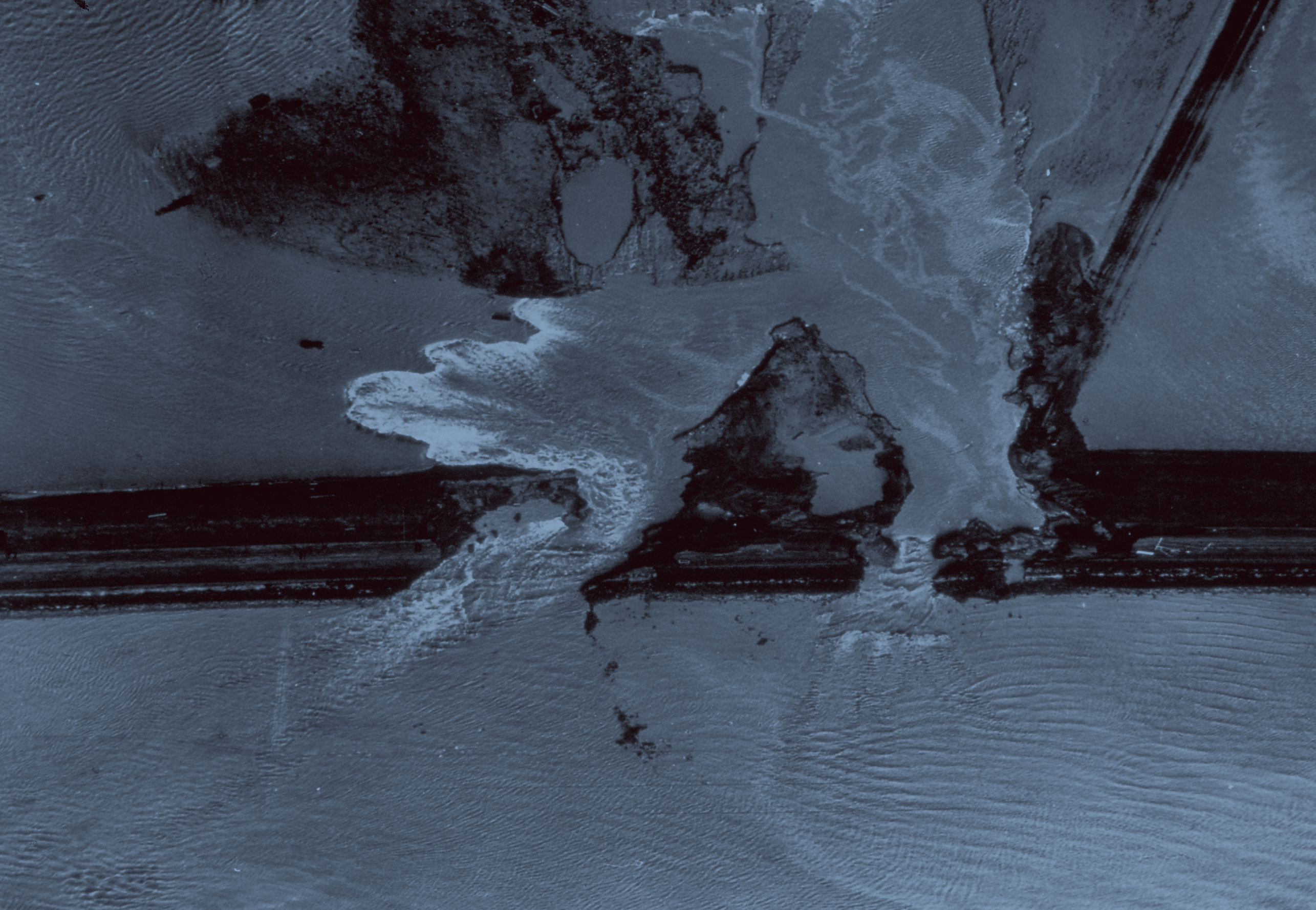
Implicaties voor vervolgonderzoek

1 De resultaten van Hoofdstuk 2 geven aan dat mensen hun overstromingservaringen associëren met zowel negatieve emoties (gevoelens van angst en onzekerheid) als positieve emoties (gevoelens van eenheid en solidariteit). Negatieve emoties hangen samen met een hogere mate van zelfgerapporteerde angst wanneer men denkt aan overstromingen, terwijl positieve emoties vaker samenhangen met minder zelfgerapporteerde angst. Een belangwekkende vervolgvraag is hoe risicocommunicatie op levendige wijze de lokale gevolgen van overstromingen kan simuleren zodanig dat zij resulteert in een emotionele respons welke leidt tot een gevoel van urgentie, en daarmee mensen motiveert zich voor te bereiden op overstromingen (fear-appeal).

2 Er is momenteel een groot gebrek aan kennis met betrekking tot de werkelijke effectiviteit van individuele voorbereidingsmaatregelen. Er bestaan complexe afhankelijkheden tussen collectieve rampenbestrijdingsplannen en de mogelijkheden van individuen om zich op overstromingen voor te bereiden. Dit heeft grote implicaties voor de inhoud van risico- en crisiscommunicatie. Onderzoek naar de werkelijke effectiviteit van voorbereidingsmaatregelen is noodzakelijk.

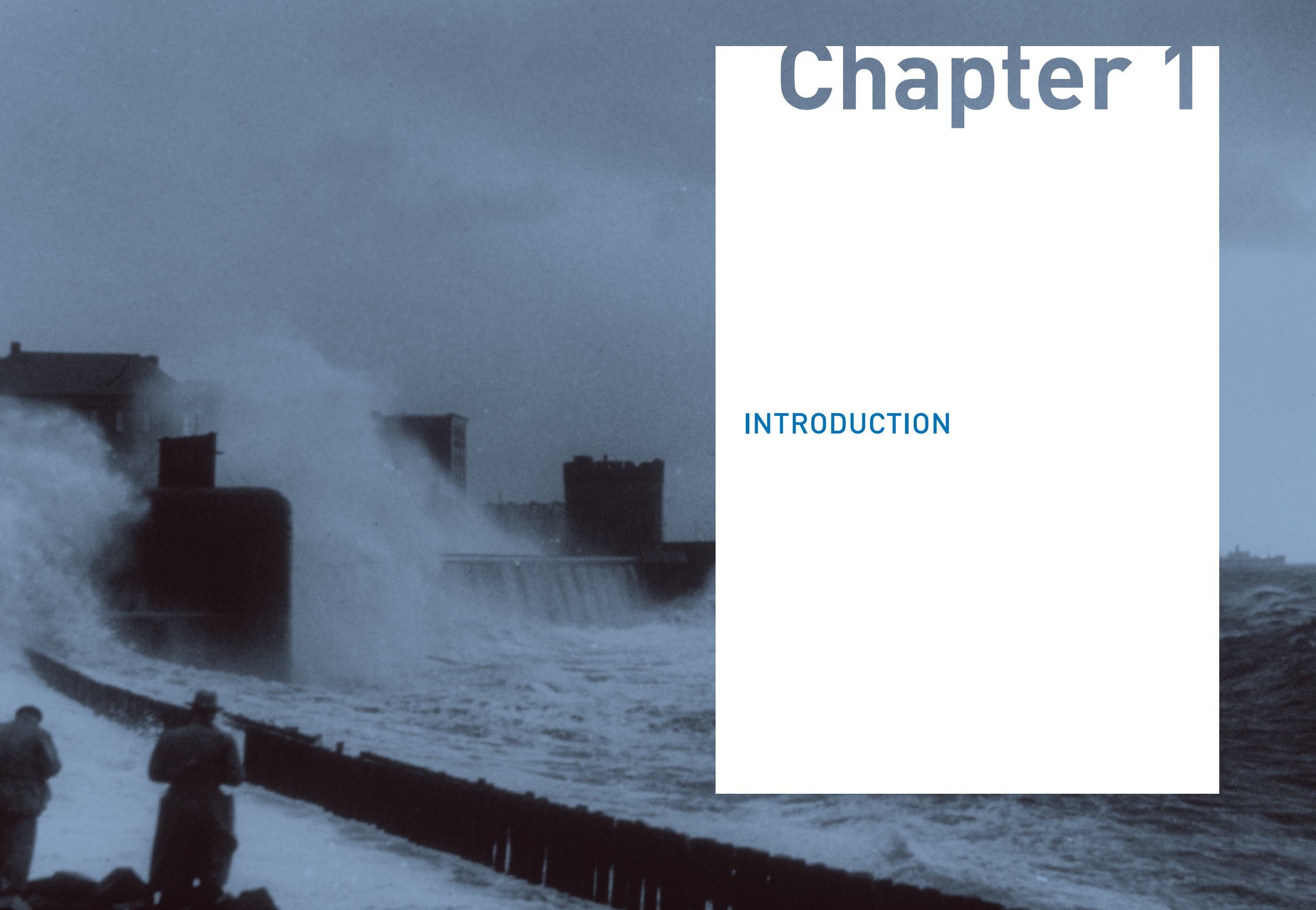
3 Risicocommunicatie op het terrein van overstromingen doet momenteel dezelfde aanbevelingen (bijvoorbeeld, het noodpakket) voor verschillende doelgroepen in verschillende risicogebieden.

Deze wijze van communiceren schiet tekort omdat zij geen rekening houdt met de lokale behoeften, en het is daarmee onwaarschijnlijk dat zij enig effect sorteert. Om te komen tot goed gefundeerde, effectieve communicatie, dient onderzoek gedaan te worden naar de causale effecten van communicatieboodschappen in een zogenaamde experimentele laboratorium setting. Uiteindelijk dient de communicatie te worden getest in het veld, waarbij expliciet rekening gehouden dient te worden met de lokale verschillen tussen gebieden en de implicaties daarvan voor de individuele mogelijkheden van mensen om zich voor te bereiden op overstromingen.



BRIEF CONTENTS

DETAILED CONTENTS



Chapter 1

INTRODUCTION

INTRODUCTION

Worldwide, 634 million people –one-tenth of the global population– live in coastal areas that lie within ten metres above sea level (McGranahan, Balk, & Anderson, 2007). Particularly the densely populated mega deltas in Asia (e.g., the Ganges-Brahmaputra delta in Bangladesh), where a significant proportion of the population lives below social and economic poverty thresholds, face increasing climate change-related impacts including a rising sea level and increasing risks of flooding from storm surges and high river discharges. As those countries have limited adaptive capacities, the development and implementation of successful adaptation strategies is both challenging and urgent (Cruz, Harasawa et al., 2007; Nicholls, Wong et al., 2007).

The Netherlands is situated on the delta of three major European rivers (the Rhine, the Meuse, and the Scheldt) and large parts of the country are at risk of flooding. However, compared to low income countries such as Bangladesh, the (wealthy) Dutch are at an incomparable advantageous position to deal with the effects of climate change. Nevertheless, the projected effects of climate change have called for and encouraged debate and research on new concepts in flood risk management. This thesis deals with an underexposed, long-neglected issue in Dutch flood risk management: how citizens perceive the risk of flooding and their preparedness for potential flood disasters. The remainder of this introduction will provide background for this study.

1.1
A BRIEF OVERVIEW OF DUTCH FLOOD RISK MANAGEMENT

Early flood risk management

Flood risk management in the Netherlands has evolved over more than 1,000 years. Their location in one of Europe's major river deltas put the Dutch in a favourable international trading position, which greatly contributed (and continues to contribute) to their prosperity. However, living in a major river delta has also marked Dutch history with numerous devastating floods, making water both a friend and foe.

The early inhabitants of the Netherlands, from around 500 BC until 1250 AD, protected themselves against flooding by constructing artificial hills (terps) on which they built their homes and farmsteads. Accelerated population growth between 800 and 1250 AD stimulated the creation of farmland, resulting in large-scale peat excavations in the coastal areas. As a consequence, much of the land that was elevated just above mean sea level then became dangerously located below sea level. To protect their villages and cultivated farmlands from floods, local village authorities coordinated flood protection. Landowners were made responsible for maintaining separate dike sections, and maintenance was supervised by the local village authority, called a 'polder board' or 'water board'.

Despite this high level of local organisation, the number of floods increased dramatically between 1250 AD and 1600 AD. Among the most notorious is the All Saints' Day flood of 1570, which ended the lives of many thousands of people and caused extensive damage (Van de Ven, 2003).

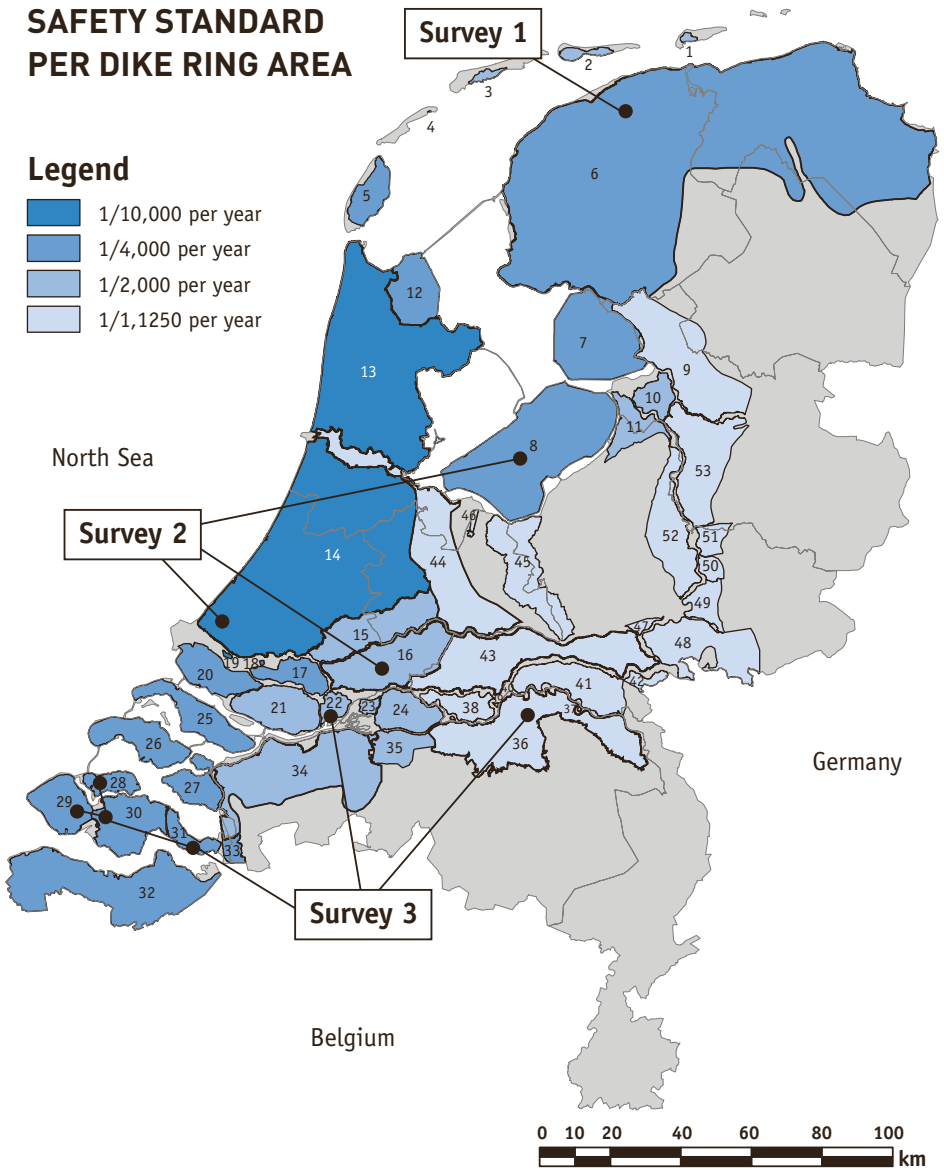
People accepted regular flooding as an act of nature, which could never be fully tamed, or as the will of God. However, by unifying themselves on polder/water boards, they allowed themselves to live below sea-level. As each water board managed its own polder, the number of water boards substantially increased during the process of continuous, stepwise land reclamation. This flood risk management method remained almost completely intact until the first half of the 20th century. At that time, there were about 3000 water boards, but hardly any overall supervision of dike maintenance. During World War II (1940-45), dike maintenance was interrupted, and dike quality quickly deteriorated. After the war, the government's main priority was to rebuild the country, which left many of the weak dikes insufficiently repaired. Eventually, this situation resulted in dangerous conditions that would allow for a major flood in 1953 (Gerritsen, 2005; Slager, 1992).

The foundations of current flood protection

On the night of 31 January to 1 February 1953 high springtides were amplified by a severe north-western storm. Many dikes in the south-western part of the country were breached, over 1800 people drowned, thousands of cattle were lost, and 150,000 ha of land was flooded (Gerritsen, 2005). In retrospect, the disaster served as the turning point in Dutch flood risk management. Guided by the deeply held conviction that this type of disaster should never happen again, the Dutch government installed what was called the Deltacommittee, which was assigned to improve flood safety. In 1958, the far-reaching Delta Act (1958) was adopted in parliament and laid the legal foundation for the implementation of the Delta Works, a comprehensive plan detailing the construction of several large dams and barriers and the reinforcement of many dikes and dunes. For the first time, standards for flood protection were expressed in exceeding frequencies of high water levels. In short, based on a cost-benefit analysis, the Deltacommittee (1960) recommended that the most economically valuable part of the country (Central Holland) be protected by flood defences as required to resist water levels that have an annual probability of 1/10,000 (0.01 percent probability per year). As a consequence, areas that were less vulnerable in terms of flood damage were assigned a lower protection standard (Ten Brinke & Bannink, 2004). The protected areas are referred to as 'dike rings'. The flood defences that constitute a dike ring are referred to as the 'primary flood defences'. As shown in Figure 1.1, the primary flood defences (e.g., dikes, dunes, barriers) are the flood defences along the major rivers and around the lake area in the heart of the country, as well as the sea defences along the Dutch coast.

Figure 1.1

Safety standards per dike ring area and survey area locations



Survey 1: Municipalities of Ferwerderadiel and Dongeradeel (dike ring 6)
Survey 2: Delfland (dike ring 14), Alblasserwaard en Vijfheerenlanden (dike ring 16), Flevoland (dike ring 8)
Survey 3: Walcheren, Noord- en Zuid-Beveland (dike rings 28-31), Eiland van Dordrecht (dike ring 22), Land van Heusden / de Maaskant (dike ring 36)

Currently, flood protection standards are legally anchored in the Flood Defence Act (1995)[1], which also stipulates that all primary flood defences are to be reviewed quinquennially against their statutory design levels. Notably, the latest review showed that 24% of the primary dikes and dunes did not meet the demanded protection level, while another 32% could not be evaluated mainly due to a lack of information (Transport and Water Management Inspectorate, 2006). Therefore, additional funding has been raised under the High Water Protection Programme, which coordinates the improvement projects and aims for all primary flood defences to meet their safety standards by 2015. Still, flooding is regarded as unlikely, but not impossible. Moreover, if flooding were to occur, economic losses could easily amount to tens of billions of euros, with the darkest scenarios predicting up to several thousand victims (Ministry of Transport, 2005). In the Netherlands, flood risk is a true low probability but high consequence risk.

Future challenges

A recurring question in flood risk management is 'how safe is safe enough?' (Jongejan, 2008). The current safety standards were derived from a cost/benefit analysis based on the social and economical period of the 1960s. Since that time, much has changed. For instance, the Dutch population has grown considerably, as has the economic value at risk. Currently, the dike ring areas together account for about 65% of the Dutch GDP and are inhabited by about 60% of the population (about nine million people) (Ten Brinke & Bannink, 2004). Moreover, the predicted effects of global warming, including a sea level rise, increasing river discharges, and higher precipitation amounts, indicate the need for planning (Royal Netherlands Meteorological Institute, 2006). In addition to the traditional goal of raising dikes and dunes, alternative strategies are more often sought in making space for water. However, the implementation of these new strategies has often met with public resistance, for instance because of concerns about impacts on the quality of the living environment (Roth & Warner, 2007; Wolsink, 2006). Public participation and two-way communication between the water management authorities and local stakeholders are necessary for successful adaptation to global warming effects (Deltacommissie, 2008).

In spite of the engineering that has been performed to reduce the probability of floods, absolute safety is not guaranteed. In December 1993 and February 1995, the Netherlands narrowly escaped major floods in the river area. Because high river discharges can be monitored upstream, water levels and their timing are well predictable several days ahead. Therefore, in 1995, about 250,000 people and all livestock were safely evacuated from their respective areas. Along the Dutch coast, warning times are much less generous, likely amounting to less than one day (Barendregt, Van Noortwijk, Van der Doef, & Holterman, 2005). Moreover, floods along the Dutch coast are accompanied by hurricane-force winds, making evacuation from the densely populated areas extremely difficult, if not impossible. Recently, Hurricane Katrina (2005) and the subsequent flooding of New Orleans (U.S.A.) brought about awareness among the Dutch authorities that Dutch society is underprepared for such large-scale floods. Therefore, in 2006, the Taskforce Management Overstromingen (TMO, Flood Management Taskforce) was assigned to improve the level of flood preparedness among regional and national authorities involved in public crisis management (Ministry of Transport, Public Works and Water Management, 2006). In its final report, TMO (2009) concluded that, although its efforts had been fruitful, much work still needed to be done.

Flood awareness and preparedness

A major challenge of future disaster management will be to increase flood awareness and preparedness among individual citizens. This new challenge has been adopted by the National Water Plan (Ministry of Transport, Public Works and Water Management, 2008), which has formulated national water policy for the period 2009-2015. Unfortunately, it is well known from the international literature that few citizens are predisposed to prepare for natural hazards. Risk communication is therefore an important instrument that is often used to improve awareness and disaster preparedness (Terpstra, Lindell, & Gutteling, 2009).

In September 2006, the Dutch Ministry of the Interior and Kingdom Relations launched the new 'Denk Vooruit' (Think Ahead) campaign, which aims to increase citizens' risk awareness and inform them about ways to prepare for a number of potential disasters, including floods. The campaign intensifies periodically during one-month periods using radio, television, and the internet to transmit risk communication messages. Although evaluations show that a fair number of people receive these messages, little effect is seen after the campaigns. In the November 2008 campaign, more than € 700,000 was spent, but citizens' low levels of disaster awareness had not changed, and only minor increases were seen in the adoption of some hazard adjustments (e.g., ensuring that one had a flashlight available), while other hazard adjustments showed slightly lower rates of adoption (e.g., possession of battery-powered radios) (DPC, Intomart & Daphne, 2009).

Public authorities could improve their campaigns by considering how people perceive risks and the hazard adjustments that help them cope with emergency situations. As shown in Table 1.1, the surveys performed in our research indicate that Dutch citizens worry less about the risk of being flooded than they do about many other potential hazards such as global warming, terrorism, or criminality. Moreover, although many people have a battery-powered radio (about 60%), a flashlight (95%), a first-aid kit (67%), or food and water supplies for three days (70%), nine out of ten people stated that they have done nothing in particular to prepare themselves for potential major riverine or sea floods in their area. However, these measurements alone are insufficient to

[1] The Flood Defence Act (1995) will be integrated into the new Water Act (2009), which has been adopted in parliament and is expected to take effect in late 2009.

explain why Dutch citizens worry so little about flood risk. Application of social-psychological theory to investigate human behaviour may improve our understanding of the lack of flood-risk awareness among at-risk citizens. Until this thesis, such research had hardly been conducted in the Netherlands.

Table 1.1

Frequency (%) of worries about a number of potential hazards

Survey 1 (n = 658) [a]	(almost) never (1)	sometimes (2)	often (3)	mean rating (1-3)
1. Global warming	29	39	32	2.02
2. Precipitation nuisance	45	36	18	1.73
3. Economic recession	43	41	16	1.72
4. ***Major flooding in your area***	***57***	***28***	***14***	***1.57***
5. Flu epidemic	60	32	9	1.49
6. Nuclear mishap	75	18	6	1.31

Survey 2 (n = 1444)	(almost) never (1)	sometimes (2)	often (3)	mean rating (1-3)
1. Environmental degradation	8	52	40	2.32
2. Cost of living	18	41	42	2.24
3. Criminality/street safety	14	46	40	2.26
4. Conflict between groups in society	12	51	36	2.24
5. Global warming	21	50	29	2.08
6. Personal health	20	61	19	1.98
7. High precipitation	26	53	21	1.95
8. Terrorism	31	49	20	1.90
9. Industrial odour	33	49	18	1.85
10. Personal financial future	36	49	15	1.78
11. Chemical factory mishap	38	45	16	1.78
12. Traffic noise	41	41	18	1.77
13. ***Major flooding in your area***	***44***	***43***	***13***	***1.70***
14. Flu epidemic	52	42	6	1.55

Survey 3 (n = 1457)	(almost) never (1)	sometimes (2)	often (3)	mean rating (1-3)
1. Cost of living	18	48	34	2.16
2. Criminality/street safety	22	53	24	2.02
3. Global warming	25	54	21	1.95
4. Terrorism	41	48	11	1.71
5. Traffic noise	50	36	14	1.64
6. House fire	48	48	4	1.56
7. ***Major flooding in your area***	***59***	***35***	***6***	***1.47***
8. Flu epidemic	59	37	4	1.44

[a] Responses were collected using a five-point scale; data have been transformed to a three-point scale for reasons of comparison with surveys two and three.

1.2 RESEARCH OBJECTIVE

Risk communication could be a suitable means of achieving public policy goals related to flood preparedness in the Netherlands, as the ultimate purpose of risk communication is to inform, persuade, and consult in order to enhance knowledge, change attitudes and behaviour, and provide effective conditions for dialogue and conflict resolution (Renn, 1998). It should be emphasized that the term risk communication does not merely refer to communication about the characteristics of the risk (in this thesis: flood risk) –risk communication also refers to communications about the characteristics of the measures that people can take in order to cope with the risk (in this thesis: flood hazard adjustments or flood preparedness actions).

Objective

Through the application of social-psychological theory, this research aims to increase understanding of Dutch citizens' flood preparedness behaviour or, as is more likely, the lack thereof. As will be explained in more detail hereafter, we will focus on a number of mechanisms involving people's perceptions of risk, their perceptions of responsibility, and their perceptions of flood hazard adjustments. Insight in these perceptions is essential for the improvement of flood risk communications.

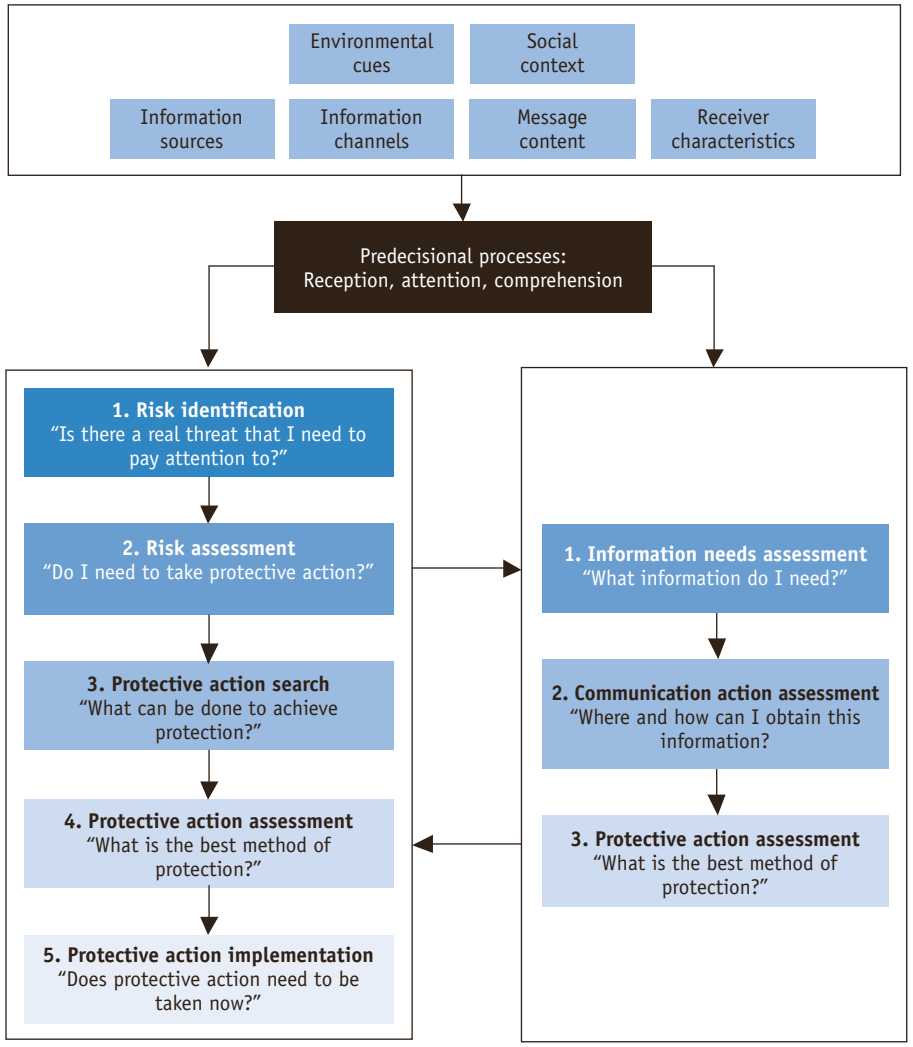
1.3 THEORETICAL PERSPECTIVE

The research presented herein was inspired by the Protective Action Decision Model (PADM). The PADM was first developed to explain people's protective action decisions in response to imminent disasters (Lindell & Perry, 1992), but it has recently been extended to account for people's long-term hazard adjustments (Lindell & Perry, 2000, 2004). An important feature of the PADM is that it integrates a variety of theoretical perspectives in order to link communicated information to people's self-protective behaviour. As such, it provides a comprehensive framework, but it shares common features with other attitude-behaviour theories, including the Theory of Reasoned Action (Fishbein & Ajzen, 1975), Protection Motivation Theory (Rogers, 1983), and Person-relative-to-Event Theory (Mulilis & Duval, 1995). Most of the results supporting the PADM have been obtained through the study of earthquake hazard adjustments among U.S.A. citizens. Therefore, the extent to which PADM is useful for studying flood preparedness among Dutch citizens is presently unknown.

Figure 1.2 depicts the PADM in the form of a flow chart. Each of the blocks in the flow chart represents a collection of variables that come into play at different times during the protective action decision-making process.

Figure 1.2

The Protective Action Decision Model (adopted from Lindell & Perry, 2004, p.47)



Generally, risk communication takes place in the absence of an immediate threat. Thus, the environment provides few cues that may disrupt people from their normal activities. That is, heavy storms that threaten the Dutch flood defences are rare by definition because of the high flood safety standards. Moreover, even if people are exposed to environmental cues, as would occur during a heavy storm, protective action decision-making will not take place unless people pay attention to and accurately interpret these environmental cues.
In the absence of an immediate threat, risk communication is more likely to initiate protective action decision-making. As with environmental cues, risk communication from authorities will not lead to protective action decision-making unless people receive, heed, and comprehend the socially transmitted risk information. Reception, attention, and comprehension are therefore important (but not sufficient) preconditions to the success of risk communication.
The PADM labels these three elements the 'pre-decisional processes'. Suppose a person who has 'successfully' received, noted, and comprehended a risk message (or an environmental cue) and thus engages in a process of protective action decision-making. The process by which a person decides whether or not to take action is conceptualised by the PADM as involving five successive steps (see steps one to five on the left-hand side in Figure 1.2). These steps are reflected in five questions that people typically ask themselves when proceeding through these stages: 1) Is there a real threat that I need to pay attention to? 2) Do I need to take protective action? 3) What can be done to achieve protection? 4) What is the best method of protection? and 5) Does protective action need to be taken now?

An important feature of these steps is that people's decisions to adopt protective actions first depend on their perceptions of the threat (steps one and two) and, subsequently, on their perceptions of the hazard adjustments (steps three to five). Only if people are convinced of the threat and perceive that protective action is required are they likely to adopt hazard adjustments. However, uncertainties at any point in the process may trigger information needs. Only if these uncertainties can be resolved by obtaining additional information is one likely to proceed. Denial of the threat or procrastination may be an equally or even more attractive behavioural strategy. In that case, people will fail to adopt hazard adjustments. Before turning to how the research was demarcated we need to explain some methodological choices.

1.4 METHODOLOGICAL CHOICES

Behavioural intentions

As we have illustrated, few citizens have adopted flood hazard adjustments. Therefore, this research focuses on citizens' behavioural intentions regarding the adoption of flood hazard adjustments in the near future. Intentions are assumed to capture the motivational factors that influence behaviour; they are indications of how hard people are willing to try or of how much effort they are planning to exert in order to effect the behavioural change (Ajzen, 1991, p.181). Behavioural intentions are generally regarded as the most proximal (and thus most suitable) predictor of behaviour; the stronger one's behavioural intentions are, the more likely one is to perform the intended behaviour.

Surveys

Because there has been little research on flood risk perception in the Netherlands, we have chosen to perform three questionnaire surveys to capture citizens' perceptions on a wide array of variables over a range of dike ring areas. The focus of this research is on quantitative rather than qualitative data, which has allowed for statistical testing of the mechanisms involved in the protective action decision-making process. As shown in Figure 1.2, this process involves several successive steps and, thus, temporal ordering. The cross-sectional data obtained in our field surveys cannot identify temporal order–i.e., if two variables are correlated, whether A caused B or vice versa (Lindell & Hwang, 2008, see also James, Mulaik, & Brett, 1982). Although hypotheses about causality have been carefully derived from the literature, additional research will be required to provide conclusive evidence in support of such hypotheses, for instance, by the application of longitudinal designs and laboratory experiments.

Study areas

This research focuses on the risk of flooding that is posed by the sea (North Sea, Wadden Sea), major rivers (Meuse and Rhine branches) and the centrally located lake area (Lake IJssel, Lake Marken). Thus, the focus is on populations that are protected by the primary flood defences –citizens who are located outside of the protected areas (e.g., in the river flood plains, on higher ground)– are excluded from this research. Moreover, we focus on a subset of the 53 dike rings present in the Netherlands. The subset of dike rings that is presented exemplifies many of the important features of the Dutch dike ring landscape. If perceptions of flood risk, responsibility, and flood hazard adjustments vary depending on dike ring features, they should be detectible in the presented subset. Figure 1.1 indicates the geographical areas (dike rings) at which these surveys were performed.

1.5 RESEARCH DEMARCATION

This research does not provide an empirical test of all variables within the PADM. Rather, we study those variables of the PADM that seem relevant predictors of flood preparedness intentions in the context of Dutch flood risk management. In addition, the focus is on the five decision stages on the left hand sight of Figure 1.2– so, we do not investigate the determinants of people's information seeking behaviour reflected in the three stages on its right hand side. Readers interested in topic of information seeking may read Ter Huurne (2008).

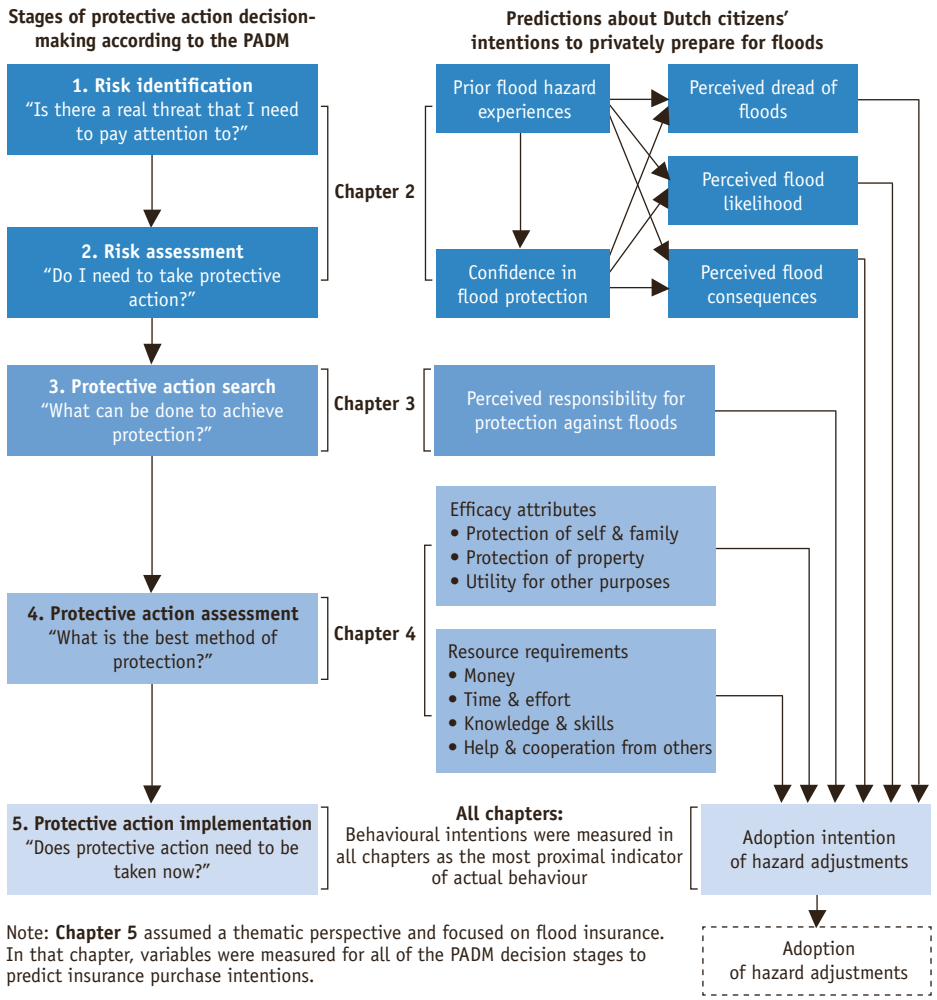
Figure 1.3 presents the variables under study and their expected causal relations, the chapters in which they are addressed, and the decision stages to which they are conceptually related. As shown, Chapter 2 studies citizens' perceptions of flood risk, Chapter 3 addresses their perceptions of responsibility in flood risk management, and Chapter 4 investigates their perceptions of flood hazard adjustments. Because the introduction of flood insurance is currently a matter of political and scientific debate in the Netherlands, Chapter 5 assumes a thematic perspective and focuses on people's attitudes towards flood insurance. Finally, Chapter 6 uses Figure 1.3 to discuss the research findings reported in the Chapters 2 to 5.

Chapter 2: Risk perceptions

Citizens' risk perceptions and their trust in public flood defences are central variables because they indicate the extent to which people perceive flood risk as a threat to themselves, their family, their belongings, and their environment. If risk perceptions are low, it is less likely that people will heed flood risk communication messages. Moreover, because flood protection is high, few Dutch citizens are likely to have had experience with floods. Still, citizens may have experienced environmental cues, such as high river discharges or mild storms, which could remind them of the risk of a flood. Such experiences may be important because attitudes based on direct experience –compared to vicarious experience as produced by socially transmitted risk communication– are more accessible within one's memory (Fazio & Zanna, 1981; Glassman & Albarracín, 2006; Regan & Fazio, 1977). In particular, personal hazard experience impacts people's protection motivation because it provides more vivid and detailed hazard information, more rapid recall of relevant information, greater personal involvement, and lower levels of uncertainty (Weinstein, 1989). In this process of recalling prior experiences, we explicitly focus on affective responses because there is increasing support for the hypothesis that emotions related to risk should be recognised and taken into account when performing risk communication. Positive and negative emotions have become associated with different phenomena through life experiences, creating an 'affective pool' of emotional images.

Finucane, Alhakami, Slovic, & Johnson (2000) suggest that people use an 'affect heuristic' summoned from this experientially developed pool when judging risk issues. Thus, Chapter 2 investigates how citizens' affective responses to their prior experiences and their levels of trust in the flood defences predict their risk perceptions and how these constructs relate to their intentions to adopt flood hazard adjustments in the future. The findings provide insight in the extent to which Dutch citizens have identified flood risk as a potential threat that requires their personal attention (stage 1, risk identification), and the extent to which they are motivated to prepare for floods (stage 2, risk assessment).

Figure 1.3 **Research model**



Note: **Chapter 5** assumed a thematic perspective and focused on flood insurance. In that chapter, variables were measured for all of the PADM decision stages to predict insurance purchase intentions.

Chapter 3: Perceived responsibility for flood protection

Citizens' perceived personal responsibility is an important construct in the context of Dutch flood risk management because, so far, Dutch citizens have only been required to contribute to flood protection passively. That is, citizens pay a compulsory tax to their local water board that takes care of the public flood defences on their behalf. Even if people receive, note, and comprehend flood risk communications, they may fail to adopt flood hazard adjustments privately if they regard the public authorities as solely responsible for their protection against floods. In that case, risk communication aiming to stimulate the adoption of private flood hazard adjustments may be ineffective, as has previously been found in relation to earthquake (Mulilis & Duval, 1995) and tornado preparedness (Mulilis & Duval, 1997) in the U.S.A. Lindell & Whitney (2000) reported that higher levels of perceived responsibility for self-protection against earthquakes correlated with higher adoption intentions of seismic hazard adjustments. However, the empirical base for this construct is small, and, according to Lindell & Perry (2004), the effects of responsibility may vary with the hazard agent. These authors have suggested that people may be more reluctant to accept responsibility for self-protection if hazards are unfamiliar and self-protection requires a substantial amount of their personal resources, such as their perceived self-efficacy for coping with a hazard's consequences. One may question to what extent Dutch citizens are familiar with flood risk. That is, due to the high level of flood protection and the minimal risk communication efforts over the past decades few citizens have direct or vicarious experiences with floods and flood hazard adjustments. Such unfamiliarity with flood risk may cause citizens to reject private responsibility for flood protection. Chapter 3 addresses this issue. The results have implications for the extent to which citizens are willing to take flood preparedness measures privately, in addition to what has been done by others (i.e., the authorities) to prevent floods (stage 3: protective action search).

Chapter 4: Perceptions of hazard adjustments

According to the PADM, people who perceive themselves as responsible for and feel motivated to adopt flood hazard adjustments will search for and evaluate potential hazard adjustments on the basis of two types of attributes: efficacy attributes and resource requirements. The efficacy attributes include how people assess a hazard adjustment's efficacy in protecting people, its efficacy in protecting property, and its utility for other purposes. In addition, whether people adopt hazard adjustments is also expected to depend on perceived resource requirements in terms of time and effort, money, knowledge and skills, and cooperation from other persons. Hazard adjustments that are high in efficacy and low in resources are expected to be the most attractive. However, most of the empirical evidence relating to these attributes relates to the adoption of seismic hazard adjustments (see Lindell & Perry, 2000, for a review).

In addition, few studies have assessed the validity of these attributes simultaneously (Lindell & Prater, 2002; Lindell & Whitney, 2000; Lindell, Arlikatti, & Prater, 2009). In the domain of flood hazards, there has only been one other European study (Grothmann & Reusswig, 2006) that has addressed citizens' flood hazard adjustment decisions. This study was unable to distinguish between the individual effects of flood hazard adjustment attributes. Chapter 4 tests the predictive validity of these attributes in addition to considering people's risk perceptions. We also assess whether citizens from different risk areas (a river risk area vs. a coastal risk area) have different preferences regarding hazard adjustments that would be plausible given the differences in the flood consequences between these areas. The findings provide insight in the fourth stage of protective action decision-making: what is the best method of protection (stage 4: protective action assessment)?

Chapter 5: Flood insurance

The final chapter assumes a thematic perspective and focuses on flood insurance. Worldwide, many countries have flood insurance arrangements. The Netherlands, however, lacks such arrangements. Although citizens are personally responsible for flood damages, past practices have shown that the government (i.e., the general taxpayer) often pays for flood damages through the 1998 Calamities Compensation Act (WTS). An insurance arrangement in the Netherlands is a matter of political and scientific debate. The design of a feasible arrangement for low-probability, high-consequence flood insurance is not easy because variation of financial damage in time is very high (compared with the high variation in space in the case of classical fire insurance for a house). The technical difficulties on the supply side of a potential flood insurance arrangement have been investigated. However, until now, issues relating to the demand side have scarcely been addressed. Such issues include whether risk area residents are willing to take out flood insurance when provided and the determinants of their intentions. In light of the topics discussed in the previous chapters, Chapter 5 tests the effects of prior flood experience, trust in flood protection, risk perceptions, perceived damage responsibility and perceptions about the perceived utility of flood insurance on citizens' intentions to take out flood insurance.

Chapter 6: Discussion

The final chapter of this thesis we will provide in integrated view on the empirical findings. In particular, we will summarize the results on citizens' behavioural intentions (stage 5: Does protective action need to be taken now?) and explain citizens' intentions by relating them back to the previous four decision stages. In addition, we address some methodological issues relating to how data were collected and analyzed. Together, these will form the basis for the recommendations regarding risk communication and further research.

1.6 THIS THESIS IN A NUTSHELL

As explained in the previous section, the chapters ahead are organized as follows:

Chapter 2 addresses people's emotions in relation to their past flood hazard experiences and their confidence in the flood defences. These two constructs are modelled as determinants of these individuals' risk perceptions and their flood preparedness intentions.

Chapter 3 focuses on the extent to which people regard themselves and the government as responsible for taking flood mitigation and emergency preparedness measures. It is expected that only when people perceive themselves as responsible for taking action will they engage in a process of protective action decision-making.

Chapter 4 evaluates how people perceive various flood hazard adjustments in terms of their perceived efficacy and their resource requirements. These attributes, together with perceived risk, are used to predict flood preparedness intentions.

Chapter 5 focuses specifically on flood insurance. Although flood insurance is currently unavailable in the Netherlands, a number of studies have studied the feasibility of designing such an insurance arrangement. Chapter 5 studies whether citizens would be willing to purchase insurance and how their intentions can be explained based on the variables that are addressed in the previous chapters.

Chapter 6 relates the findings from the previous chapters back to the PADM's five decision stages and discusses the research methodology. Together, these will form the basis for the recommendations regarding risk communication and further research.

1.7 REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Barendregt, A., Van Noortwijk, J. M., Van der Doef, M., & Holterman, S. R. (2005). *Determining the time available for evacuation of a dike-ring area by expert judgement.* Paper presented at the International Symposium on Stochastic Hydraulics Conference, 23/24 May 2005, Nijmegen, the Netherlands.

Calamities Compensation Act (1998). Law of 25 May 1998, Containing Rules on the Compensation of Damage and the Costs in case of Floods by Fresh Water, Earthquakes or other Disasters and Severe Accidents (in Dutch: Wet van 25 mei 1998, houdende regels over tegemoetkoming in de schade en de kosten in geval van overstromingen

door zoet water, aardbevingen of andere rampen en zware ongevallen (Wet Tegemoetkoming Schade bij Rampen en Zware Ongevallen, WTS)). The Hague.

Cruz, R. V., Harasawa, H., Lal, M., Wu, S., Anokhin, Y., Punsalmaa, B., et al. (2007). Asia. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. Van der Linden & C. E. Hanson (Eds.), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 469-506). Cambridge, UK: Cambridge University Press

Delta Act (1958). *Law of 8 May 1958, Regarding the Closure of the Estuaries Between the Western Scheldt and the Rotterdam Waterway and the Reinforcement of the Flood Defences for Protection of the Land Against Storm Floods* (in Dutch: Wet van 8 mei 1958, houdende de afsluiting van de zeearmen tussen de Westerschelde en de Rotterdamsche waterweg en de versterking van de hoogwaterkering ter beveiliging van het land tegen stormvloeden (Deltawet)). The Hague.

Deltacommittee (1960). *Report Deltacommittee. Part I: Final Report and Interim Advices* (in Dutch: Rapport Deltacommissie. Deel 1: Eindverslag en Interimadviezen). The Hague: Staatsdrukkerij- en Uitgeverijbedrijf.

Deltacommittee (2008). *Working Together with Water. A Living Land Builds for its Future. Findings of the Deltacommittee 2008* (in Dutch: Samen werken met water. Een land dat leeft, bouwt aan z'n toekomst. Bevindingen van de Deltacommissie 2008). Rotterdam: Deltacommittee.

DPC, Intomart & Daphne (2009). Communication Campaign on Disasters 'Think Ahead. Final Report Campaign Effect Research (in Dutch: *Campagne voorlichting bij rampen 'denk vooruit' (j02). Eindrapportage campagne-effectonderzoek.*) The Hague: Ministry of Interior and Kingdom Relations.

Fazio, R. H., & Zanna, M. P. (1981). Direct experience and attitude-behavior consistency. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol. 14, pp. 161-202). San Diego CA: Academic Press.

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making, 13*(1), 1-17.

Flood Defence Act (1995). *Law of 21 December 1995, Containing General Rules to Ensure Protection by Flood Defences Against Floods Caused by Outside Waters, and Regulation of Some Related Affairs* (in Dutch: Wet van 21 december 1995, houdende algemene regels ter verzekering van de beveiliging van de waterkeringen tegen overstromingen door het buitenwater en regeling van enkele daarmee verband houdende aangelegenheden (Wet op de Waterkering)). The Hague.

Gerritsen, H. (2005). What happened in 1953? The big flood in the Netherlands in retrospect. *Philosophical Transactions of the Royal Society A, 363*(1831), 1271-1291.

Glassman, L. R., & Albarracín, D. (2006). Forming attitudes that predict future behavior: A meta-analysis of the attitude-behavior relation. *Psychological Bulletin, 132,* 778-822.

Grothmann, T., & Reusswig, F. (2006). People at risk of flooding: Why some residents take precautionary action while others do not. *Natural Hazards, 38*(1-2), 101-120.

James, L. R., Mulaik, S. A., & Brett, J. M. (1982). *Causal Analysis: Assumptions, Models and Data.* Beverly Hills: Sage.

Jongejan, R. B. (2008). *How Safe is Safe Enough? The Government's Response to Industrial and Flood risks:* Dissertation.

Lindell, M. K., Arlikatti, S., & Prater, C. S. (2009). Why people do what they do to protect against earthquake risk: Perceptions of hazard adjustments and their attributes. *Risk Analysis, 29*(8), 1072-1088.

Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis, 28*(2), 539-556.

Lindell, M. K., & Perry, R. W. (1992). *Behavioral Foundations of Community Emergency Planning.* Washington, D.C.: Hemisphere Publishing Corporation.

Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard: A review of research. *Environment and Behavior, 32*(4), 461-501.

Lindell, M. K., & Perry, R. W. (2004). *Communicating Environmental risk in Multiethnic Communities.* Thousand Oaks, California: Sage Publications, Inc.

Lindell, M. K., & Prater, C. S. (2002). Risk area residents' perceptions and adoption of seismic hazard adjustments. *Journal of Applied Social Psychology, 32*(11), 2377-2392.

Lindell, M. K., & Whitney, D. J. (2000). Correlates of household seismic hazard adjustment adoption. *Risk Analysis, 20*(1), 13-25.

McGranahan, G., Balk, D., & Anderson, B. (2007). The rising tide: Assessing the risks of climate change and human settlements in low elevation coastal zones. *Environment and Urbanization, 19*(1), 17-37.

Ministry of Transport, Public Works and Water Management (2005). *Flood Risks and Safety in the Netherlands (Floris): Full report.* The Hague.

Ministry of Transport, Public Works and Water Management (2006). *Cabinet Viewpoint on Disaster Management of Flooding, 10 November 2006* (in Dutch: Kabinetsstandpunt Rampenbeheersing Overstromingen). The Hague.

Ministry of Transport, Public Works and Water Management (2008). *National Water Plan (draft)* (in Dutch: Ontwerp Nationaal Waterplan). The Hague.

Mulilis, J. P., & Duval, T. S. (1995). Negative threat appeals and earthquake preparedness: A person-relative-to-event (PrE) model of coping with threat. *Journal of Applied Social Psychology, 25*(15), 1319-1339.

Mulilis, J. P., & Duval, T. S. (1997). The PrE model of coping and tornado preparedness: Moderating effects of responsibility. *Journal of Applied Social Psychology, 27*(19), 1750-1766.

Nicholls, R. J., Wong, P. P., Burkett, V. R., Codignotto, J. O., Hay, J. E., McLean, R. F., et al. (2007). Coastal systems and low-lying areas. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. Van der Linden & C. E. Hanson (Eds.), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 315-356). Cambridge, UK: Cambridge University Press.

Regan, D. T., & Fazio, R. (1977). Consistency between attitudes and behavior. Look to method of attitude formation. *Journal of Experimental Social Psychology, 13*(1), 28-45.

Renn, O. (1998). The role of risk communication and public dialogue for improving risk management. *Risk Decision and Policy, 3*, 5-30.

Rogers, R. W. (1983). Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In J. T. Cacioppo & R. E. Petty (Eds.), *Social Psychophysiology: A Source Book* (pp. 153–176). New York: Guilford Press.

Roth, D., & Warner, J. (2007). Flood risk, uncertainty and changing river protection policy in the Netherlands: The case of 'calamity polders'. *Tijdschrift voor Economische en Sociale Geografie, 98*(4), 519-525.

Royal Netherlands Meteorological Institute (2006). *KNMI Climate Change Scenarios 2006 for the Netherlands. KNMI Scientific Report WR 2006-01*. De Bilt: KNMI

Slager, K. (1992). *The Disaster: A Reconstruction* (in Dutch: De ramp: Een reconstructie). Goes: De Koperen Tuin.

Ten Brinke, W. B. M., & Bannink, B. A. (2004). *Dutch Dikes and Risk Hikes. A Thematic Policy Evaluation of Risks of Flooding in the Netherlands* (in Dutch: Risico's in bedijkte termen, een thematische evaluatie van het Nederlandse veiligheidsbeleid tegen overstromen). Bilthoven: RIVM.

Ter Huurne, E. F. J. (2008). *Information Seeking in a Risky World. The Theoretical and Empirical Development of FRIS: A Framework of Risk Information Seeking. Thesis.*

Terpstra, T., Lindell, M. K., & Gutteling, J. M. (2009). Does communicating (flood) risk affect (flood) risk perceptions? Results of a quasi-experimental study. *Risk Analysis, 29*(8), 1141-1155.

TMO (2009). *Report of Findings* (in Dutch: Rapport van bevindingen). The Hague: Taskforce Management Overstromingen.

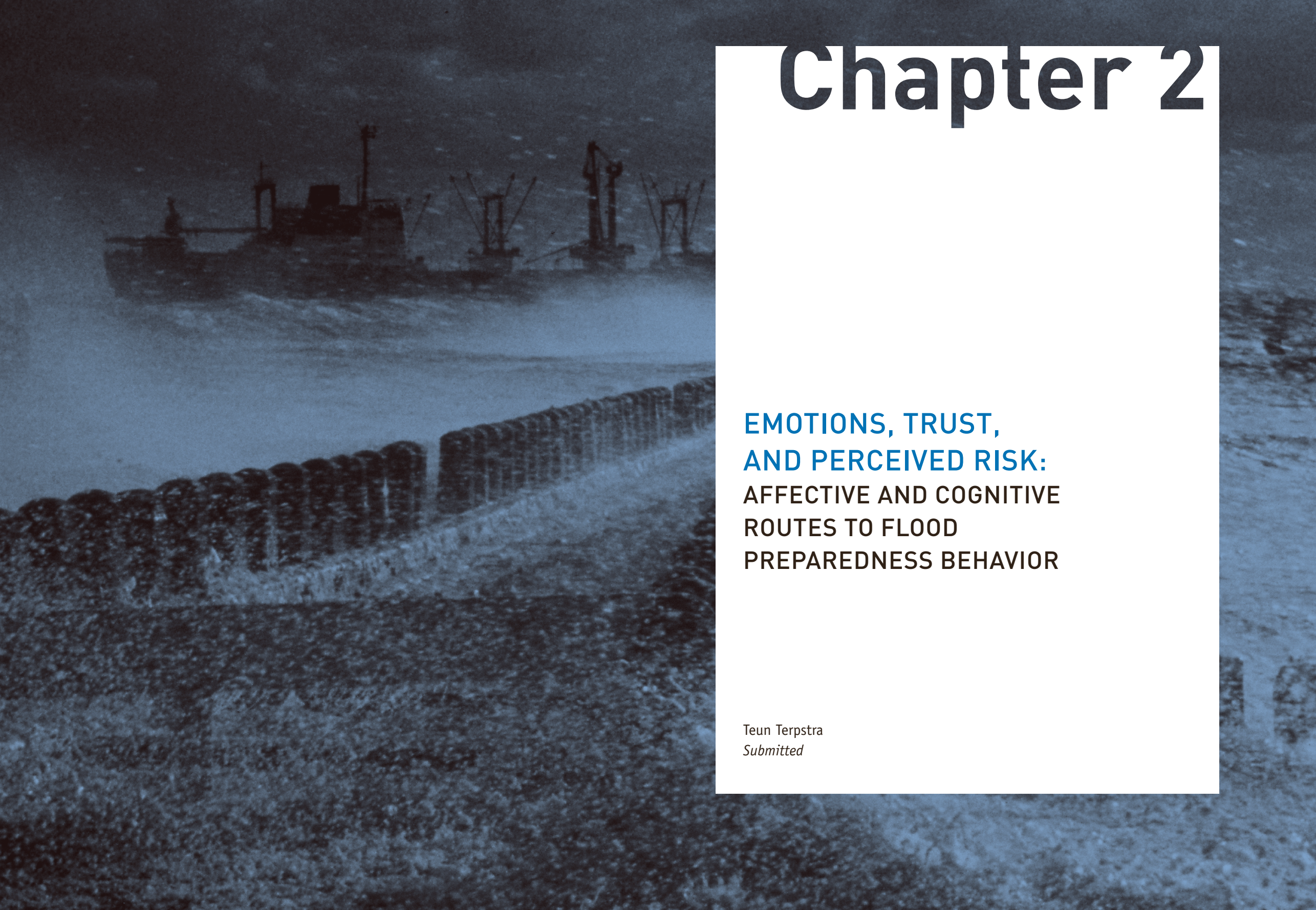
Transport and Water Management Inspectorate (2006). *Assessment of Primary Flood Defences in the Netherlands. National Report on 2006*. Lelystad: Transport and Water Management Inspectorate.

Van de Ven, G. P. (2003). *Man-made Lowlands: History of Water Management and Reclamation in the Netherlands* (in Dutch: Leefbaar laagland: Geschiedenis van de waterbeheersing en landaanwinning in Nederland). 5th ed. Utrecht: Matrijs.

Water Act (2009). *Law of 29 January 2009, Containing Rules Regarding the Management and Use of Water Systems* (in Dutch: Wet van 29 januari 2009, houdende regels met betrekking tot het beheer en gebruik van watersystemen (Waterwet)). The Hague.

Weinstein, N. D. (1989). Effects of personal-experience on self-protective behavior. *Psychological Bulletin, 105*(1), 31-50.

Wolsink, M. (2006). River basin approach and integrated water management: Governance pitfalls for the Dutch space-water-adjustment management principle. *Geoforum, 37*(4), 473-487.



Chapter 2

EMOTIONS, TRUST, AND PERCEIVED RISK: AFFECTIVE AND COGNITIVE ROUTES TO FLOOD PREPAREDNESS BEHAVIOR

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Submitted

ABSTRACT

Despite the prognoses of the effects of global warming (e.g., rising sea levels, increasing river discharges), few international studies have addressed how flood preparedness should be stimulated among private citizens. This paper aims to predict Dutch citizens' flood preparedness intentions by testing a path model, including previous flood hazard experiences, trust in public flood protection, and flood risk perceptions (both affective and cognitive components). Data were collected through questionnaire surveys in two coastal communities (n = 169, n = 244) and in one river area community (n = 658). Causal relations were tested by means of Structural Equation Modeling (SEM). Overall, the results indicate that both cognitive and affective mechanisms influence citizens' preparedness intentions. First, a higher level of trust reduces citizens' perceptions of flood likelihood, which in turn hampers their flood preparedness intentions (cognitive route). Second, trust also lessens the amount of dread evoked by flood risk, which in turn impedes flood preparedness intentions (affective route). Moreover, the affective route showed that levels of dread were especially influenced by citizens' negative *and* positive emotions related to their previous flood hazard experiences. Negative emotions most often reflected fear and powerlessness, while positive emotions most frequently reflected feelings of solidarity. The results are consistent with the affect heuristic and the historical context of Dutch flood risk management. The great challenge for flood risk management is the accommodation of both cognitive and affective mechanisms in risk communications, especially when most people lack an emotional basis stemming from previous flood hazard events.

KEYWORDS

affect heuristic
emotions
experience
trust
risk perception
flood hazard

2.1 INTRODUCTION

Floods have devastating effects all over the globe, both in terms of material damage (Linnerooth-Bayer & Amendola, 2003) as well as in lost lives (Jonkman, 2005). Because global warming will put low-lying, densely populated deltas and river area communities at even greater risk (IPCC, 2007), the improvement of public flood protection as well as citizens' flood preparedness will become a world-wide challenge. Global warming is one of the driving forces behind the debate on flood risk management in the Netherlands, which is on the verge of shifting from a primarily prevention-based approach towards a broader risk management approach that includes citizens' disaster preparedness (Terpstra & Gutteling, 2008). Unfortunately, however, only a few international studies have addressed the issue of citizens' flood preparedness behavior (Grothmann & Reusswig, 2006).

This paper focuses exclusively on Dutch citizens' flood preparedness intentions. Without the existing river and sea flood defenses, two-thirds of the Netherlands would be permanently flooded. As these areas are inhabited by 60% of the population (about nine million people), many citizens depend heavily on the flood defenses for their safety. Due to its high flood protection standards, the Netherlands is currently also one of the best protected deltas in the world (Ten Brinke & Bannink, 2004). Since the last severe flood occurred over 55 years ago (in 1953, claiming 1836 casualties), most citizens have no personal recollection of flooding. It is often assumed that the high levels of public flood protection and the lack of flood experiences have lowered citizens' flood risk perceptions, which in turn keeps them from preparing for potential flood disasters (Terpstra, Lindell, & Gutteling, 2009). Thus far, however, these assumptions have never been tested. This paper therefore investigates citizens' flood preparedness intentions and focuses on three underlying determinants: citizens' flood risk perceptions, their trust in public flood protection, and their previous flood hazard experiences.

2.2 THEORY AND EXPECTATIONS

Effects of hazard experiences

The personal experience of a disaster makes people uniquely aware of their vulnerability to a disaster's consequences. Disaster experience is therefore often assumed to increase people's risk perceptions (Peacock, Brody, & Highfield, 2005). For instance, both Grothmann & Reusswig (2006) and Siegrist & Gutscher (2006) came to this conclusion in regards to flood hazards. However, studies in other hazard domains have shown opposite effects (e.g., Halpern-Felsher et al., 2001).

To resolve these inconsistencies, Lindell & Perry (2004) suggested that the effect of hazard experience depends on how people interpret their experiences or what they have learned from them. Indications of how people interpret their flood experiences were recently presented by Siegrist & Gutscher (2008). These authors found that roughly 20% to 35% of the flood victims interviewed mentioned feelings of uncertainty and insecurity, fear and shock, and helplessness as the worst outcomes of their flood experience, while among non-victims, hardly any respondents anticipated these emotions as the worst outcomes of future flooding. According to Siegrist & Gutscher (2008), these negative emotions were a key factor in explaining why flood victims had taken substantially more precautionary actions against future floods than non-victims. These results are generally consistent with the findings of two recent experimental studies. Keller, Siegrist, & Gutscher (2006) aimed to increase negative affect by presenting subjects with pictures of flooded houses. Although no manipulation checks were performed, these authors suggested that the presentation of emotion-laden images contributed to a higher level of perceived flood risk in the subjects. Vastfjall, Peters, & Slovic (2008) manipulated negative affect associated with the 2004 East Asia Tsunami. By reminding their Swedish subjects of the tsunami, they indeed elicited negative affect, which in turn resulted in more pessimistic expectations about the future. Interestingly, none of these subjects had been directly involved in the disaster, but the Swedish media covered the tsunami extensively, since six hundred Swedish tourists were killed or lost.

The notion that negative emotions increase risk perceptions (and potentially adaptive behavior) is consistent with research on affect and decision making (affect heuristic, e.g., Slovic, Finucane, Peters, & MacGregor, 2007) and is coined the risk-as-feelings hypothesis (Loewenstein, Weber, Hsee, & Welch, 2001). In other words, people may interpret their hazard experiences differently, depending on whether these experiences evoke negative emotions– or as Slovic, Finucane, Peters, & MacGregor (2004) described negative affect, (subtle) feelings of 'badness' (p. 312). If negative affect is experienced when making risk judgments, the perceived risk should increase. Moreover, according to the affect heuristic, positive affect (feelings of 'goodness') should decrease perceived risk. For instance, experiments by Finucane, Alhakami, Slovic, & Johnson (2000) showed that an increased negative affect associated with nuclear technology resulted in higher risk judgments, while positive affect had the opposite effect. Unfortunately, few studies have investigated positive emotions associated with disasters. Rather, studies have focused on negative emotions and adverse health impacts. These studies have found that the intensity of negative emotions increases with the severity of personal disaster consequences (e.g., property losses, injuries, stresses in social relations). Interestingly, such negative emotions may develop into more severe health problems (e.g., posttraumatic stress disorder), particularly when people lack the economic, social, and

psychological resources needed to cope with these experiences (Norris et al., 2002). Moreover, in the field of trauma research, increasingly more studies have shown that stronger coping abilities and resilience against health impairments are related to the experience of positive emotions (Agaibi & Wilson, 2005; Folkman & Moskowitz, 2000). According to the broaden-and-build theory (Fredrickson, 2001), positive emotions contribute to the ability to cope with stress and negative life experiences, because they stimulate thought and increase the number of perceived coping behaviors, thereby adding to one's physical, intellectual, social, and psychological resources (Tugade & Fredrickson, 2004). Regarding disasters, Fredrickson, Tugade, Waugh, & Larkin (2003) supported the link between positive emotions (e.g., gratitude, interest) and resilience (e.g., life satisfaction, optimism) in the context of the 9/11 terrorist attacks. Moreover, increases in coping resources may be enduring, which makes people more resilient when dealing with future events (Tedeschi & Calhoun, 2004). Vazquez, Cervellon, Perez-Sales, Vidales, & Gaborit (2005) investigated positive emotions among earthquake survivors in refugee camps in El Salvador. In addition to negative emotions, almost 75% of the interviewees recalled moments of happiness that could be attributed to either 'being alive' or 'feeling accompanied'. Community and social activities largely contributed to positive emotions and the ability to cope with the difficult circumstances (Perez-Sales, Cervellon, Vazquez, Vidales, & Gaborit, 2005). Moreover, the majority of survivors indicated that they had gained something positive (e.g., regarding social relations and personal skills) and felt better able to cope with future events. Similar findings were reported by Tang (2006), who investigated posttraumatic growth among Thai survivors of the 2004 East Asia Tsunami. Regression analyses showed that the seeking and/or receiving of social support was the most important predictor of positive adaptation (perceived positive changes in, for instance, relations with others and appreciation of life).

In summary, the affect heuristic predicts that positive and negative emotions attached to natural hazard experiences should influence risk perceptions and, possibly, preparedness behavior. Indicators of the effects of negative emotions have recently been shown by Siegrist & Gutscher (2008). Although positive emotions have been investigated in the context of trauma (e.g., abuse, violence) and crisis (e.g., 9/11 attacks) in relation to people's coping abilities and resilience in dealing with future events, we are unaware of any studies that have investigated the effect of positive emotions on the perceived risk of natural hazards and subsequent preparedness behavior. Moreover, in addition to experiencing positive and negative emotions after disasters, people may also be left emotionally 'unimpressed'. This paper will explore whether it is useful to distinguish between people who experience positive affect, those who experience negative affect, and those who are left emotionally unimpressed when evaluating the effects of flood hazard experiences in the Netherlands.

Trust in public flood protection

Despite the high flood protection standards in the Netherlands, no flood protection system is perfect. Relatively recently, in 1993 and 1995, high river discharges unexpectedly threatened several upriver communities that narrowly escaped flood disaster. Typically, citizens lack the expert knowledge to judge the uncertainties that cause such unexpected events. Only when citizens trust the risk experts will they be able to tolerate these uncertainties and live relatively unconcerned behind the flood defenses (Earle & Cvetkovich, 1995). Trust serves to reduce the complexity of a situation (Siegrist & Cvetkovich, 2000). These authors argued that, especially when people lack knowledge about a hazard, their risk judgments are based on the degree to which they trust the responsible risk managers. That is, when trust is high, risk perception is low, and vice versa (Siegrist, Gutscher, & Earle, 2005).

Trust shares conceptual similarity with affect. Affective responses are generated quickly and automatically and are experienced as a feeling state, defining whether something is perceived as 'good' or 'bad' (Slovic et al., 2007). Thus, both trust and affect reduce the complexity of risk judgments because neither requires a consideration of all of the pros and cons related to the risks. Poortinga & Pidgeon (2005) suggested that trust and affect share similarities because they reflect more general attitudes towards risk, which in turn drives more specific risk judgments. Although we expect that trust and affect both predict more specific attitudes towards flood preparedness, we also foresee that more cognitive evaluations of flood risk play a role. First, this would be consistent with research showing that many decisions are informed by the integrated effect of affective and cognitive processes (e.g., Slovic et al., 2004). Second and less obvious, however, compared to other types of risks, flooding risk may be a special case. For most technological risks (e.g., a nuclear power plant, genetically modified food), one cannot actually see from the outside what constitutes the risk and what has been done precisely to reduce the likelihood of a mishap. Therefore, positive feelings and trust in risk managers are highly important because these are virtually the only means through which people accept their own lack of knowledge about a risk. However, flood probability is reduced by the construction of flood defenses. These flood defenses (e.g., a dike or dam) are grossly visible in the landscape and thus provide some information about the quality of risk management. In the Netherlands, people can physically walk on dikes and dams, and characteristics such as their magnitude, height, and state provide a yardstick for estimating the provided protection level. Thus, although lay people lack the expertise needed to calculate the actual protection level provided by flood defenses, they may derive flood likelihood based on the amount of trust that is inspired by their observations. Moreover, public and media communications often boast about the quality of the Dutch flood defenses.

Therefore, trust may not only relate to affective responses to risk (e.g., dread), but trust may also predict how people assess flood likelihood (a more cognitive evaluation of flooding risk). Grothmann & Reusswig (2006) confirmed this relation among citizens from the German city of Cologne, which is located about 175 kilometer upstream from the Dutch border along the river Rhine. They found that those citizens with more faith in public flood protection revealed lower flood risk perceptions (a conjoint measure of perceived flood probability and severity) and had taken less precautionary measures. We too expect to find that perceptions of flood risk (especially flood likelihood) are decreased by a high level of trust in the flood defenses, which in turn keeps citizens from preparing for potential flood disasters.

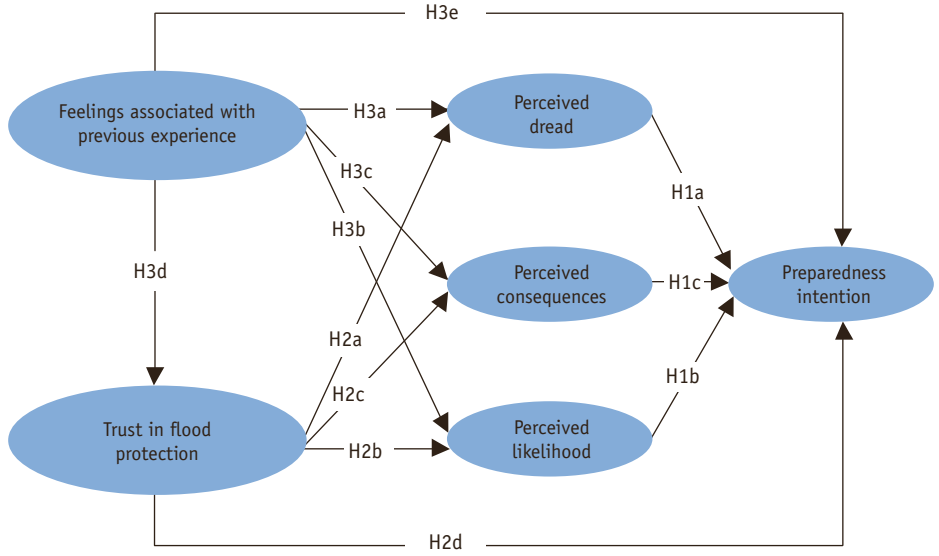
Aims and expectations

This paper investigates the predictors of flood preparedness among Dutch citizens. We focus specifically on how affect associated with previous flood hazard experiences, trust in public flood protection, and cognitive and affective evaluations of flood risk shapes flood preparedness intentions. Figure 2.1 presents the expected relations among these variables.

First, the model reflects our view that higher risk perceptions increase citizens' flood preparedness intentions (H1a, H1b, and H1c). Second, we expect that higher levels of trust have a direct negative impact on citizens' risk perceptions (H2a, H2b, and H2c) and their flood preparedness intentions (H2d).

Figure 2.1

Path model of predicted causal effects



Finally, we predict that citizens' affective interpretations of their flood hazard experiences directly influence their flood risk perceptions (H3a, H3b, and H3c), their trust in flood protection (H3d), and their flood preparedness intentions (H3e). Specifically, we predict that positive affect increases trust and decreases perceived risk and preparedness intentions due to an optimistic bias. Negative affect results in the opposite effect. In addition to these direct effects, we will also test for mediated effects. Our model proposes two mediating variables–trust in flood protection and flood risk perceptions. Although direct empirical evidence is scarce, Grothmann & Reusswig (2006) provided indirect evidence by investigating citizens' flood damage mitigation behavior through hierarchical regression analyses. Flood experience contributed most to explaining the variance in precautionary behavior since it was entered first in the regression analyses. In subsequent separate steps, risk perception and trust added little unique explanatory power (3 - 6%). However, because these variables did show significant, mediocre correlations with precautionary behavior (.21 - .39), the almost complete absence of unique effects of trust and perceived risk on precautionary behavior suggests partial and possibly full mediation. We will therefore test for the potential mediation effects of trust and perceived risk. The model displayed in Figure 2.1 will be tested using Structural Equation Modeling (SEM). SEM is currently regarded as the most sophisticated method for evaluating causal relations among multiple dependent variables based on cross-sectional data, due to its incorporation of both latent and observed variables and the inclusion of measurement errors (Byrne, 2001; Kline, 2005; Schumacker & Lomax, 2004).

In addition, we will validate a three-way classification of emotions (negative emotions, neutral emotions, and positive emotions), by comparing these three groups to citizens who lack any flood hazard experiences. In line with the affect heuristic, citizens who are left emotionally unimpressed (neutral emotions) should reveal the same levels of perceived risk, trust, and preparedness intentions as inexperienced citizens. Citizens with negative emotions should reveal higher risk perceptions, less trust, and lower preparedness intentions, as compared to the inexperienced respondents, while the opposite is expected for citizens with positive emotions.

2.3 THE PRESENT STUDIES

Predictions were tested in two studies. Study 1 was conducted in a coastal community that recently experienced a heavy storm. Study 2 was performed to replicate causal relations in two different flood risk contexts–in the impact area of the 1953 flood disaster at the Dutch coast and in the river area that came close to experiencing floods in 1993 and 1995.

Moreover, Study 2 aimed to gain further insight into which emotions are evoked by previous flood hazard experiences.

2.3.1 *Study 1: The effects of storm experiences*

Method

Study area, sample, and procedures

Data were collected in the northern end of the Netherlands at the Wadden Sea coast. Early November 2006, about one month before data collection, a heavy storm (force 10 on the Beaufort-scale) caused storm water levels near the study area that, according to statistics, occur fifteen times every one thousand years[1] (1.5% probability per year). Despite the relatively high water levels, there was no imminent risk of flooding because the existing dike protects against water levels reached during storms that occur once in every 4,000 years (0.025% probability per year). Still, this event gained much (inter)national media attention, primarily because a hundred horses in an unprotected flood plain needed rescue.

A random sample of 7,000 household addresses, gathered from a telephone book, received a letter explaining our research and inviting them to participate in our internet survey[2]. The letter contained the internet address and a password for taking the questionnaire. Data were collected between December 8, 2006 and January 10, 2007. Respondents were thanked for participation in the invitation letter, on the website, and again at the end of the survey. In total, 826 citizens participated in the survey (response rate 11.8%). For the purpose of this study, we selected a sub-sample of 244 respondents who recalled a personal experience of storm events in the study area (but who reported no other flood hazard experiences). In addition, we also selected respondents who failed to recall any flood hazard experiences (n = 228). This latter, inexperienced group serves exclusively as a reference group for comparison with the experienced respondents. Of the 472 respondents (244 with experience of storm events, and 228 without recollection of flood hazard experiences), 338 (72%) respondents were males, and the mean age was 50.4 years (*SD* = 12.8).

Measurements

Emotions related to storm events were measured by asking those who reported personal experiences of storm events in the study area, 'Could you indicate the type of feelings you experience now, when recalling what you experienced at that time?' We provided five choices: 'very negative feelings', 'rather negative feelings', 'neither negative nor positive feelings', 'rather positive feelings', and 'very positive feelings'. All other questionnaire items were labeled using the prefixes 'not at all', 'hardly', 'somewhat', 'quite', and 'very' (five-point

[1] From the website of the Royal Dutch Meteorological Institute (www.knmi.com) accessed on 4 November 2006.
[2] In 2008, 86% of the Dutch households were connected to the internet which is among the highest rates of internet penetration in Europe (Statistics Netherlands, 2008).

Likert type scales). In addition, the questionnaire measured trust in flood protection (four items, Cronbach's Alpha = .90), risk perceptions –by three constructs, perceived dread (three items, Cronbach's Alpha = .94), perceived flood likelihood (one item), and perceived flood consequences (three items, Cronbach's Alpha = .79)– and flood preparedness intentions (three items, Cronbach's Alpha = .86). Table 2.1 presents all item contents.

Analysis

The proposed path model of Figure 2.1 was evaluated using Structural Equation Modeling (SEM) in AMOS 17 (SPSS Inc., Chicago, IL, USA), including both latent and observed (i.e., indicator) variables. Prior to analysis, the data were checked for normality. The subsequent analysis was performed in two steps (for another recent application of this procedure see for instance Peters, 2009). First, to ensure that the questionnaire items measured their intended constructs correctly, the measurement model was validated by performing first-order confirmatory factor analysis (CFA). Based on goodness-of-fit indices, factor loadings, and modification indices it was decided whether the model needed adjustment (e.g., see Byrne, 2001). Second, if the measurement model was satisfactory, AMOS was subsequently used to estimate the regression paths of Figure 2.1, simultaneously.

Mediation effects were evaluated following Brown (1997). Imagine a model predicting Y1 from X1 and the potential mediator Y2. Mediation then requires compliance with three conditions. There should be a significant direct effect of X1 on the mediating variable Y2 (condition 1) and a significant direct effect of Y1 on the mediator Y2 (condition 2). Third, when controlling for the mediating variable Y2, the significant direct effect of X1 on Y1 should become less significant (partial mediation) or disappear (full mediation). In Amos, condition 3 can be verified by assessing the total effect that is composed of a direct and indirect effect. In case the total effect of X1 on Y1 is significant, but the direct effect becomes less significant or drops below significance due to a significant indirect effect, then there is evidence of partial or full mediation, respectively.

A problem often encountered in performing SEM is a lack of consensus on the criteria for accepting or rejecting a model. Based on state of the art knowledge, Kline (2005) recommends reporting at least the (1) model chi-square, (2) the Steiger-Lind root mean square error of approximation (RMSEA) with its 90% confidence interval (90% CI), (3) the Bentler comparative index (CFI), and (4) the standardized root mean square residual (SRMR). The model chi-square is often divided by the model degrees of freedom (χ^2 / df), which is less sensitive to fluctuations in sample size. This test statistic should be below five and preferably below two in order to accept the model. A CFI value (which varies from 0 to 1) above .90 and preferably above .95 indicates a model fit.

RMSEA values should be as low as .08 and preferably .06 or lower in order to accept the model. Finally, SRMR values below .10 are considered as favorable.

The classification of respondents in three emotions groups –negative, non-specific, and positive emotions– was verified by comparing their scale means to those of the inexperienced respondents. Thereto we performed a Multivariate Analysis of Variance and post hoc tests, using SPSS 15 (SPSS Inc., Chicago, IL, USA).

Results

Analysis of the proposed model

Measurement model. Because emotions associated with previous storm weather experiences could only be measured for respondents who indicated such experiences, the subsequent analysis only applies to those respondents (n = 244). Using a first-order confirmatory factor analysis (CFA), the measurement model estimated the extent to which the observed items loaded onto their respective latent variables. Thereto all latent constructs but no observed error variances were allowed to covary with one another. Constructs were scaled by fixing one factor loading to one of each of the four latent variables, which ensured the identification of the model. All other factor loadings were left unconstrained. The CFA included four latent constructs and thirteen measured variables with accompanying error terms–trust (four items), dread (three items), perceived consequences (three items), and preparedness intention (three items).

Note that emotions attached to previous experiences and perceived flood likelihood were omitted from this validation procedure, since these variables were measured by one item only. Results indicated satisfactory factor loadings on all constructs (see Table 2.1) and a good fit (Table 2.2, Model 1), indicating that questionnaire items loaded on the intended latent constructs while cross loadings were absent.

Structural model. Next, we evaluated the proposed path model of Figure 2.1. In addition to the four latent variables –trust (four items), dread (three items), perceived consequences (three items), and preparedness intention (three items)– the model included emotions attached to previous experiences and perceived flood likelihood. The causal structure was specified by drawing the regression paths identical to Figure 2.1. The model revealed a good fit (see Table 2.2, Model 2). The results of this procedure are depicted in Figure 2.2.

First, the analysis supported the predicted effects of perceived dread (H1a; $\beta = .20$, $p < .05$) and perceived likelihood (H1b; $\beta = .46$, $p < .001$) on preparedness intention, but rejected the predicted effect of perceived consequences on preparedness intention (H1c; $\beta = -.09$, *ns*).

Table 2.1

Latent variables, items and factor loadings in Study 1

Latent Variable	Item	loading
Emotions related to storm events	Could you indicate the type of feelings you experience now, when recalling what you experienced at that time?	-
Trust in flood protection	I am confident that the flood defenses along Wadden Sea coast are maintained well	.81
	I have confidence in the technological skills of flood risk managers	.88
	I have confidence in the strength of the flood defenses along Wadden Sea coast	.89
	I am confident that there are sufficient, properly qualified people working with the water management authorities	.74
Perceived dread	Could you indicate how you feel now, at this moment, when you think of the risk of flooding in your area?	
	I feel frightened	.90
	I feel worried	.83
	I feel restless	.97
Perceived flood likelihood	How likely do you find major flooding in your area within the next 10 years?	-
Perceived flood consequences	How severely do you feel a flood's consequences will affect you personally?	.61
	How likely do you regard a flood will damage your possessions?	.87
	How likely do you regard a flood will have fatal consequences for you personally?	.69
Flood preparedness intentions	To what extent are you interested in information about flood preparedness?	.76
	To what extent do you intend to search for information about flood preparedness?	.84
	To what extent do you intend to prepare for flooding?	.80

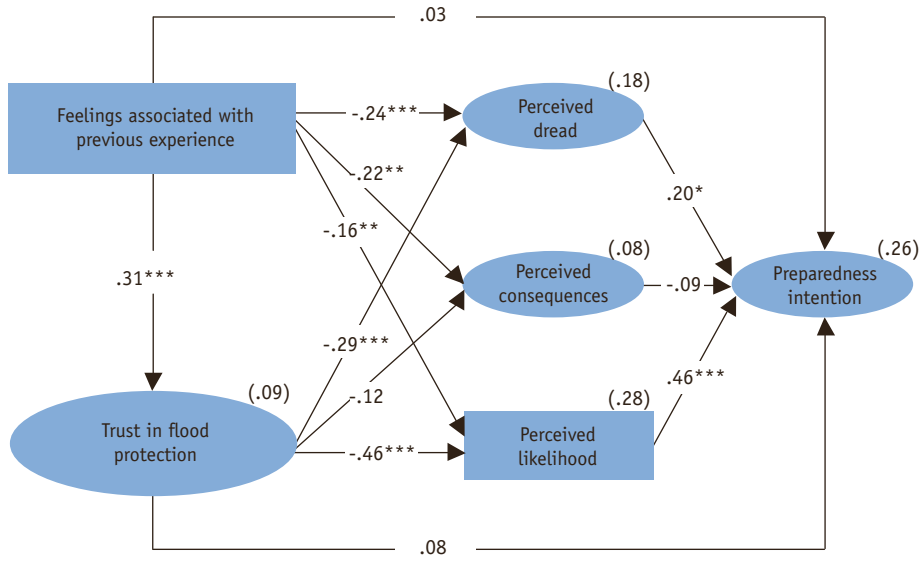
Table 2.2

Model Fit indices Study 1

Model	Analysis	Items/constructs	n	χ^2	df	χ^2 / df	RMSEA (90% CI)	CFI	SRMR
1	Measurement model (First order CFA)	13 / 4	244	102.02	59	1.73	.05 (.03 – .07)	.98	.05
2	Structural model (Path analysis)	13 / 4 + 2 single indicator variables	244	134.35	77	1.74	.06 (.04 – .07)	.97	.04

Figure 2.2

Path modeling Study 1 results



Note:
1. Oval variables reflect latent variables; rectangular variables reflect single indicator (i.e., observed) variables. Reported numbers are standardized regression coefficients (β) indicating direct effects. Indirect (mediated) effects are explained in the results section.
2. Explained variances (R^2) are provided in parentheses.
3. n = 244
4. *** p < .001, ** p < .01, * p <.05

Second, the model supported that trust was a significant predictor of perceived dread (H2a; β = -.29, p < .001) and perceived flood likelihood (H2b; β = -.46, p < .001) –but the model rejected that trust predicted the perceived consequences (H2c; β = -.12, *ns*). In addition, the AMOS output indicated that the total effect of trust on preparedness intention was significant (β = -.18, p < .05), but there was no support for a direct effect of trust on preparedness intention (H2d; β = .08, *ns*). Rather, the indirect was significant (β = -.26, p < .001)– that is, the significant effects of perceived dread and perceived likelihood on preparedness intention together with the significant effects of trust on perceived dread and perceived likelihood supported that perceived dread and perceived likelihood fully mediated the effect of trust on preparedness intention–with perceived likelihood accounting for about 80% of the mediation effect.

Third, the results supported the predicted direct effects of emotions attached to previous storm weather experiences on the perceived risk variables–more positive (and less negative) emotions reduced perceived dread (H3a; β = -.24, p < .001), perceived likelihood (H3b; β = -.16, p< .01), and perceived consequences (H3c; β = -.22, p < .001). Also, more positive emotions increased trust in flood protection (H3d; β = .31, p < .001). Moreover, the AMOS output also indicated a significant indirect effect of emotions on perceived likelihood (β = -.14, p < .05), which supported that the total effect of emotions on perceived likelihood was partly mediated by trust in flood protection. Finally, the total effect of emotions on preparedness intention consisted of a non-significant direct effect, which rejects H3e (β = .03, *ns*), and a significant indirect effect (β = -.15, p < .05). There were four mediation paths from emotions to preparedness intention–mediation by the combinations trust/perceived likelihood (about 30%), trust/perceived dread (10%), and mediation by perceived dread (about 35%) and by perceived likelihood (20%). The remaining 5% of the total effect was mediated by non-significant paths.

Comparison to the respondents without recollection of flood hazard experiences

Non-specific (neutral) emotions and negative and positive emotions were reported by 137 (56%), 67 (27%), and 40 (16%) respondents, respectively. These groups did not differ in terms of gender distribution (Kruskal-Wallis test, $\chi^2_{(3)}$ = 7.37, *ns*) or mean age ($F_{3, 448}$ = 1.43, *ns*). To validate the emotion classification of non-specific (neutral), negative, and positive emotions, we performed a multivariate analyses of variance, using the group without flood hazard experiences as a reference group (n = 228). Indeed, the Manova was significant ($F_{12,1401}$ = 5.45**) and Table 2.3 indicates that there were significant differences among groups.

Comparing inexperienced respondents to the respondent groups with negative, non-specific, and positive emotions on each of five variables, required evaluating fifteen (three times five) hypotheses. Table 2.3 indicates that eleven of them (73%) were supported by the data. Specifically, in line with the affect heuristic, respondents who indicated neither negative nor positive emotions (i.e., non-specific emotions) should reveal the same levels of trust, perceived risk, and preparedness intentions as inexperienced respondents. This prediction was confirmed on all but the perceived consequences variable. Second, respondents with negative emotions should reveal less trust, higher risk perceptions, and higher preparedness intentions, as compared to the inexperienced respondents. This prediction was confirmed for all variables, but on the trust variable the difference failed to reach significance. Finally, respondents with positive emotions should reveal higher trust, lower risk perceptions, and lower preparedness intentions, as compared to the inexperienced respondents.

This was confirmed regarding trust and dread measurements, but not on the variables measuring perceived consequences and preparedness intentions.

Table 2.3

Analysis of Study 1 scale means (*SD*) using Manova and post hoc tests

Coastal area	No experience (reference group, n = 257)	Non-specific Feelings (n = 105)	Negative feelings (n = 47)	Positive feelings (n = 15)
Trust in flood protection	3.78 (*.71*)	3.78 (*.60*)	3.65 (*.62*)	4.21** (*.61*)
Perceived dread	2.14 (*.98*)	2.21 (*.90*)	2.66** (*.99*)	1.70** (*.87*)
Perceived likelihood	2.16 (*1.01*)	2.28 (*.95*)	2.61** (*.97*)	1.70** (*.79*)
Perceived consequences	2.91 (*1.03*)	3.28** (*.89*)	3.69** (*.88*)	2.93 (*1.01*)
Preparedness intention	2.74 (*.92*)	2.86 (*.88*)	3.14** (*.92*)	2.71 (*1.07*)

Asterisks indicate significant deviations from the 'No experience' group; ** p < .01, * p < .05

Discussion

Respondents with heavy storm experience not only reported negative feelings (27%) but also non-specific (neutral, 56%) and positive (16%) feelings. A comparison of these groups to respondents without any flood hazard experiences largely supported this three-way classification.

Path analysis showed, consistent with our predictions based on the affect heuristic (Slovic et al., 2007), that negative feelings decreased trust in flood protection, and increased risk perceptions. Positive feelings had the opposite effect. Additionally, the effects of emotions on preparedness intention were indirect–mediation followed four paths, 1) through perceived dread, 2) through perceived likelihood, 3) via trust through perceived dread, and 4) via trust through perceived likelihood. Thus, trust in flood protection played a central role because it had both indirect effects on preparedness intention and partly mediated the effects of emotions. Remarkably, perceptions of flood consequences failed to predict flood preparedness intentions.

A major shortcoming of this study lies in the fact that it is unclear which feelings respondents meant when they reported negative and positive feelings. In addition, one could argue that the results of affect were found because the data were collected only one month after a storm. Finally, the response rate was lower than desired. The next study aims to overcome these shortcomings.

2.3.2 *Study 2: The effects of experiencing the 1953 flood disaster and the 1993/1995 high river discharges*

Method

Study areas, samples, and procedures

Study 2 included two samples. First, a sample was drawn from the impact area of the 1953 flood disaster at the North Sea coast in the southwestern part of the Netherlands (coastal community). The second sample was drawn from two communities in the river area (river area communities) that experienced near floods in 1993 and 1995 (i.e., extremely high river discharges but no dikes were breached). The procedures for data collection were identical to those in Study 1. However, in order to increase the response rate, reminders were sent three and five weeks after the invitation letter. All invitations were sent out on April 1, 2008, and the internet survey was closed on May 31, 2008. We selected random samples of 5,000 household addresses from the coastal community and in total 11,000 household addresses from the two river area communities. Despite the two reminders, response rates were again lower than desired; between 9.6% and 12.9%. This issue will be addressed in the final discussion.

In the coastal community, we selected a sub-sample of 428 respondents–including 169 respondents with personal experience of the 1953 flood disaster and 259 respondents without any flood hazard experiences. Overall, 69% were males, and the mean age was 56.1 years (*SD* = 13.3; 4 persons failed to report their age). Because both river area samples were similar with respect to gender (Mann-Whitney U, Z = -.80, *ns*) and mean age (t_{850} = -.61, *ns*), we treated them as one homogeneous group. This was done to increase the reliability and statistical power of the path model. The selected sub sample consisted of 861 respondents–658 respondents personally experienced the 1993/1995 high river discharges, while 203 lacked any flood hazard experiences. Overall, 69% were males, and the mean age was 52.5 years (*SD* = 13.0; 9 persons failed to report their age).

Measurements

Emotions related to flood hazard experiences. Respondents indicated the type of feelings they sensed when thinking about their personal experiences. Response labels were 'exclusively negative feelings', 'more negative than positive feelings', 'no (dominance of) positive or negative feelings', 'more positive than negative feelings', and 'exclusively positive feelings'. As Study 1 failed to investigate which particular feelings were experienced on recall, respondents were invited to provide *verbal descriptions of their negative and positive feelings*. Additionally, as in Study 1, the questionnaire measured *trust in flood protection* (three items), risk perceptions –by three constructs, *perceived dread* (two items with a negative connotation and two items with a positive connotation), *perceived flood likelihood* (one item), *perceived flood consequences* (four items)– and *flood preparedness intentions* (four items). Response labels were tailored to the item contents. Items that were intended to form a multi-item scale were presented in a randomized order. Cronbach's Alpha was larger than .80 on all scales. Table 2.4 presents all item contents.

Analysis

Identical to Study 1.

Results

Analysis of the proposed model

Measurement model. As in Study 1, we applied first-order CFA to estimate the extent to which the observed items loaded onto their respective latent variables. Thus, all latent variables but no observed error variances were allowed to covary with one another. Both in the coastal community (1953 impact area, n = 169) and the river area community (n = 658) the initial model consisted of four latent, unobserved variables and fifteen observed variables with accompanying error terms–trust in flood risk management (three items), dread (four items), perceived consequences (four items), and preparedness intention (four items). Table 2.5 reveals a moderate fit of the initial model in both areas for (Model 1). Modification Indices (MIs) revealed that the error terms of the two positively formulated dread items shared a substantial amount of variance. Moreover, as these two items also showed poor factor loadings, we removed them from the models. In addition, the river area model could be further improved by removing a perceived consequences indicator that showed poor performance. Factor loadings of the final models were satisfactory (see Table 2.4), and goodness of fit statistics were within the desired ranges (see Table 2.5)

Structural model coastal area (1953 flood disaster). Figure 2.3 presents the results of the path analysis. The analysis supported the predicted effects of perceived dread (H1a; β = .31, p < .01) and perceived likelihood (H1b; β = .32, p < .001) on preparedness intention, but rejected the predicted effect of perceived consequences (H1c; β = .09, *ns*). In addition, the model supported that trust was a significant predictor of perceived dread (H2a; β = -.44, p < .001) and perceived flood likelihood (H2b; β = -.41, p < .001), but rejected the effect of trust on the perceived consequences (H2c; β =.00, *ns*). The AMOS output indicated a counter-intuitive but non-significant direct effect of trust on

preparedness intention (H2d; β = .16, *ns*). Rather, the indirect effect was significant (β = -.27, p < .01). Perceived dread and perceived likelihood fully mediated the effect of trust on preparedness intention, with either path accounting for about 50% of the mediation effect.

Table 2.4

Latent variables, items and factor loadings in Study 2

Latent Variable	Item	Coastal area	River area
Emotions related to prior experiences	Could you indicate the type of feelings you experience now, when recalling what you experienced at that time?	-	-
Trust in flood protection	*How confident are you …*		
	… there has been thought well about the strength and height of the flood defenses in [area]?	.88	.87
	… that the flood defenses [area] are maintained properly?	.81	.73
	… that the water management authorities in you area have sufficient knowledge about flood protection?	.82	.75
Perceived dread	*Could you indicate how you feel now, at this moment, when you think of the risk of flooding in your area?*		
	I feel frightened	.94	.88
	I feel restless	.86	.92
	I feel relaxed	-	-
	I feel at ease	-	-
Perceived flood likelihood	How likely do you find major flooding in your area within the next 10 years?	-	-
Perceived flood consequences	*Imagine there will be a flood in your area. How likely do you regard the following?*		
	Substantial damage to public facilities (roads, parks, etc.) in your city	.92	.84
	Substantial damage to your house or possessions	.89	.84
	You and/or your family will face a life threatening situation	.76	-
	Your daily life (job and other daily routines) will be disrupted for a long time	.82	.80
Flood preparedness intentions	*To what extent do you intend to do the following in the near future?*		
	Assemble an emergency kit (including water, food, a battery powered radio, a first aid kit, etc)	.78	.71
	Collect information about flood consequences, evacuation routes, and safe/high locations.	.86	.83
	Making a to-do list that is helpful in case of an evacuation or flood (household plan)	.94	.94
	Making agreements with family, friends, and neighbors on how to help each other in case of evacuation/flooding	.84	.83

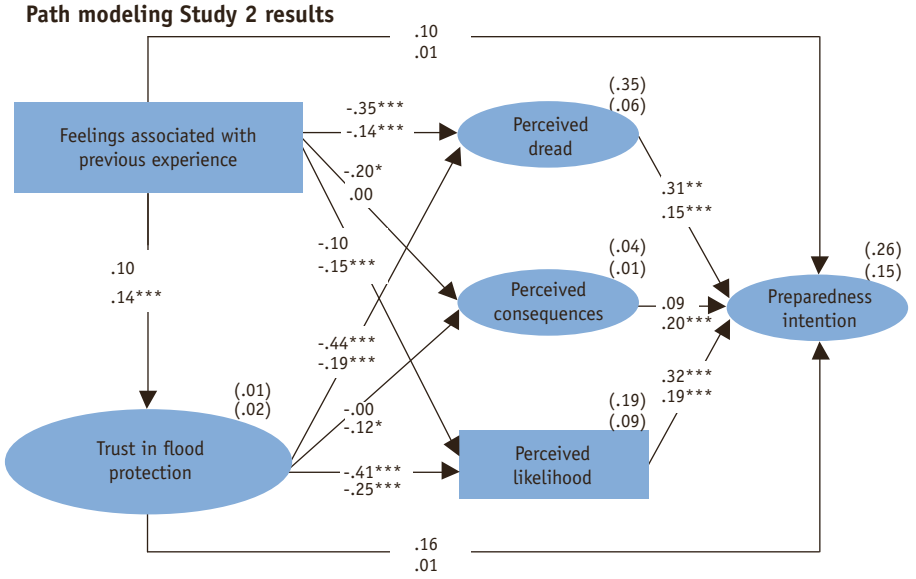
Table 2.5

Model Fit indices Study 2

Coastal area Models	Analysis	Items/ constructs	n	χ^2	df	χ^2 / df	RMSEA (90% CI)	CFI	SRMR
1	Measurement model (First order CFA)	15 / 4	169	213.14	84	2.54	.10 (.08 – .11)	.92	.05
2	Measurement model (First order CFA)	13 / 4	169	90.18	59	1.53	.06 (.03 – .08)	.98	.05
3	Structural model (Path analysis)	13 / 4 + 2 single indicator variables	169	114.71	77	1.49	.05 (.03 – .07)	.98	.05
River area Models	**Analysis**	**Items/ constructs**	**n**	**χ^2**	**df**	**χ^2 / df**	**RMSEA (90% CI)**	**CFI**	**SRMR**
1	Measurement model (First order CFA)	15 / 4	658	641.49	84	7.64	.10 (.09 – .11)	.90	.05
2	Measurement model (First order CFA)	12 / 4	658	66.23	48	1.38	.02 (.00 – .04)	1.00	.02
3	Structural model (Path analysis)	12 / 4 + 2 single indicator variables	658	85.91	64	1.34	.02 (.01 – .03)	.99	.02

Figure 2.3

Path modeling Study 2 results



Note Figure 2.3:
1. Upper numbers relate to the coastal area (1953 flood disaster, n = 169) and lower numbers to the river area (1993/1995 high river discharges, n = 658).
2. Oval variables reflect latent variables; rectangular variables reflect single indicator (i.e., observed) variables. Reported numbers are standardized regression coefficients (β) indicating direct effects. Indirect (mediated) effects are explained in the results section.
3. Explained variances (R^2) are provided in parentheses.
4. *** p < .001, ** p < .01, * p <.05

In addition, results supported the predicted direct effects of emotions on perceived dread (H3a; β = -.35, p < .001) and perceived consequences (H3c; β = -.20, p < .05), but the analysis rejected the proposed direct effect of emotions on perceived likelihood (H3b; β = -.10, *ns*). Moreover, the analysis also failed to support the effect of emotions on trust in flood protection (H3d; β = .10, *ns*). Therefore, trust failed to function as a mediator between emotions and perceived risk.

Finally, the total effect of emotions on preparedness intention consisted of a non-significant direct effect, which rejects H3e (β = .10, *ns*), and a significant indirect effect (β = -.17, p < .05). This latter indirect effect was mediated by perceived dread only, because the direct paths from emotions to perceived dread (condition 1) and from perceived dread to preparedness intention (condition 2) were both significant. Perceived dread accounted for about 65% of the mediation effect–the remaining 35% was transmitted through non-significant paths.

Structural model river area (1993/1995 high river discharges). Figure 2.3 also presents the results for the path model in the river area. The analysis supported the predicted effects of perceived dread (H1a; β = .15, p < .001), perceived likelihood (H1b; β = .19, p < .001), and perceived consequences (H1c; β = .20, p < .001) on preparedness intention. The results also supported that trust was a significant predictor of perceived dread (H2a; β = -.19, p < .001), perceived likelihood (H2b; β = -.25, p < .001), and perceived consequences (H2c; β = -.12, p < .05). However, the results rejected a direct effect of trust on preparedness intention (H2d; β = .01, *ns*), but the indirect was just significant (β= -.10, p < .05). This indirect effect was mediated by all three risk perception variables–perceived dread (about 25%), perceived likelihood (about 50%), and perceived consequences (about 25%). In addition, the results supported the predicted direct effects of emotions on perceived dread (H3a; β = -.14, p < .001) and perceived likelihood (H3b; β = -.15, p < .001), but the effect on perceived consequences (H3c; β = .00, *ns*) was rejected. There was support for a direct effect of emotions on trust in flood protection (H3d; β = .14, p < .001), but there was no support for a direct effect of emotions on preparedness intention (H3e; β = .01, *ns*). Moreover, none of the emotions effects were mediated by trust or perceived risk, because none of the indirect effects reached significance.

Comparison to the respondents without recollection of flood hazard experiences

In the coastal area, non-specific (neutral) feelings and negative and positive feelings were reported by 107 (63%), 47 (28%), and 15 (9%) respondents, respectively. In the river area, the distribution was similar–non-specific (neutral), negative, and positive feelings were reported by 433 (65%), 149 (23%), and 76 (12%) respondents, respectively. As in Study 1, we validated this classification through two separate multivariate analyses of variance, using the groups without recollection of flood hazard experiences as reference groups (coastal area, n = 269; river area, n = 203). Because in both areas the four groups (three emotion groups plus the reference group) differed in gender distribution (Kruskal-Wallis test; coastal area, $\chi^2_{(3)}$ = 22.77; river area, $\chi^2_{(3)}$ = 12.09; p < .01) and in mean age (coastal area, $F_{3,\ 420}$ = 74.80; river area, $F_{3,\ 848}$ = 6.31; p < .01), these variables were entered as covariates. Table 2.6 presents the results.

Both in the coastal and river area, significant multivariate effects were obtained for feelings associated with previous flood hazard experience (coastal area, $F_{15,1398}$ = 4.55, p < .01; river area, $F_{15,2532}$ = 4.19, p < .01)–that is, after controlling for the effects of gender (coastal area, $F_{5,414}$ = 8.04, p < .01; river area, $F_{5,842}$ = 13.84, p < .01) and age (coastal area, $F_{5,414}$ = 1.89, *ns*; river area, $F_{5,842}$ = 5.94, p < .01). Overall, Table 2.6 supports the three-way classification, especially regarding the distinction between negative and non-specific feelings. Positive emotions generally showed somewhat smaller effects than negative emotions.

Table 2.6

Analysis of Study 2 scale means (*SD*) using Manova and post hoc tests

Coastal area	No experience (reference group, n = 257)	Non-specific feelings (n = 105)	Negative feelings (n = 47)	Positive feelings (n = 15)
Trust in flood protection	3.72 (.71)	3.76 (.83)	3.49 (.96)	3.67 (.95)
Perceived dread	1.78 (1.00)	1.51 (.78)	2.26** (1.25)	1.40 (.51)
Perceived likelihood	1.98 (.95)	1.87 (.83)	2.28** (1.08)	2.00 (.76)
Perceived consequences	3.82 (.98)	3.74 (1.07)	4.05** (.89)	3.38 (.98)
Preparedness intention	2.60 (.98)	2.55 (.98)	2.90 (1.10)	2.68 (1.12)
River area	**No experience (reference group, n = 198)**	**Non-specific feelings (n = 430)**	**Negative feelings (n = 148)**	**Positive feelings (n = 75)**
Trust in flood protection	3.56 (.81)	3.52 (.73)	3.32** (.90)	3.68 (.86)
Perceived dread	1.93 (1.00)	1.70* (.85)	2.15** (1.03)	1.61 (.79)
Perceived likelihood	2.27 (.97)	2.33 (1.00)	2.74** (1.10)	2.05 (.95)
Perceived consequences	3.42 (1.02)	3.43 (1.06)	3.45 (1.11)	3.33 (1.11)
Preparedness intention	2.64 (.92)	2.64 (.92)	2.71 (.92)	2.53 (.95)

Asterisks indicate significant deviations from the 'No experience' group; ** p < .01, * p < .05

More specifically, both the coastal and the river area respondents with non-specific (neutral) emotions did not deviate in their scale means from the inexperienced respondents, except on the dread scale in the river area. Second, all negative emotion effects occurred in the expected directions. Due to a small gro up size in the coastal area (n = 47), however, the lower level of trust in flood protection and the higher preparedness intention rating were not significant. In the river area, the effects on the perceived consequences and preparedness intentions scales were marginal. Finally, positive emotions failed to show any significant effects. In the coastal area, this is partly explained by the small group size (n = 15). Still, clear deviations were observed in the expected directions on the dread and perceived consequences scales in the coastal area, and on the dread scale in the river area.

Verbal descriptions of negative and positive feelings

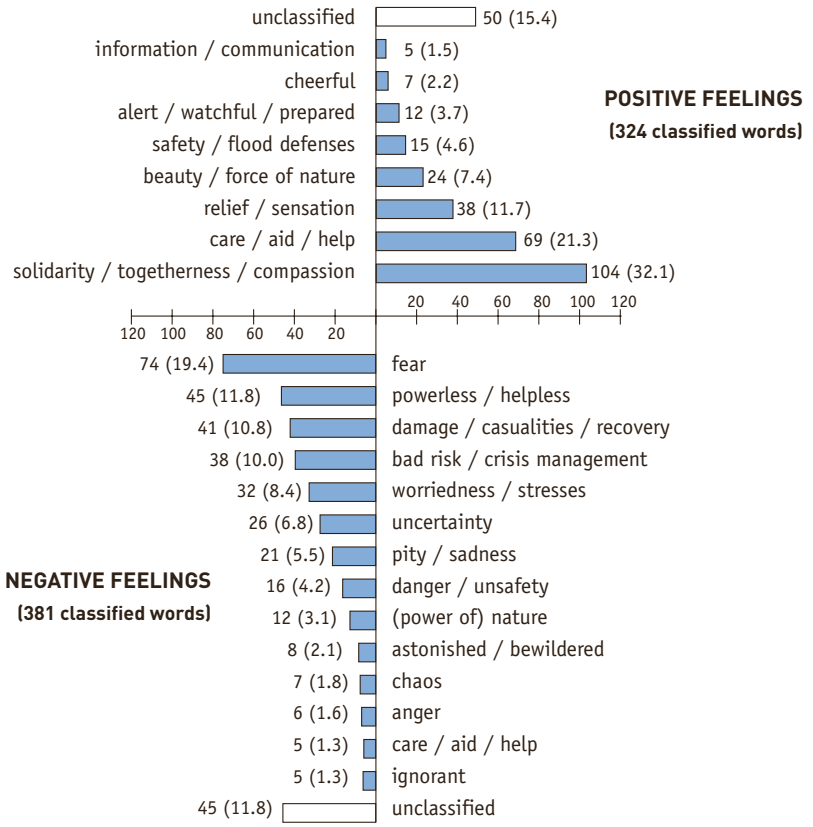
In addition to rating their feelings, respondents were invited to provide verbal descriptions of their feelings, with a maximum of three words for negative and three words for positive feelings. A total of 292 respondents (35% of all respondents with flood hazard experiences) provided verbal descriptions; 109 respondents filled out only negative verbal descriptions, 82 provided only positive verbal descriptions, and 102 respondents filled out both negative and positive verbal descriptions.

To validate our measurements, we verified whether the respondents had filled out description boxes that were potentially inconsistent with how they rated their feelings. One respondent rated his feelings as negative but inconsistently filled out a positive description box only ("helpful"). Among the 540 respondents who indicated 'no (dominance of) positive or negative feelings', 30 respondents (6%) inconsistently filled out either a negative or a positive verbal description box only. However, because all of the words that were filled out in the negative description box had a true negative connotation (e.g., "fear") and because all of the words filled out in the positive description boxes also had a true positive connotation (e.g., "solidarity"), we kept these words for further analysis.

All of the positive words (324) and negative words (381) were classified into broader categories (see Figure 2.4). Classes were based on words that were used most frequently. For instance, the word "fear" was counted 67 times. Fear-related words (e.g., "dread", "horrified") were subsequently included in this class. In addition, 45 negative words and 50 positive words (13.5%) could not be classified because these words were expressed only once or twice and did not properly fit into the other classes (e.g., "waking up", "pain", "change", "courage").

FIGURE 2.4

Classification of positive and negative feelings (combined for the coastal and river area). Numbers are word counts within classes (percentages in parentheses)



Regarding the negative feelings, fear and feelings of powerlessness and helplessness were frequently mentioned. Together, these two classes accounted for 31% of all expressed negative feelings. Ten percent of the negative words were focused on the amount of damage, casualties, and difficulties encountered during the recovery period, while another 10% reflected poor risk and crisis management on the part of the government and local water board (e.g., "poor maintenance of dikes", "poor organization of evacuation", "mismanagement", "warnings given too late"). In addition, worries and stresses (8%), feelings of uncertainty (7%), and pity and sadness (6%) were mentioned relatively frequently.

Among the expressions of positive feelings, solidarity (togetherness and unity) was by far mentioned the most frequently (32%). The word "solidarity" itself was mentioned 60 times (19%). The care/aid/help dimension (21%) was closely related, but contained words that were more directed to the act of helping itself (e.g., "helping evacuated friends and family members", "caring for others", "helpfulness", etc.). Other recurring words reflected feelings of sensation and relief (12%) and accounts of feeling impressed by the beauty and force of nature (7%).

Thus, the vast majority of respondents who rated their feelings as negative also described their feelings with words that clearly had a negative connotation, while the opposite was found for respondents who rated their feelings as positive. These findings support the validity of our measurements and provide insight into the origin and meaning of negative and positive feelings.

2.4 GENERAL DISCUSSION

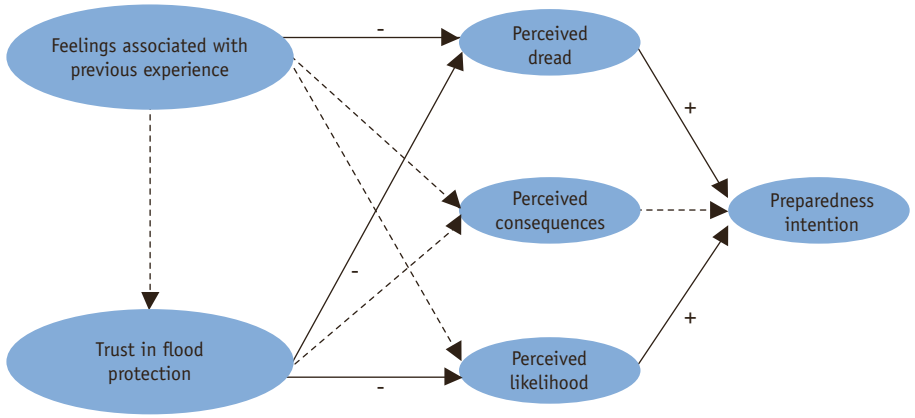
Dutch flood risk management is on the verge of shifting from a primarily prevention-based approach towards a broader risk management approach that includes citizens' disaster preparedness (Terpstra & Gutteling, 2008). This paper aimed to predict citizens' flood preparedness intentions from their risk perceptions, their trust in flood protection, and their previous flood hazard experiences. Moreover, we aimed to expand empirical evidence of the role of affect associated with previous experiences, by focusing on negative and positive feelings evoked by these experiences.

Results showed that citizens experience not only negative feelings when recalling their previous flood hazard experiences but also positive feelings. However, positive feelings seem to be evoked less frequently than negative feelings–on average, in Study 1 and 2, positive and negative feelings were reported by 12% and 25% of the respondents, respectively. The majority (63%), however, reported that they were not emotionally affected by their experiences. The validity of this three-way classification was generally supported when comparing their scale means to those of citizens without flood experiences. However, there were also some unexpected findings. For instance, in the river area groups hardly differed in perceived of flood consequences. Although this study assessed emotions as the sole factor channeling the effects of experience more cognitive evaluations may play a role as well. For instance, having witnessed (or: not witnessed) a flood's consequences provides knowledge that can be applied to estimate consequences of future floods.

Verbal expressions supported the validity of how feelings were measured. Study 2 showed that positive feelings most often reflected solidarity and unity and were related to helping one another during the 1953 flood disaster and during the 1993/1995 near river floods. In addition, respondents mentioned feelings of sensation and relief, and some were impressed by the beauty and force of nature (e.g., water flows, views). Furthermore, Vazquez et al. (2005) reported a sense of relief ('being alive') and feelings of solidarity ('feeling accompanied') among earthquake survivors in El Salvador. Such positive feelings are important because they add to people's social and psychological resources, which are necessary for coping with the negative consequences of disasters (Fredrickson, 2001; Tugade & Fredrickson, 2004). Negative feelings most often reflected fear, powerlessness and helplessness, worries, feelings of uncertainty, and sadness. Moreover, respondents sometimes focused on the amount of damage and number of casualties and on poor risk and crisis management on the part of the government and local water board (e.g., poor maintenance of flood defenses, poor organization of the evacuation).

Structural Equation Modeling was performed to test the causal relations among variables. Figure 2.5 provides a summary of the path analysis results (two coastal communities and a river area community). Although the majority of our expectations were confirmed, three relations had little to no support. First, emotions attached to prior flood hazard experiences failed to have significant, direct effects on flood preparedness intentions. The absence of an effect of emotions would be in contrast with Siegrist & Gutscher (2008), who argued that negative emotions explained why flood victims had taken more precautionary measures than non-victims. However, in the two coastal communities emotions influenced preparedness intentions indirectly. That is, in Study 1 emotions attached to experience with a recent storm were mediated by trust, perceived dread, and perceived flood likelihood. In Study 2 emotions attached to experience with the 1953 flood disaster failed to affect levels of trust in flood protection, but emotions influenced preparedness intentions indirectly through perceived dread only. However, in the river area (Study 2) emotions attached to experiences of the 1993/1995 high river discharges revealed only direct effects on trust, perceived dread, and perceived flood likelihood. Thus, the effects of emotions in terms of the paths through which they affected trust, perceived risk, and preparedness intentions differed between the three study areas.

Figure 2.5
Summary of path modeling results in Study 1 and 2



Note:
Solid lines are supported in all three areas. Dashed lines reflect inconsistent results between studies.

This discrepancy may be explained by the severity of disaster consequences combined with the time at which the emotions were assessed. A review on health impairments after disasters showed that high impact disasters lead to more severe health impairments, as compared to moderate or low impact disasters, while the symptoms of health impairments generally decrease with time (Norris et al., 2002). Because Siegrist & Gutscher (2008) investigated negative emotions only nine months after an actual flood event, the intensity of those emotions may have caused a more direct and larger effect on preparedness behavior, as compared to the indirect effects that we found in our studies –which were performed two months after a heavy storm in 2006, about fifteen years after the near river floods in 1993 and 1995, and fifty-five years after the 1953 flood disaster. Moreover, there may be other qualitative differences between hazards that influence how (near) mishaps are perceived; e.g., whether one is exposed voluntarily (Slovic, 1987) or whether a hazard is perceived as natural or manmade (Sjoberg, 2000)– which are both relevant dimensions in the context of flood risk management in the Netherlands.

Second, trust in flood protection failed to have significant, direct effects on flood preparedness intentions. However, in the two coastal areas the effects of trust were mediated by perceived dread and perceived flood likelihood and in the river area also by the perceived flood consequences. Thus, trust played an important, central role because it reduced risk perceptions, had mediated effects causing lower preparedness intentions, and functioned as a mediator in itself for emotions.

Third, in contrast to claims that perceived consequences are the most important factor in risk perceptions (Sjöberg, 2006), our results showed that the perceptions of flood consequences play a marginal role in flood preparedness–

i.e., there were few consistent paths to and from perceived consequences (see Figure 2.5). More consistent, in all three areas trust in flood protection lessened perceptions of flood likelihood and dread, and these in turn predicted preparedness intentions. These results should be viewed in the context of Dutch flood risk management. Historically, the Dutch have relied primarily on the maintenance of strong and sizeable flood defenses. By observing the magnitude of these flood defenses (e.g., personally, on television, or on the internet), people are provided with a yardstick for estimating the protection level, most likely inspiring trust in flood protection. In addition, government risk communications during the previous decades have primarily emphasized the strength of the Dutch flood defenses. Since risk communications have almost completely failed to inform citizens about the potentially large consequences of flooding, it is not surprising that citizens' perceptions of flood consequences have little effect on their attitudes towards private flood preparedness.

Another way to view the results is to summarize the mechanisms in two parallel paths: an affective route and a cognitive route, from perceptions to behavior. Both paths include multiple dependent variables and indicate how people combine affect and reason in order to respond to risk (see Finucane & Holup, 2006). The affective route is reflected in the chain "emotions attached to previous experience / trust in flood protection → perceived dread → preparedness intention". Affect is an important resource for judging risks for two reasons. First, because lay people lack the knowledge needed to make expert judgments, they require a more intuitive mechanism for making risk judgments (Siegrist & Cvetkovich, 2000). Our path models showed that negative feelings decreased trust in flood protection and increased flood risk perceptions, while positive feelings had the opposite effect. Because we tapped these feelings at the end of the questionnaire, priming effects were impossible. Rather, we argue that these findings should be interpreted in the light of the affect heuristic (e.g., Slovic et al., 2007). It seems plausible that by confronting citizens with questions about flood risk, their memory was triggered to search for relevant information. Among the retrieved information were positive and negative feelings that were associated with the subject's experiences. Likely, these available affective feelings subsequently guided the respondent's perceptions of flood risk–in particular, the amount of dread evoked by flood risk. In addition, trust in flood protection was also influenced by positive and negative feelings associated with previous flood hazard experiences. This supports the idea that trust and affect share similarities (Poortinga & Pidgeon, 2005) and that both may serve as a quick guide for judging risks, because both reduce the complexity of judging risk. Consistent with this view, Poortinga & Pidgeon (2006) found that people's feelings about genetically modified food guided their trust in risk regulation of genetically modified food. In addition, Metlay (1999) found that trust in the U.S. Department of Energy was partly explained by affective beliefs about this institution.

Second, affective, intuitive feelings are also important because they are essential for guiding more cognitive, rational judgments (e.g., Damasio, 1994; Epstein, 1994; Slovic, Peters, Finucane, & MacGregor, 2005).

The more cognitive route is reflected in the chain "trust→perceived likelihood→preparedness intention". Although we place trust in the affective route, we also believe that it is informed by logical thinking. Research that has been devoted to distinguishing dimensions of trust has often found that perceived competence or expertise of risk management institutions underpinned trust ratings (e.g., see Poortinga & Pidgeon, 2003; Siegrist et al., 2005). The perceived expertise of risk management authorities can be regarded as a more cognitive component of trust because it can be judged based on these authorities' past behavior. In general, Dutch flood risk management authorities are highly regarded for their technical skills[3]. Moreover, the expertise and quality of flood risk management can also be judged by personally observing the flood defenses. Indeed, our model supported the idea that beliefs about flood likelihood are lessened by high levels of trust in flood protection. Low perceptions of flood likelihood in turn hampered citizens' flood preparedness intentions.

It is important to acknowledge the studies' limitations. First, both surveys had low response rates (approximately 10%) which might raise questions about the extent to which the sample is representative of the Dutch population. Indeed, comparison of the respondents from each risk area to NRM2004 database[4] (Goudappel Coffeng, 2004) showed the samples over-represented males and older residents–just as in U.S. samples (e.g., Lindell & Hwang, 2008; Lindell, Arlikatti, & Prater, 2009). This could be problematic for two reasons. First, over-representation of some demographic categories could produce biases in the means of psychological variables, but only to the degree the latter are correlated with demographic variables. However, the samples in this paper were non-representative of the Dutch population by definition because we were aiming to assess the effects of a specific population characteristic–i.e., the effects of emotions attached to previous flood hazard experiences. Thus, rather than means we were interested in correlations. Lindell & Perry (2000) argued that low response rates would affect correlations only if the item variances were severely restricted by severe over-representation of respondents at one end of the response distribution, which was not the case. Because correlation coefficients are resistant to mean bias the results can be taken at face value. Second, this study –like all cross-sectional designs– has limited ability to draw conclusive causal inferences. Strictly, the cross sectional data cannot identify temporal order–i.e., whether, if two variables are correlated, A caused B or vice versa (Lindell & Hwang, 2008; see also James, Mulaik, & Brett, 1982). Although hypotheses about causality were carefully derived from the literature, additional research will be required to provide conclusive evidence; for instance by applying longitudinal designs and laboratory experiments.

[3] According to a nationwide opinion poll, knowledge of water management was the number one source of national pride among the Dutch (Water Forum Online, 4 May 2006).

[4] The NRM2004 database provides information about the demographic characteristics of the Dutch population on the level of zip codes within predefined flood risk areas (so-called dike rings). The primary source of NRM are the demographic population characteristics from Statistics Netherlands, who is the responsible organization in the Netherlands for collecting and processing data in order to publish statistics to be used in practice, by policymakers and for scientific research.

In summary, the goal of this paper was to gain insight about the mechanisms that influence citizens' flood preparedness intentions, with a specific focus on the role of emotions, trust, and perceived risk. The results showed that both affective and cognitive processes together influenced citizens' behavioral intentions. Moreover, this finding is consistent with much of the work that has been conducted on affect and decision making (e.g., Loewenstein et al., 2001; Slovic et al., 2005). However, the finding that, in addition to negative emotions, positive emotions also play a role is a novel empirical finding. Moreover, not only do actual disasters seem to evoke such emotions, but near misses and milder threats also seem to contribute to people's cognitive and affective responses to risk.

We recommend that measures of emotions be improved in future studies. The validity of the single item measure used in this paper was supported by respondents' negative and positive verbal descriptions of their feelings. Future studies may further improve the reliability of this measure by using verbal descriptions to develop multi-item scales. In addition, the current model can be extended by including more factors that explain preparedness behavior, for instance, by including people's beliefs about the efficacy of preparedness measures (e.g., an emergency kit) and their abilities to adopt such measures. A suitable framework is provided by the Protective Action Decision Model (Lindell & Perry, 2000; Lindell & Perry, 2004), which distinguishes between people's perceived resources to adopt hazard adjustments (e.g., time, skills, money, and cooperation from others) and beliefs about the efficacy of hazard adjustments (e.g., efficacy for protecting persons and property) (Terpstra & Lindell, in preparation). The current model did not include such measures due to its specific focus on affect, trust, and risk perceptions.

The results further suggest that risk communications should accommodate both the affective and cognitive routes for motivating disaster preparedness behavior. The current study showed that previous experiences fuel the affective route with emotions. However, because flood probability is low in the Netherlands, the challenge is therefore how to "infuse needed 'doses of feeling' into circumstances where lack of experience may otherwise leave us too 'coldly rational'" (Slovic et al., 2004, p.320).

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2.6 REFERENCES

Agaibi, C. E., & Wilson, J. P. (2005). Trauma, ptsd, and resilience: A review of the literature. *Trauma Violence & Abuse, 6*(3), 195-216.

Brown, R. L. (1997). Assessing specific mediational effects in complex theoretical models. *Structural Equation Modeling, 4,* 142–156.

Byrne, M. B. (2001). *Structural Equation Modeling with Amos. Basic Concepts, Applications, and Programming.* Mahwah, NJ: Lawrence Erlbaum Associates.

Damasio, A. R. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain*. New York: Avon.

Earle, T. C., & Cvetkovich, G. T. (1995). *Social Trust. Towards a Cosmopolitan Society*. London: Praeger.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist, 49*(8), 709-724.

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making, 13*(1), 1-17.

Finucane, M. L., & Holup, J. L. (2006). Risk as value: Combining affect and analysis in risk judgments. *Journal of Risk Research, 9*(2), 141-164.

Folkman, S., & Moskowitz, J. T. (2000). Positive affect and the other side of coping. American Psychologist, 55(6), 647-654.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology - the broaden-and-build theory of positive emotions. *American Psychologist, 56*(3), 218-226.

Fredrickson, B. L., Tugade, M. M., Waugh, C. E., & Larkin, G. R. (2003). What good are positive emotions in crises? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *Journal of Personality and Social Psychology, 84*(2), 365-376.

Goudappel Coffeng (2004). NRM-basisbestand 2004. Delft: Dienst Verkeer en Scheepvaart. Grothmann, T., & Reusswig, F. (2006). People at risk of flooding: Why some residents take precautionary action while others do not. *Natural Hazards, 38*(1-2), 101-120.

Halpern-Felsher, B. L., Millstein, S. G., Ellen, J. M., Adler, N. E., Tschann, J. M., & Biehl, M. (2001). The role of behavioral experience in judging risks. *Health Psychology, 20*(2), 120-126.

IPCC (2007). Summary for policymakers. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M.Tignor & H. L. Miller (Eds.), *Climate change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

James, L. R., Mulaik, S. A., & Brett, J. M. (1982). *Causal analysis: Assumptions, Models and Data*. Beverly Hills: Sage.

Jonkman, S. N. (2005). Global perspectives on loss of human life caused by floods. *Natural Hazards, 34*(2), 151-175.

Keller, C., Siegrist, M., & Gutscher, H. (2006). The role of the affect and availability heuristics in risk communication. *Risk Analysis, 26*(3), 631-639.

Kline, R. B. (2005). *Principles and Practice of Structural Equation Modeling* (2 ed.). New York: The Guilford Press.

Lindell, M. K., Arlikatti, S., & Prater, C. S. (2009). Why people do what they do to protect against earthquake risk: Perceptions of hazard adjustments and their attributes. *Risk Analysis, 29*(8), 1072-1088.

Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis, 28*(2), 539-556.

Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard - a review of research. *Environment And Behavior, 32*(4), 461-501.

Lindell, M. K., & Perry, R. W. (2004). *Communicating Environmental Risk in Multiethnic Communities*. Thousand Oaks, California: Sage Publications, Inc.

Linnerooth-Bayer, J., & Amendola, A. (2003). Introduction to special issue on flood risks in Europe. *Risk Analysis, 23*(3), 537-543.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127*(2), 267-286.

Metlay, D. (1999). Institutional trust and confidence: A journey into a conceptual quagmire. In G. T. Cvetkovich & R. E. Lofstedt (Eds.), *Social Trust and the Management of Risk*. (pp. 100 -116). London: Earthscan.

Norris, F. H., Friedman, M. J., Watson, P. J., Byrne, C. M., Diaz, E., & Kaniasty, K. (2002). 60,000 disaster victims speak: Part I. An empirical review of the empirical literature, 1981-2001. *Psychiatry-Interpersonal and Biological Processes, 65*(3), 207-239.

Peacock, W. G., Brody, S. D., & Highfield, W. (2005). Hurricane risk perceptions among Florida's single family homeowners. Landscape and Urban Planning, 73(2-3), 120-135.

Perez-Sales, P., Cervellon, P., Vazquez, C., Vidales, D., & Gaborit, M. (2005). Post-traumatic factors and resilience: The role of shelter management and survivours' attitudes after the earthquakes in El Salvador (2001). *Journal of Community & Applied Social Psychology, 15*(5), 368-382.

Peters, O. (2009). A social cognitive perspective on mobile communication technology use and adoption. *Social Science Computer Review, 27*(1), 76-95.

Poortinga, W., & Pidgeon, N. F. (2003). Exploring the dimensionality of trust in risk regulation. *Risk Analysis, 23*(5), 961-972.

Poortinga, W., & Pidgeon, N. F. (2005). Trust in risk regulation: Cause or consequence of the acceptability of gm food? *Risk Analysis, 25*(1), 199-209.

Poortinga, W., & Pidgeon, N. F. (2006). Prior attitudes, salient value similarity, and dimensionality: Toward an integrative model of trust in risk regulation. *Journal of Applied Social Psychology, 36*(7), 1674-1700.

Schumacker, R. E., & Lomax, G. L. (2004). *A Beginner's Guide to Structural Equation Modeling* (2 ed.). Mahwah, NJ Lawrence Erlbaum.

Siegrist, M., & Cvetkovich, G. T. (2000). Perception of hazards: The role of social trust and knowledge. *Risk Analysis, 20*(5), 713-719.

Siegrist, M., & Gutscher, H. (2006). Flooding risks: A comparison of lay people's perceptions and expert's assessments in Switzerland. *Risk Analysis, 26*(4), 971-979.

Siegrist, M., & Gutscher, H. (2008). Natural hazards and motivation for mitigation behavior: People cannot predict the affect evoked by a severe flood. *Risk Analysis, 28*(3), 771-778.

Siegrist, M., Gutscher, H., & Earle, T. C. (2005). Perception of risk: The influence of general trust, and general confidence. *Journal of Risk Research, 8(*2), 145-156.

Sjoberg, L. (2000). Factors in risk perception. *Risk Analysis, 20*(1), 1-11.

Sjöberg, L. (2006). Will the real meaning of affect please stand up? *Journal Of Risk Research, 9*(2), 101-108.

Slovic, P. (1987). Perception of risk. *Science, 236,* 280-285.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis, 24*(2), 311-322.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research, 177*(3), 1333-1352.

Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision making. *Health Psychology, 24*(4), S35-S40.

Statistics Netherlands (CBS) (2008). Media products more often through the internet (*Dutch:* Mediaproducten steeds meer via internet). Press release pb08-071, October 28.

Tang, C. S. K. (2006). Positive and negative postdisaster psychological adjustment among adult survivors of the Southeast Asian earthquake-tsunami. *Journal of Psychosomatic Research, 61*(5), 699-705.

Tedeschi, R. G., & Calhoun, L. G. (2004). Posttraumatic growth: Conceptual foundations and empirical evidence. *Psychological Inquiry, 15*(1), 1-18.

Ten Brinke, W. B. M. & Bannink, B.A. (2004). *Dutch Dikes and Risk Hikes: A Thematic Policy Evaluation of Risks of Flooding in the Netherlands. (in Dutch: Risico's in Bedijkte Termen: Een Thematische Evaluatie van het Nederlandse Veiligheidsbeleid Tegen Overstromen)*. Bilthoven, The Netherlands: RIVM.

Terpstra, T., & Gutteling, J. M. (2008). Households' perceived responsibilities in flood risk management in the Netherlands. *International Journal of Water Resources Development, 24*(4), 555-565.

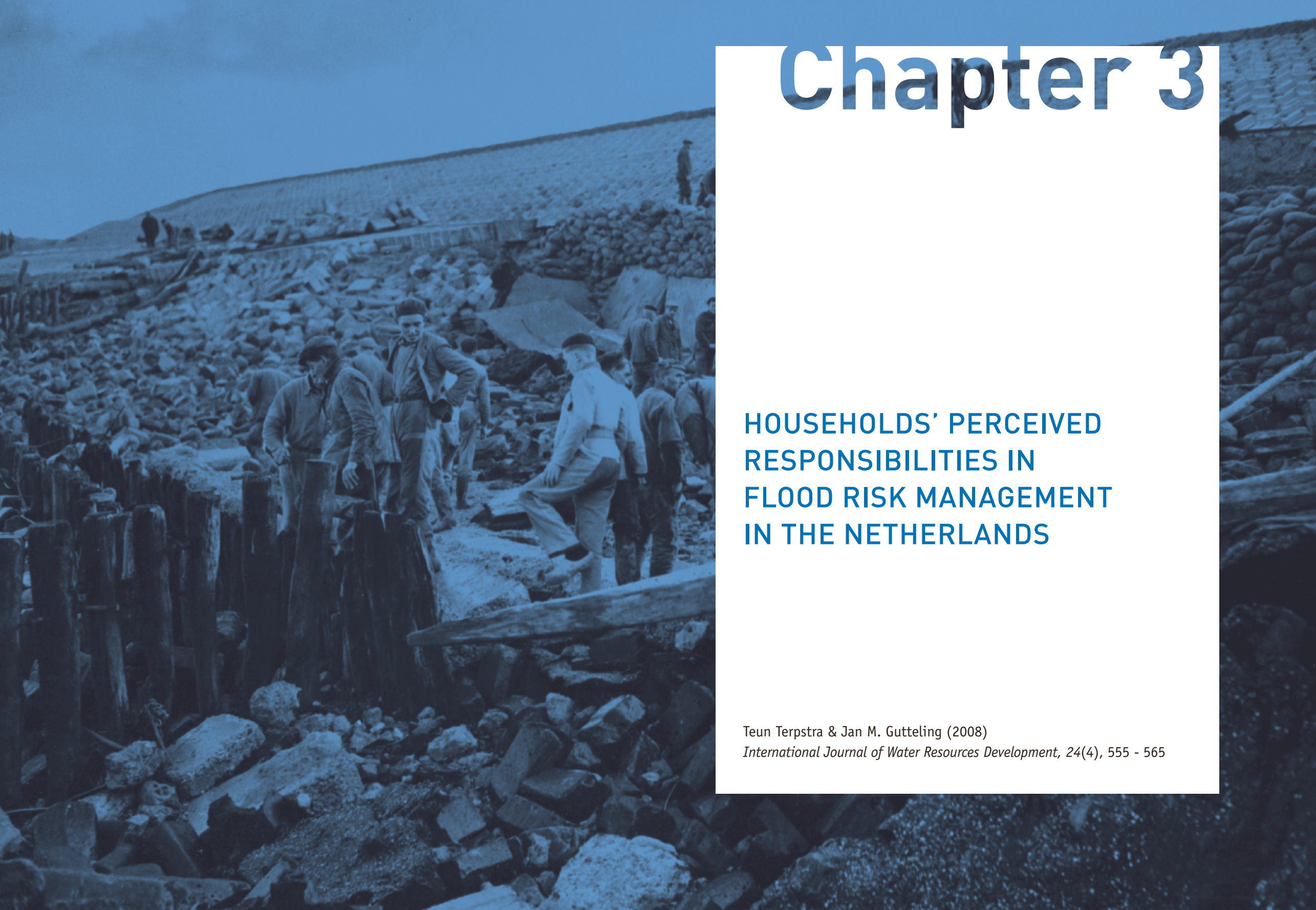
Terpstra, T., & Lindell, M. K. (in preparation). Citizens' perceptions of flood hazard adjustments: An application of the protective action decision model.

Terpstra, T., Lindell, M. K., & Gutteling, J. M. (2009). Does communicating (flood) risk affect (flood) risk perceptions? Results of a quasi-experimental study. *Risk Analysis, 29*(8), 1141-1155.

Tugade, M. M., & Fredrickson, B. L. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology, 86*(2), 320-333.

Vastfjall, D., Peters, E., & Slovic, P. (2008). Affect, risk perception and future optimism after the tsunami disaster. *Judgment and Decision Making Journal, 3*(1), 64-72.

Vazquez, C., Cervellon, P., Perez-Sales, P., Vidales, D., & Gaborit, M. (2005). Positive emotions in earthquake survivors in El Salvador (2001). *Journal of Anxiety Disorders, 19*(3), 313-328.



Chapter 3

HOUSEHOLDS' PERCEIVED RESPONSIBILITIES IN FLOOD RISK MANAGEMENT IN THE NETHERLANDS

Teun Terpstra & Jan M. Gutteling (2008)
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ABSTRACT

Flood risk management in the Netherlands is on the eve of shifting primarily from prevention towards risk management, including disaster preparedness and response and citizen participation. This study explores Dutch households' perceived responsibility for taking private protection measures. Survey results (n = 658) indicate that flood risk perception is low, that 73% of the respondents regard the government as primarily responsible for protection against flood damage, but that about 50% viewed disaster preparedness as an equal responsibility between themselves and the government. Thus, a substantial part of the public may have an open attitude to communication about disaster preparation measures. Dilemmas for increasing citizen participation are discussed.

KEYWORDS

flood risk
personal protection responsibility
risk perception
trust
disaster preparedness
damage mitigation

3.1 INTRODUCTION

Flood Risk in the Netherlands

The Netherlands is situated in one of the world's major delta areas in North West Europe. Bordered by the North Sea, several major European rivers (Rhine, Meuse and Scheldt) flow through the country and eventually discharge into the sea. For centuries the primary aim of water management has been to protect this low-lying, waterlogged country against flooding from the sea and the rivers (Beesen, 1998). However, despite all past and current engineering operations to maintain and increase flood safety, there is no such thing as absolute safety, and flood risk will always remain a major risk to the Netherlands (Ministry of Transport, Public Works & Water Management, 2006).

Since the Middle Ages, many floods have been chronicled (Buisman, 1995). In managing flood risk, dykes were built increasingly stronger and higher, continually reducing the likelihood of flooding. In a reaction to devastating floods, two major engineering projects carried out in the 20th century have greatly contributed to a reduction of flood probability in the Netherlands. First, in 1932 the Closure-dyke was finished, sealing off the Zuider Zee (now: Lake IJssel) from the North Sea. During the second half of the 20th century the Delta Works were carried out, encompassing the construction of many dams that resulted in high safety standards for flood protection.

Public Flood Risk Management

Until today, flood risk has always been managed by means of collective flood protection. Because 26% of the country lies below sea level and two-thirds would be regularly inundated without protective dykes even in a normal situation (Nes et al., 2001), a cooperative system of flood risk management has been an essential part of life to fight the water. Since the 12th century the 'water board' has been a form of local government and cooperation with just one purpose: to keep the land dry. These local organizations were formed throughout the country, and at one time many thousands existed. The Dutch constitution that was adopted in 1848 was the first national law to regulate water management. The water board was made responsible for water management in the Netherlands under the supervision of the provincial government. In the 19th and 20th century reorganizations changed the 'landscape' of the water boards by increasing their scale of operations and management power. Currently, the country has 27 water boards.

Since the completion of the engineering works in the 20th century, the economic value at risk in the low-lying areas of the Netherlands has grown considerably, as has the population. With a growing awareness of the potential consequences of global climate change in the form of rising sea levels and potentially more frequent and more devastating flood events–the impact of

which has been painfully illustrated by the effects of hurricane Katrina and the subsequent flooding of New Orleans in 2005–flood risk is starting to become a major (political) issue once again. The discussions between experts in flood risk management seem to have taken a new (historical) turn. Instead of focusing primarily on prevention by maintaining a very small flood probability, increasingly more attention is given to disaster preparedness and response. In this expert debate, one of the focal points is the divide between public and private responsibilities in flood risk management in the Netherlands.

Individual Flood Risk Management

Since, historically, flood risk has been an issue of local, provincial and national governments, the level of participation by Dutch individual citizens has been very low. While the government is becoming increasingly aware of the fact that it cannot guarantee its citizens 100% safety from flood risk, questions arise about what individual citizens can do –in addition to the high quality government flood prevention activities– to protect themselves against flood risk, what type of public behaviour may be expected in flood crisis situations, or what other options individuals might have for flood risk management (such as buying flood insurance for their property).

Because private responsibility by individual citizens has not existed, flood risk has never been the subject of public debate in the Netherlands. With the large amount of expertise on flood protection, the high safety standards of Dutch flood defences and no substantial governmental risk communication, it can be expected that the average Dutch individual has a low sense of urgency for thinking about his own responsibility in taking risk mitigation activities. Therefore, this study investigates public perceptions of flood risk as a proxy for 'sense of urgency', and focuses specifically on the relation between flood risk perception and people's perceived own responsibility for flood protection.

In the field of disaster research, people's beliefs about their own levels of responsibility for protection from a hazard is generally believed to be an important variable, contributing to the understanding of why people fail or succeed in protecting themselves from environmental hazards (Lindell & Perry, 2000, 2004; Lindell & Whitney, 2000; Paton, 2003). Early studies in the United States on earthquake hazard (Jackson, 1977, 1981; see Lindell & Perry, 2000) reported low levels of earthquake preparedness among risk area residents. Interestingly, the majority of these respondents also attributed responsibility for preparedness to public authorities. A later study by Garcia (1989) reported an inverse pattern where high-perceived personal responsibility coincides with a higher level of seismic adjustment adoption. Since then, a number of studies have shown that individuals, who believe that protection against risks is their personal responsibility, can be expected to have a stronger tendency to take protective actions. For example, Lindell & Whitney (2000) conducted a survey

(n = 168) and found significant positive correlations between measurements of personal protection responsibility and seismic adjustments intention and adoption. Mulilis & Duval (1995, 1997) and Duval & Mulilis (1999) showed that individuals' levels of earthquake and tornado preparedness depended on whether perceived resources (self efficacy and response efficacy) to cope with the threat were perceived as sufficient relative to the perceived magnitude of the threat (likelihood of the threat, severity of consequences). Given the resources perceived as sufficient, higher levels of perceived risk resulted in higher levels of preparedness. Whereas the results of Mulilis & Duval (1995) already pointed to a higher level of earthquake preparedness for a stronger self-attribution of responsibility, Mulilis & Duval (1997) provided substantial evidence. Lalwani & Duval (2000) further investigated the conditions under which people attribute responsibility for protection to the self or to others (the latter they call "defensive attribution" p. 2235). These authors showed that when external factors indicated that a person was self-responsible for earthquake preparedness, this responsibility was accepted only in case the perceived resources were sufficient relative to the threat. In case resources relative to the threat were evaluated as insufficient, responsibility was attributed to the government. In contrast, when external factors indicated that earthquake preparedness was not a personal responsibility, the perceived (in)sufficiency of resources did not affect the locus of protection responsibility. In other words, a person's initial belief of protection responsibility *combined* with their assessment of resources versus threat seems to matter for the outcome of perceived locus of protection responsibility.

Hypotheses and Research Questions

Research on the role of personal protection responsibility for flood protection issues in the Netherlands is non-existent, and is modest in a more general sense with most of the investigations focusing on seismic hazards in the USA. Lindell & Perry (2004) suggested that correlations between personal protection responsibility and other variables may vary with the hazard agent involved. Therefore, it is important that research findings will also be extended to other hazards domains. Given (1) these considerations and (2) the current debate on the divide between public and private responsibility in Dutch flood risk management –with an increasing appreciation to promote disaster preparedness– an empirical study was conducted of Dutch households' perceptions of responsibility for protection against flood risk. The paper explores how personal protection responsibility relates to flood risk perception, trust, flood mitigation attitudes and flood mitigation behavioural intentions.

Based on the existing literature on personal responsibility for risk mitigation, and based on the historically grown situation of a low level of participation by individual citizens in flood risk management in the Netherlands, the study is expected to find that, on average, respondents express a low level of

risk perception and a high level of trust in flood risk management. Furthermore, it is expected that the majority of the respondents will attribute responsibility for flood risk preparation and flood damage mitigation to the government. With respect to the individual's perception of their own responsibility for flood risk mitigation and preparedness, it is expected that a negative correlation will be found for flood mitigation attitudes and flood mitigation behavioural intentions.

3.2 METHOD

Study Area, Sample and Procedures

Data were collected by means of an Internet survey in the province of Friesland, which is prone to flooding from two water bodies; in the west from the fresh water lake, Lake IJssel, and in the north from the tidal Wadden Sea which is connected to the North Sea. Data were collected in two municipalities, Ferwerderadeel and Dongeradeel, which are located at the coast of the Wadden Sea. The inhabitants of this area are protected by a dyke with an allowable frequency for overtopping of 1/4000 per year. About one month before data collection this part of the Netherlands experienced storm conditions (10-11 Beaufort Scale), pushing the water of the Wadden Sea to a relatively high level. This event gained significant national and international media attention, due to the fact that approximately 100 horses were trapped on small plot of land and surrounded by rising water on an unprotected floodplain.

A random sample of household addresses from the telephone directory was sent a letter inviting them to participate in the study. The letter contained an Internet address guiding respondents to the questionnaires as well as a password to enter the questionnaire version they had been invited to complete. Data were collected between 8 December 2006 and 10 January 2007. In total, 826 people participated (response rate 11.8%). After deleting incomplete questionnaires, 658 completed questionnaires were analyzed. A description of the demographic characteristics of the sample is given in Table 3.1. The Table indicates that overall 71% of the respondents are male, and that the distribution of male/female respondents is identical for both versions. The mean age of the respondents is 50.76 years, and is similar for both versions.

Measures

The survey questionnaire addressed all variables under study. To reduce the questionnaire's size, two versions were developed. Both versions tapped respondents' risk perceptions and trust in flood risk management; version 1 continued with the topic 'private measures to mitigate potential flood damage to possessions', while version 2 addressed 'actions to become disaster prepared'.

Of the respondents, 318 completed version 1 of the questionnaire, and 340 version 2 (see Table 3.1).

Table 3.1
Distribution of gender and age of the 631 respondents in the study

	Version 1 damage mitigation	Version 2 disaster preparedness	Total
Gender, N (%)			
Male	229 (72%)	241 (71%)	470 (71%)
Female	89 (28%)	99 (29%)	188 (29%)
Total	318 (100%)	340 (100%)	658 (100%)
[a] Age, M (*SD*)	50.21 (*12.78*)	51.23 (*13.12*)	50.76 (*12.97*)

N = number of cases; M = Mean; *SD* = Standard Deviation.
Distribution of gender and age is similar in version 1 and 2.
[a] 28 respondents failed to report their age (26 respondents in version 1 and 2 respondents in version 2).
Distribution of gender and age is not representative of the general population in the two municipalities.

All items were provided on five-point Likert-scales. Response categories were labeled using the prefixes 'totally not', 'hardly', 'somewhat', 'quite', and 'very', unless stated differently in this section. For a number of measures multi-item scales were developed. Scales were tested for internal consistency and satisfactory Cronbach's alphas (between .87 and .92) were found. Furthermore, most items referred explicitly to the Wadden Sea as the water body under consideration. Risk perceptions were investigated using a number of measures. Respondents rated their personal risk of flooding, the likelihood of a flood event in Friesland within the next 10 years, severity of personal consequences, feelings of fear when thinking about flooding (six-item scale), perceived control during a flood event (six-item scale), and the frequency with which they thought (salience) of flood risk (scale ranging from 'almost never' to 'very often'). To measure trust, the questionnaire referred explicitly to a number of public authorities with responsibilities for flood risk management in Friesland. Respondents rated trust in their expertise (four-item scale) and their credibility (four-item scale).

To investigate opinions on damage mitigation and disaster preparedness, first, respondents were presented with a number of potential mitigation measures (version 1), such as installing flood-proof materials for floors and placing sockets in higher positions, and preparedness measures (version 2), such as having an evacuation plan and having an emergency kit. Subsequently, their attitudes were measured towards taking private measures (four bipolar scales with response labels ranging from 'good-bad', 'for-against', 'negative-positive',

'advantageous-disadvantageous'). Finally, respondents rated responsibility for damage mitigation and disaster preparedness, ranging on a five-point scale from 'I am completely' to 'the government is completely'.

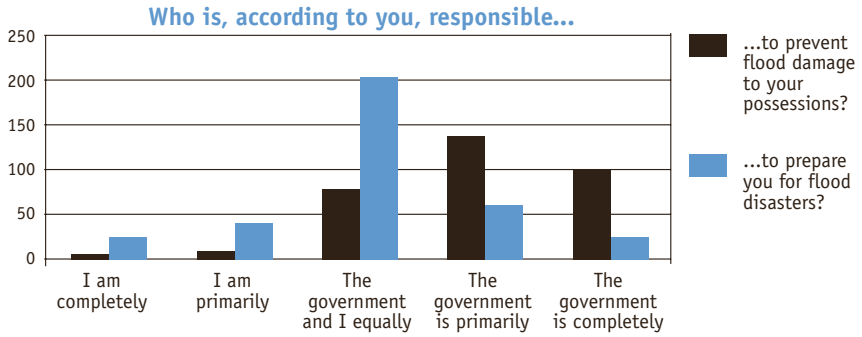
3.3 RESULTS

Personal Protection Responsibility

Perceptions of personal protection responsibility were investigated using two items (one in each version of the questionnaire). Figure 3.1 indicates that the vast majority of the respondents hold government primarily or completely responsible for damage mitigation. On the other hand, an overwhelming majority find both government and themselves equally responsible for preparing them (or the public) for flood disaster. So, respondents regarded public administrations as being primarily responsible for preventing or mitigating damage to their possessions (M = 3.99, *SD* = .85), while for disaster preparedness the average attitude reflected an equal division of responsibility (M = 3.05, *SD* = .89). The mean difference between these two measures was significant (t = 13.85, df = 656, p < .001). This result confirms the expectation with regard to prevention of damage. The respondents attributed more responsibility to themselves for disaster preparation than expected and than assumed by flood risk managers in the country. This open attitude by large parts of the public offers opportunities for a communication processes for disaster preparedness.

Figure 3.1

Distributions of number of respondents with respect to flood risk responsibility attribution



Risk Perceptions and Trust

In general, respondents revealed low-risk perceptions, which were reflected in the measures here of personal risk, salience, perceived likelihood and feelings of fear (see Table 3.2), e.g. the average score of 1.77 (measured on a five-point scale where 1 means that respondents think of and discuss flood risk with their peers almost never, and 5 means they think of and discuss flood risk with their peers very often) indicates a low level of salience. Nevertheless, to some extent the severity of personal consequences of flooding was appreciated (average score of 3.46, with 1 indicating not severe and 5 very severe). Finally, respondents had some confidence in their own capabilities to live through a flood event (average score on control is 3.10, with 1 no control and 5 much control).

Two dimensions of trust were measured. In particular, the perceived expertise of flood risk management gained rather high trust ratings (mean score of 3.77 on a five-point scale with 1 indicating no trust and 5 much trust). To some degree, managers and their organizations were also perceived as credible (average score 3.29); however, these ratings were significantly lower than the trust ratings for expertise (t = - 20.38, df = 657, p < .001). This result confirms the expectation with regard to flood risk perception and the level of trust.

Table 3.2

Means and standard deviations (*SD*) for all variables in the study

	M	*SD*
Risk perception and Trust (N = 658)		
Personal risk	2.40	1.02
Salience	1.77	.78
Severity consequences	3.46	1.20
Likelihood (10 years)	2.26	.99
Dread	2.53	.98
Control	3.10	.76
Trust: credibility	3.29	.85
Trust: expertise	3.77	.68
Disaster preparedness (N = 340)		
Responsibility preparedness	3.05	.89
Attitude preparedness	3.50	.83
Preparedness intention	2.73	1.09
Damage mitigation (N = 318)		
Responsibility mitigation	3.99	.85
Attitude mitigation	2.99	.98
Mitigation intention	2.47	.99

Note:
Variables on a 1 – 5 scale. '1' reflects the left hand side of the scales: no – high personal risk; hardly – very salient; not severe – very severe; not likely – very likely; no – much dread; no control – much control; no– much trust; self responsible – government responsible; negative – positive attitude; no – high intention.

Damage Mitigation and Disaster Preparedness

After having presented respondents with potential measures to mitigate flood damage and to prepare for flood disaster, they were asked to rate the responsibility for damage mitigation, and their attitude toward and behavioural intention to take flood damage mitigation actions (version 1) or the responsibility for disaster preparedness, and their attitude toward and behavioural intention to prepare for flood disasters (version 2). Table 3.2 indicates that behavioural intentions of the respondents on both versions of the questionnaire were not very high (preparedness intentions mean score 2.73, damage mitigation intention mean score 2.47), but higher for disaster preparedness ($t = 3.17$, $df = 656$, $p < .01$). The attitude toward disaster preparedness was more positive than the attitude for damage mitigation (mean score preparedness 3.50 versus 2.99 for damage mitigation; $t = 7.22$, $df = 656$, $p < .001$). As previously reported, respondents see themselves and the government equally responsible for disaster preparedness while damage mitigation is seen predominantly as a government responsibility. Together these results confirm the expectation with respect to damage mitigation, but they do not confirm the assumption regarding disaster preparedness.

Correlations between Measures

Perceived responsibility for mitigation and preparedness is not significantly correlated with mitigation and preparedness intentions (see Table 3.3). Responsibility for damage mitigation is significantly correlated with the perception of the severity of flood consequences, is negatively correlated with control, and negatively correlated with the attitude toward damage mitigation. This implies that when people express a less favourable attitude toward damage mitigation, perceive to have less control over their personal safety during a flood disaster and have a higher perception of the severity of flooding consequences, they are more likely to attribute responsibility for damage control to the government. With respect to disaster preparedness, all risk perception indicators are correlated significantly with attributed responsibility, but none of the others (trust, attitude or behavioural intention). This implies that when people see flooding more as a personal risk, it is more salient for them, they expect the consequences to be more severe, see floods as more probable in the near future, express more fear by floods, and perceive to have less control over their personal safety during flood disaster then they are more likely to attribute responsibility to government. This result only partly confirms the expectation regarding the negative correlation between attitudes and behavioural intentions with respect to damage mitigation and disaster preparedness. Only a negative significant relationship was found between attributed responsibility and attitude toward damage mitigation.

Table 3.3

Spearman correlations between attributed responsibility and risk perceptions, trust, attitude and behavioural intentions toward damage mitigation and disaster preparedness

	Attributed responsibility for damage mitigation	Attributed responsibility for disaster preparedness
Personal risk	.004	.206 **
Salience	.026	.133 *
Severity consequences	.142 *	.133 *
Likelihood (10 years)	-.005	.171 *
Dread	.039	. 205 **
Control	-.188 **	-.219 **
Trust: credibility	-.058	-.030
Trust: expertise	.006	-.066
Attitude toward damage mitigation	-.299 **	n/a
Intention toward damage mitigation	-.071	n/a
Attitude toward disaster preparedness	n/a	-.049
Intention toward disaster preparedness	n/a	.094

Note:
positive correlations imply a stronger attribution of responsibility to the government and less to the self; negative correlations imply the opposite.
** $p < .01$, * $p < .05$

3.4 CONCLUSION AND DISCUSSION

Flood risk management in the Netherlands is on the eve of shifting from primarily probability management (i.e. prevention) towards risk management with attention for prevention as well as flood disaster preparedness and response, and citizen participation. When flood disaster strikes, success or failure of society's response will also depend on citizens' individual capabilities to cope with the situation they are in. Therefore, increasing households' disaster preparedness may be crucial for saving lives and mitigating damage. This implies that individual citizens have a private responsibility for implementing their own mitigation and preparedness measures, which is, in the Dutch context of flood management, a new notion for both government and citizen. This study, undertaken among 658 households at the Wadden Sea-coast of the province of Friesland, is the first in the Netherlands to explore households' flood risk perceptions and their perceived responsibility for taking private damage mitigation and disaster preparedness measures.

Questions and concepts in the measurement instrument and expectations about the results to be found were derived from the international literature on responsibility attribution processes in the context of disaster preparedness and damage mitigation. In studying responsibility attribution, Lalwani & Duval (2000) showed that when there is not an obvious personal responsibility, subjects failed to take their personal responsibility even under conditions of a high threat and sufficient resources to cope with the threat. Their study also showed that when personal responsibility for disaster preparedness was more obvious, this responsibility was only accepted when individual coping resources were assessed as being sufficient relative to the perceived threat. Applying these results to the Dutch flood risk context it could be said that Dutch citizens are probably unaware of their personal responsibility in managing flood risk and unaware of their own coping possibilities, either by preparing for flooding or by making their homes flood resilient.

As predicted, respondents generally held low perceptions of flood risk, e.g. they hardly perceived flood risk as a personal risk, the vast majority (85%) indicated almost never or only sometimes thinking of flood risk, and the occurrence of flooding in the next 10 years was regarded as hardly likely. These findings seem to reflect flood risk management of the last decades quite well, characterized by a strong emphasis on flood prevention under complete governmental control, and with a lack of communication about the potential consequences of flooding.

However, as circumstances and risk management policies are changing, it should be known what citizens think about a situation in which they themselves must take some responsibility for disaster preparedness and damage mitigation. As predicted, this study indicates that the majority of the respondents (73%) regarded the government as primarily responsible for protection of their possessions against potential flood damage. As a consequence of the Dutch policy on flood risk management this result is not very surprising. However, with respect to the attributed responsibility for disaster preparedness the picture was different; about half of the respondents viewed disaster preparedness as an equal responsibility between themselves and the government, while 18% even expressed this primarily or exclusively as a personal responsibility. This is an important finding because it deviates from what many flood risk managers would have expected, and it indicates that large parts of the population are open to the suggestion that they should undertake some personal action to prepare for flood disaster.

But how do attributions of responsibility and risk perceptions affect mitigation and preparedness attitudes and behavioural intentions? The answer to this question is not straightforward in the case of Dutch flood management. The general proposition would be that people who perceive that they are personally responsible for protection from a hazard are more likely to adjust to that hazard (Lindell & Perry, 2004). However, the data here indicate that responsibility attribution is not correlated to intentions to implement damage mitigation or disaster preparedness measures. The data here also indicate that the attitude towards damage mitigation is related to perceived responsibility for damage mitigation, implying that those people who attribute responsibility for damage mitigation to government have a less positive attitude toward their own damage mitigation activities.

The results show a potential dilemma for the attempts to increase the level of participation of the Dutch public in flood risk management. Those who acknowledge the public's (and their own) role in flood risk management may be interested in finding out what would be the best personal strategy for disaster preparedness, and (risk) communication may be a suitable instrument to help them. The relatively low level of 'sense of urgency' in terms of risk perception is an issue here that may reduce this group's responsiveness to risk communication, and increasing this sense of urgency seems imperative. On the other hand, those that are not convinced about their own role and responsibility for taking disaster preparations may not be open to accept that type of information because people will not accept the notion of their own personal responsibility. The question remains what can be done to increase the level of involvement of this particular group. It is not acceptable to take this situation for granted. Future studies on the issue of responsibility attribution for flood disaster preparedness will have to focus on the question how this group can be motivated to take action. Options seem to lie in measures to increase the perception of risk in combination with a clear communication about the changing roles of government and the individual in flood risk management in the Netherlands.

3.5 REFERENCES

Beesen, van der, A. A. H. G. C. (1998). *Fourth National Policy Document on Water Management Government Decision: Abridged Version*. The Hague: Ministry of Transport, Public Works and Water Management.

Buisman, J. (1995). *Duizend Jaar Weer, Wind en Water in de Lage Landen*. Franeker: Van Wijnen.

Duval, T. S. & Mulilis, J. P. (1999). A person-relative-to-event (PrE) approach to negative threat appeals and earthquake preparedness: A field study. *Journal of Applied Social Psychology, 29*(3), 495–516.

Garcia, E. M. (1989). Earthquake preparedness in California: A survey of Irvine residents. *Urban Resources, 5*, 15–19.

Jackson, E. L. (1977). Public response to earthquake hazard. *California Geology, 30*, 278–280.

Jackson, E. L. (1981). Response to earthquake hazard: the West Coast of North America. *Environment and Behavior, 13*, 387–416.

Lalwani, N. & Duval, T. S. (2000). The moderating effects of cognitive appraisal processes on self-attribution of responsibility. *Journal of Applied Social Psychology, 30*(11), 2233–2245.

Lindell, M. K. & Perry, R. W. (2000). Household adjustment to earthquake hazard: A review of research. *Environment and Behavior, 32*(4), 461–501.

Lindell, M. K. & Perry, R. W. (2004). *Communicating Environmental Risk in Multiethnic Communities*. Thousand Oaks, CA: Sage Publications.

Lindell, M. K. & Whitney, D. J. (2000). Correlates of household seismic hazard adjustment adoption. *Risk Analysis, 20*(1), 13–25.

Ministry of Transport, Public Works and Water Management (2006). *Kabinetsstandpunt Rampenbeheersing Overstromingen,* DGW/WV 2006/1306.

Mulilis, J. P. & Duval, T. S. (1995). Negative threat appeals and earthquake preparedness: A person-relative-to event (PrE) model of coping with threat. *Journal of Applied Social Psychology, 25*(15), 1319–1339.

Mulilis, J. P. & Duval, T. S. (1997). The PrE model of coping and tornado preparedness: Moderating effects of responsibility. *Journal of Applied Social Psychology, 27*(19), 1750–1766.

Nes, R. v., Horsten, H. & Faddegon, K. (2001). *Watermonitor 2001. Veiligheid en Overlast, Verdroging en Watervervuiling*. Bussum: Van Nes Research Management.

Paton, D. (2003). Disaster preparedness: a social cognitive perspective. *Disaster Prevention and Management, 12*(3), 210–216.

Chapter 4

CITIZENS' PERCEPTIONS OF FLOOD HAZARD ADJUSTMENTS: AN APPLICATION OF THE PROTECTIVE ACTION DECISION MODEL

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Submitted

ABSTRACT

This paper addresses the attributes that may underlie people's attitudes towards flood hazard adjustments in the Netherlands, by applying the Protective Action Decision Model (PADM). The data, collected from randomly selected residents from two flood prone areas in the Netherlands (n = 1115), supported the construct validity of PADM's hazard-related attributes (perceived efficacy for protecting persons, property, and utility for other purposes) and resource-related attributes (requirements for cost, knowledge/skill, time/effort, cooperation from others). We tested a path model comprising five hypotheses to explain citizens' hazard adjustment adoption intentions. The model included the hazard adjustment attributes, attribute importance, risk perceptions, risk area, and demographic characteristics. First, correlation analysis indicated that the hazard-related attributes were positively correlated with adoption intentions, but rejected the hypothesis that resource requirements would show negative correlations. Second, to improve the predictive validity of the attributes we examined whether attribute importance moderated the effect of the attributes on adoption intentions. Although the results indicated that the hazard-related attributes were regarded as more important than the resource requirements, moderated regression analysis failed to detect substantial interaction effects. Third, as predicted, risk perception was positively correlated to adoption intentions but explained less variance than did the hazard-related attributes. Fourth, of the demographic variables, only female gender was correlated with risk perceptions and the hazard adjustment attributes. Finally, results indicated that there were differences in risk perception between the two risk areas. Directions for further research and practical implications are discussed.

KEYWORDS

hazard adjustment attributes
flood
protective action
attribute importance

4.1 INTRODUCTION

According to Munich Re (2000), European floods caused an estimated $U.S. 35.4 billion in economic losses during the period 1985-2000. In the current decade, European countries have suffered severe flood losses in 2002, 2005, and 2007 (Linnerooth-Bayer & Amendola, 2003). Besides the protection measures that are taken by governments (e.g., building flood defenses, installing early warning systems, issuing building regulations), risk area residents can take their own actions to protect their families and property against floods. According to the International Commission for the Protection of the Rhine (Egli, 2002), preparing for flooding by planning potential actions such as (re)moving furniture can reduce property damage up to 80%.

However, in a survey of 4,000 residents of flood prone areas in Germany, the Netherlands, Norway, Sweden, and the UK, over 80% indicated they had taken no steps to mitigate future losses or to prepare for flood emergency (Krasovskaia, 2005). Despite the very low level of protective action, little research has been undertaken to explain why residents fail to adopt flood hazard adjustments. Some evidence suggests that citizens' (over)confidence in collective flood defenses, such as dams and dikes, reduces their flood risk perceptions and inhibits their adoption of household flood hazard adjustments (Grothmann & Reusswig, 2006; Harding & Parker, 1974; Terpstra, in preparation).
Though previous flood experiences can fuel people's risk perceptions with the emotions that are important for stimulating adaptive behavior (Siegrist & Gutscher, 2008; Terpstra, in preparation-a), relatively few people have flood experience. Moreover, people sometimes misinterpret the relevance of past experience. Even some of those who have previously experienced flooding have a low perception of risk and refuse to protect themselves from an imminent flood hazard (Perry, Lindell, & Greene, 1981).

In addition to (over)confidence in collective flood defenses and lack of flood experience, there are other variables that are likely to influence citizens' attitudes towards household flood hazard adjustments. For instance, many behavioral theories predict that people will engage in problem focused coping (i.e., actions that actually reduce a threat) provided that they perceive opportunities that effectively reduce that threat, and believe they are personally capable of performing those actions. Such theories include, for instance, the Theory of Reasoned Action (TRA, Fishbein & Ajzen, 1975), Theory of Planned Behavior (TPB, Ajzen, 1991), Protection Motivation Theory (PMT, Rogers & Prentice-Dunn, 1997), and Person-relative-to-Event (PrE) Theory (Mulilis & Duval, 1995). So far, however, only Grothmann & Reusswig (2006) have used any of these theories to address citizens' attitudes towards flood hazard adjustments. Their application of PMT indeed showed that coping appraisal correlated slightly higher with the

adoption of flood mitigation measures than did their measure of threat appraisal. However, people's appraisal of informing themselves about self-protection did not correlate with information seeking behavior. Because the authors only reported the results of an overall measure of coping appraisal, it is unclear how the individual measures of perceived response efficacy, self efficacy, and the perceived response costs of hazard adjustments correlated separately with hazard adjustment adoption. In addition, a series of PrE-studies in the U.S. on earthquake (Mulilis & Duval, 1995) and tornado (Mulilis & Duval, 1997) hazards showed that risk area residents adopted hazard adjustments provided they believed the coping options were sufficient relative to the perceived threat and they felt personally responsible for taking protective action.

The current study therefore delves further into people's attitudes towards adopting flood hazard adjustments. The study is performed in the Netherlands, where flood risk management is currently shifting from primarily probability management (i.e., prevention) towards risk management with focus on prevention, flood disaster preparedness and response, as well as citizen participation (Ministry of Transport, Public Works, and Water Management, 2008). However, little research has been performed to investigate citizens' responses towards private flood preparedness. One theoretical framework seems particularly suited for this task because of its detailed conceptualization of the attributes that may underlie citizens' attitudes towards household adjustment to environmental hazards; the Protective Action Decision Model (PADM–Lindell & Perry, 1992, 2000, 2004; Perry et al., 1981).

4.2 THEORY AND HYPOTHESES

The PADM was first developed to explain people's protective action decisions in response to imminent disasters (Lindell & Perry, 1992), but has recently been extended to account for people's long-term hazard adjustments (Lindell & Perry, 2000, 2004). Similar to Janis & Mann's (1977) conflict model of decision making, PADM models citizens' protective action decisions as a stepwise process. These steps are reflected in five successive questions including "Is there a real threat that I need to pay attention to", "Do I need to take protective action", "What can be done to achieve protection", "What is the best method of protection", and "Does protective action need to be taken now?" Such a stepwise conceptualization is also recognized in PMT (Rogers & Prentice-Dunn, 1997), which asserts that a threat appraisal, PADM's first two questions, is required before one appraises potential coping behaviors, PADM's last three questions.

An important difference between PADM and PMT concerns how they conceptualize the variables related to the coping appraisal process.

PMT asserts that an adaptive coping response is predicted by three attributes; the perceived efficacy of a protective action for reducing the threat (response efficacy), a person's perceived self-efficacy for performing the protective action (self efficacy), and the perceived costs and barriers associated with performing the protective action (response barriers). Although PMT has been used extensively–but mostly in studies of health behavior–because of its many positive features (Floyd, Prentice-Dunn, & Rogers, 2000), it fails to distinguish between self-efficacy and response barriers. That is, measures of self efficacy often question "the problems individuals expect to encounter in adopting the precaution or doubts about their ability to change current patterns of behavior", which would be "labeled as cost or barriers by other theories" (Weinstein, 1993, p.327). Thus, it is unclear how PMT's construct of self-efficacy differs from its construct of response barriers.

As noted by Lindell et al. (1997), PADM organizes the attributes that people consider when searching for, selecting, and adopting hazard adjustments as hazard-related attributes (which describe the relationship between the hazard adjustment and the hazard) and resource-related attributes (which describe the relationship between the hazard adjustment and the household's resources). Hazard-related attributes ("efficacy attributes") include a hazard adjustments' perceived efficacy for protecting persons, property, and utility of hazard adjustments for other purposes. Resource-related attributes ("resource requirements") reflect perceived requirements for money, time and effort, knowledge and skills, tools and equipment, and cooperation from other persons to adopt hazard adjustments. PADM predicts that higher levels of perceived efficacy increase adoption intentions as well as actual adoption behavior, while higher levels of perceived resource requirements decrease adoption intentions and actual behavior.

Although a hazard adjustment's perceived efficacy for protecting persons and property and its perceived requirements for knowledge and skills are similar to PMT's response efficacy and self efficacy, respectively, there are distinct differences. First, PADM's efficacy attributes and resource requirements reflect a more detailed set of salient beliefs that affect the adoption of hazard adjustments. Second, unlike PMT's self-efficacy –which is a characteristic of an individual– PADM's resource requirements are characteristics of the hazard adjustments. Thus, hazard managers can assess people's beliefs about the resource requirements of different hazard adjustments and, if these beliefs are inaccurate, they can focus their hazard awareness programs on correcting the misconceptions.

A wide variety of studies on earthquake hazard adjustment adoption have reported evidence supporting the hazard adjustment attributes identified by PADM (see Lindell & Perry, 2000, for a review). More recent studies have shown the validity of distinguishing between hazard-related and resource-related attributes. In the context of earthquake risk, Lindell & Whitney (2000) and Lindell & Prater (2002) found that hazard attributes were highly intercorrelated

with each other, as were the resource attributes. Moreover, as predicted, the hazard attributes showed strong and positive correlations with adoption intentions. However, contrary to predictions, the correlations of the resource attributes were small and often not significant–indicating that the resource attributes had little predictive ability. More recently, Lindell, Arlikatti, & Prater (2009) found further support for the validity of the hazard- and resource-related attributes by showing significant differences among the mean ratings of the hazard adjustments on each attribute. Moreover, the fact that ratings of the hazard adjustments on each of the attributes were not uniformly distributed over their response scales and the mean attribute ratings deviated significantly from their scale midpoints suggested that these attributes were meaningful to respondents.

Most of these results supporting the PADM were obtained in studying earthquake hazard in the U.S. Thus, it remains to be seen to what extent these attributes generalize to other hazards and other populations. Because household hazard adjustment adoption is a novel element of environmental hazard management, few Dutch citizens so far may have thought about flood hazard adjustments and the attributes by which they can be evaluated. In addition to the practical problem this unfamiliarity poses to environmental hazard managers, it also is a potential problem for survey researchers because people who are asked for their opinions about issues for which they have no information, sometimes produce pseudo-attitudes (Converse, 1970; Schuman & Kalton, 1985). Pseudo-attitudes are usually influenced by extraneous conditions in the measurement context and are likely to be extremely unreliable (Lindell & Perry, 1991). Accordingly, it is important to examine the construct validity of hazard adjustment attribute ratings by following the procedures previously used by Lindell & Prater (2002), Terpstra, Lindell, & Gutteling (2009), and Lindell et al. (2009). Specifically, construct validity of the hazard adjustment attributes implies four hypotheses.

H1a: The distribution of the ratings for each of the hazard adjustment attributes will be significantly different from a uniform distribution.

H1b: The mean ratings for each of the hazard adjustment attributes will be significantly different from the midpoint of the scale.

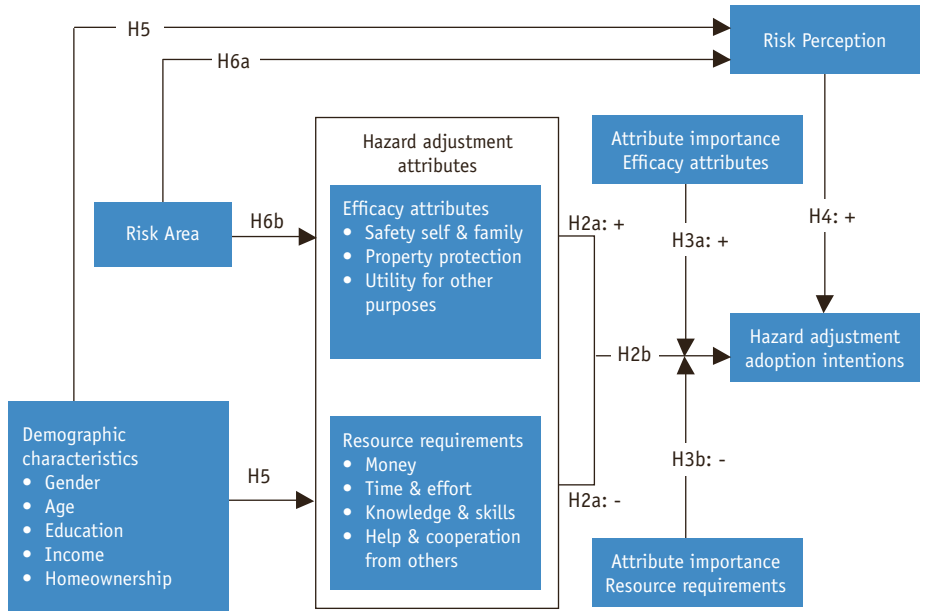
H1c: Each of the hazard adjustment attributes will differentiate among the hazard adjustments, as indicated by significant differences among hazard adjustments in respondents' mean ratings on each attribute.

H1d: The three hazard-related attributes (efficacy in protecting self and family, efficacy in protecting property, and suitability for other purposes) will be distinct from the four resource-related attributes (cost; knowledge and skill requirements; required time and effort; and required cooperation with others) as indicated by loadings on separate factors in a factor analysis.

In addition to assessing the construct validity of the hazard adjustment attributes, it will be necessary to assess their ability to predict citizens' behavioral responses to flood hazard. The examination of the hazard adjustment attributes' predictive validity is based on the model described in Figure 4.1, where perceptions of risk, hazard adjustment attributes, and attribute importance are hypothesized to predict hazard adjustment adoption intentions, and risk area and demographic characteristics are used to predict perceptions of risk and hazard adjustment attributes. This model implies a series of hypotheses that follow from the findings of previous research.

Figure 4.1

The Protective Action Decision Model applied to flood hazard adjustment adoption in the Netherlands



First, PADM's predictions that hazard adjustment attributes will affect hazard adjustment adoption intentions have received at least partial support but recent research suggests that efficacy attributes are more important than resource requirements (Lindell & Perry, 2000; Lindell & Prater, 2002; Lindell et al., 2009).

H2a: Hazard-related attributes will be positively correlated and resource-related attributes will be negatively correlated with adoption intentions.

H2b: Hazard-related attributes will be more strongly correlated with adoption intention than will be the resource-related attributes.

The finding that resource requirements seemed meaningful to the respondents but correlated less with adoption intentions than did efficacy attributes (Lindell & Prater, 2002; Lindell et al., 2009) might be explained by the idea that hazard adjustments are not only chosen based on the perceived qualities of hazard adjustments on these attributes (e.g., buying an emergency kit costs little money) but also on the basis of whether these attributes are important to one's adoption decisions. In fact, this idea that intentions and behavior are guided by both the expected outcomes on attributes (i.e., evaluation of attributes) and also their valences (i.e., perceived importance of attributes, or their salience) is an underlying assumption in many attitude-behavior models (e.g., TRA, TPB, PMT, and PADM). Thus, previous studies' lack of substantial correlations for the resource requirements with adoption intentions may only indicate that these attributes are much less important in making adjustment decisions than are the hazard attributes. Lindell et al. (2009) addressed this explanation indirectly by testing levels of interrater agreement on the hazard- and resource-related attributes and by comparing them to the levels of interrater agreement on the hazard adjustment adoption intentions. They argued that the more similar respondents' perceptions are of a given hazard adjustment on a particular attribute, the smaller will be the variance in the ratings on that attribute. However, even if people agree on the rating of a hazard adjustment on an attribute, the valence of that attribute (i.e., its perceived importance for adopting hazard adjustments) is still likely to differ among respondents. As a consequence, respondents would be expected to show less agreement on their adoption intentions than on their attribute ratings. Consistent with this reasoning Lindell et al. (2009) indeed found that there was less agreement in adoption intentions than on the attribute ratings. Although these findings indirectly support the notion of an expectancy-valence effect, it would be preferable to test this effect more directly by asking risk area residents about the importance of each of the hazard- and resource-related attributes for making decisions about the adoption of hazard adjustments. It is therefore predicted that attribute importance will moderate the effect of the attributes on adoption intentions.

H3a: For a high level of the hazard-related attributes, people who regard these attributes as important for their adoption decisions will have higher adop tion intentions than those who do not regard these attributes as important.

H3b: For a high level of the resource requirements, people who regard these attributes as important for their adoption decisions will have lower adoption intentions than those who do not regard these attributes as important.

In addition to the hazard- and resource-related attributes, perceived risk might also directly affect adoption intentions. Previous studies have generally shown that perceived risk is positively correlated with the adoption of hazard adjustments for earthquakes (Lindell & Perry, 2000), hurricanes (Lindell & Hwang, 2008), and floods (Lindell & Hwang, 2008; Terpstra, in preparation). However, Lindell & Whitney (2000) and Lindell & Prater (2002) reported that perceived seismic risk was less strongly correlated with adoption intentions than were the hazard-related attributes. This finding is consistent with TRA, which predicts that a one's attitude toward an act (i.e., attitude toward adopting a hazard adjustment) is more predictive of one's behavior than one's attitude toward an object (i.e., attitude toward the hazard). Data obtained by Grothmann & Reusswig (2006) on the adoption of flood hazard adjustments also supports this conclusion. Their measures of threat appraisal (i.e., perceived risk) and coping appraisal (i.e., a conjoint measure including response efficacy, self efficacy and response costs) both correlated positively with past adoption of flood mitigation measures, with coping appraisal showing the slightly higher correlations.

H4a: Risk perceptions will be a significant predictor of flood hazard adjustment intentions.

H4b: The amount of variance explained by perceived risk will be less than the amount of variance explained by the hazard-related attributes.

Previous research has also reported significant correlations of demographic characteristics with both risk perception (Adeola, 2000; Fothergill, 1996; Fothergill, Maestas, & Darlington, 1999; Fothergill & Peek, 2004; Lindell & Hwang, 2008) and hazard adjustment attributes (Lindell et al., 2009). With regard to the latter, older respondents, Whites, and homeowners gave lower ratings to those adjustments' resource requirements but they also gave lower ratings to those hazard adjustments' effectiveness. Moreover, women considered the hazard adjustments to be more effective and cost more, but were no different from men in their assessments of the remaining resource requirements. Nonetheless, the effects of these demographic variables were much smaller than the tendency of respondents with higher hazard experience, risk perception, and hazard intrusiveness (all of which were intercorrelated, see Lindell & Prater, 2002) to rate the hazard adjustments higher on the effectiveness attributes.

H5a: Demographic characteristics –gender (women higher), age, and homeownership (homeowners lower)– will be significantly related to risk perception.

H5b: Demographic characteristics –gender (women higher), age, and homeownership (homeowners lower)– will be significantly related to both the hazard- and resource-related attributes.

Recent research has shown that location in a risk area is a significant predictor of risk perception, both indirectly (via hazard experience, Terpstra, in preparation) and directly (Lindell & Hwang, 2008). However, it seems plausible that location in a risk area would also affect people's perceptions of hazard adjustments, particularly their perceptions of efficacy in protecting persons and property.

H6a: Risk area will be correlated with risk perception.
H6b: Risk area will be correlated with two hazard-related attributes, efficacy for protecting persons and efficacy for protecting property, but not the remaining attributes.

4.3 METHOD

Study areas, samples, and procedures

An internet based questionnaire survey was performed in two areas– a coastal area and a river area. Samples of 5,000 (coastal risk area) and 7,000 (river risk area) household addresses were drawn at random from a telephone book. Sample members were sent a letter explaining our research and inviting them to participate in our internet survey. Each letter contained the internet address and a password for taking the questionnaire. All invitations were sent April 1, 2008, followed by two reminders three and five weeks after the invitation letter. The questionnaire entries were closed at May 31, 2008. Response rates were 12.9 % (coastal area) and 9.6% (river area), respectively. About 15% of the respondents failed to complete substantial parts of the questionnaire and were therefore omitted from the analyses.

The resulting samples –consisting of 553 (coastal area) and 562 (river area) questionnaires, respectively– were similar with respect to the distribution of gender (Mann-Whitney U, Z = -.07, *ns*), mean age (t_{1106} = -.66, *ns*), education (χ^2_3 = 2.88, *ns*), home ownership (Mann-Whitney U, Z = -1.55, *ns*), and income (χ^2_4 = 4.24, *ns*). Overall, 68% were males, mean age was 53.3 years (*SD* = 13.2), 82% owned their house, median education was higher level secondary school (which is five or six years of formal education after primary school) or higher level of vocational school (a bachelor degree), and median income was between € 34,000 and € 56,000 per year (before taxes). Seven persons failed to report their age, and an additional seven persons failed to report their education and income as well.

The response rate is lower than desired, which might raise questions about sample representativeness. Indeed, comparison of the respondents from each risk area to NRM2004 database[1] (Goudappel Coffeng, 2004) showed the sample over-represented males, homeowners, and older residents–just as in U.S. samples (e.g., Lindell & Hwang, 2008; Lindell et al., 2009). Although education could not be compared directly to the NRM2004 database, because of a mismatch between the questionnaire and the database education-classification, the sample most likely also overrepresented higher levels of education than the populations from which they were drawn. However, over-representation of some demographic categories will produce bias in psychological variables only to the degree the latter are correlated with demographic variables. However, such correlations are generally low (Lindell & Perry, 2000). Moreover, reports by Curtin, Presser, & Singer (2000), Keeter, Miller, Kohut, Groves, & Presser (2000), and Lindell & Perry (2000) indicate low response rates do not appear to bias central tendency estimates such as means and proportions. Lindell & Perry (2000) argued that low response rates would affect correlations only if the item variances were severely restricted by severe over-representation of respondents at one end of the response distribution.

Measures

Hazard adjustments. The questionnaire measured efficacy attributes, resource requirements, attribute importance, and adoption intentions in relation to six different flood hazard adjustments: (1) an emergency kit (including food, water, battery powered radio, etc.), (2) information about flood consequences (e.g., depth), evacuation routes, safe/high places in the neighborhood, (3) a list telling what to do in case of an evacuation or flood (household emergency plan), (4) agreements with family/relatives, friends, and neighbors about how to help each other during an evacuation or flood, (5) sandbags and/or flood skirts, and (6) flood insurance[2]. *Hazard-related attributes* measured efficacy of hazard adjustments during evacuation or flooding, for (a) increasing safety of self and family, (b) reducing damage and financial consequences, and (c) utility of hazard adjustments for other purposes. Each attribute was measured on a single scale ranging from *very little to very much*. Similarly, *resource-related attributes* measured respondents' beliefs about the (a) cost requirements for adopting hazard adjustments (*very cheap – very expensive*), (b) the time and effort requirements (*very little – very much time and effort*), (c) knowledge and skill requirements (*very easy – very difficult*), and (d) help and cooperation requirements from other persons (*very little – very much help*). In addition, we measured *attribute importance* by presenting respondents with a list of the efficacy and resource attributes. Subsequently, we asked them to tick off the attributes they regarded as the most important for their decision to adopt hazard adjustments (coded *not selected* = 1, *selected* = 2). Participants were allowed to select as many attributes as they wanted (minimum zero, maximum eight). Finally, we used single items to measure *adoption intentions* (Do you intend to adopt the following hazard adjustments in the near future? Scale, *certainly not – certainly*).

Risk perceptions. Participants reported their perceptions of *flood likelihood* (How likely do you find major flooding in your area within the next 10 years? *very unlikely – very likely*) and their perceptions of *flood consequences* (four items; e.g., How likely do you find major damage to your home / possessions in case of flooding? *very unlikely – very likely*).

Demographic variables. Respondents reported their sex (*male* = 0, *female* = 1), age (in years), their highest level of education (*primary school or lower level*

[1] The NRM2004 database provides information about the demographic characteristics of the Dutch population on the level of zip codes within predefined flood risk areas (so-called dike rings). The primary source of NRM are the demographic population characteristics from Statistics Netherlands, who is the responsible organization in the Netherlands for collecting and processing data in order to publish statistics to be used in practice, by policymakers and for scientific research.

[2] Currently, the Netherlands lacks a flood insurance arrangement. However, this study investigated citizens' responses to flood insurance should it become available in the future.

of vocational school (four years of vocational education after primary school) = 1, *lower level of secondary school* (four years of formal education after primary school) or *middle level of vocational school* (four years of vocational education after secondary school) = 2, *higher level secondary school* (five or six years of formal education after primary school) or *higher level of vocational school* (four years of vocational education after secondary school) = 3, *university education* (bachelor or master university degree) = 4), home ownership (*renter* = 0, *homeowner* = 1), and income (*less than € 13,000 = 1, between € 13,000 and € 20,000* = 2, *between € 20,000 and € 34,000* = 3, *between € 34,000 and € 56,000* = 4, and *more than € 56,000* = 5). In addition, we coded the risk areas (*coastal area* = 0, *river area* = 1) of respondents' homes.

Analysis

The hypotheses about content validity (H1a-H1d) were tested according to procedures previously used by Lindell & Prater, (2002), Terpstra et al. (2009), and Lindell et al. (2009). To determine if it was plausible that the hazard adjustment attribute ratings were based on nothing more than random response, we tested H1a by comparing the observed distribution of responses to a uniform distribution by computing $\chi^2_{K-1} = (K-1)s_X^2 / \sigma^2_{EU}$, where *K* is the number of raters, s_X^2 is the observed variance in the responses on a specific rating dimension and σ^2_{EU} the variance of a uniform distribution. The latter term equals (c^2 -1)/12, so σ^2_{EU} = 2 when using a five point scale (Lindell & Brandt, 1997; Tinsley & Weiss, 1975). Rejecting the null hypothesis supports the conclusion that responses are not completely random. Moreover, the degree of interrater agreement in the ratings of each hazard adjustment on each attribute can be measured by $r_{WG} = 1 - s_X^2 / \sigma^2_{EU}$ (James, Demaree, & Wolf, 1993).

A finding that the responses are not completely random does not ensure that the rating dimensions are indeed meaningful to the respondents. Because all attributes were rated on 1-5 scales, the scale midpoint (3) reflects a neutral position. Scale means that are close to this neutral position may reflect *central tendency error*, which is a response bias that is commonly encountered when people are asked to rate objects on dimensions about which they feel they have insufficient information (Cascio & Aguinis, 2004). Thus, we also need to test H1b by comparing the mean ratings against their scale midpoints by conducting single sample t-tests.

We continued the assessment of construct validity by using a Multivariate Analysis of Variance (MANOVA) to assess the significance of the differences among the means of the six flood hazard adjustments on the eight hazard adjustment attributes (H1c) and concluded the assessment of construct validity by conducting a factor analysis of the correlations among the eight hazard adjustment attributes (H1d).

To address the predictive validity of the hazard adjustment attributes (H2) we performed a series of regression analyses of adoption intentions onto the hazard- and resource-related attributes, separately for each hazard adjustment. To determine whether there was an interaction between the hazard adjustment attributes and attribute importance (H3a and H3b), we conducted a moderated regression analysis of adoption intentions onto these two variables using the procedures described by James & Brett (1984). In addition, we calculated inter-item correlations in order to test the effects of risk perceptions on adoption intentions (H4a and H4b), the correlations of demographic variables with risk perception (H5a) and the hazard adjustment attributes (H5b), and the correlations of risk area with risk perception (H6a) and the hazard adjustment attributes (H6b).

4.4 RESULTS

Construct validation of hazard adjustment attributes

Consistent with H1a, the distribution of the ratings for each of the hazard adjustment attributes was significantly different from a uniform distribution. Table 4.1 indicates that all 96 scales (seven attributes + adoption intention * six hazard adjustments * two areas) had positive levels of interrater agreement ($r_{WG} > 0$). Performing the χ^2 tests revealed that all 96 calculated values of χ^2 were significant at the $p < .05$ level (two tailed), which rejects the hypothesis that the responses to the hazard-related and resource-related attributes, and the adoption intentions were nothing more than random response.

There was substantial support for H1b, because most of the mean attribute ratings for the hazard adjustments were significantly different from the midpoint of the scale. That is, 92% (88 / 96) of all scale means deviated significantly from their scale midpoints (3 on a 1-5 scale) at the $p < .05$ level. Because the sample size was so large that it was possible to classify even small deviations as statistically significant, we calculated an average effect size, $\bar{d} = \frac{1}{k}\sum \frac{|M_i - 3|}{SD_i}$, where *k* is the number of ratings (96), M_i is mean of the i^{th} rating, 3 is the midpoint of the scale, and SD_i is the standard deviation of the i^{th} rating. The average attribute effect size was .55 –just over one half of a standard deviation– with notable differences between the hazard-related attributes (.31), the resource-related attributes (.71), and adoption intentions (.59). Thus, the single-sample t-tests generally revealed no statistically or practically significant central tendency.

Table 4.1

Minimum, median, and maximum values of interrater agreement (r_{WG}), by attribute

	Minimum	Median	Maximum
Protect persons	0.13	0.30	0.36
Protect property	0.05	0.22	0.29
Other uses	0.03	0.27	0.54
Effectiveness attributes	0.03	0.25	0.54
Cost	0.50	0.63	0.67
Knowledge and skill	0.23	0.48	0.67
Time and effort	0.34	0.48	0.61
Cooperation	0.06	0.29	0.55
Resource requirements	0.06	0.49	0.67
Adoption intention	0.28	0.43	0.64

Consistent with H1c, a MANOVA revealed that the eight hazard adjustment attributes differentiated among the hazard adjustments, as indicated by significant differences among hazard adjustments in respondents' mean ratings on each attribute. That is, the main effect for *hazard adjustment* ($F_{5, 1110} = 113.97$, $p < .001$) indicated that mean ratings differed among hazard adjustments (across all attributes) whereas the main effect for *attributes* ($F_{7, 1108} = 215.28$, $p < .001$) indicated that mean ratings differed among attributes (across all hazard adjustments). Moreover, the significant *interaction* effect ($F_{35, 1080} = 125.94$, $p < .001$) revealed that the differences in mean attribute ratings differed among hazard adjustments; in other words, the hazard adjustment profiles as shown in Figure 4.2 were not parallel.

Consistent with H1d, the hazard-related attributes (efficacy in protecting persons, efficacy in protecting property, and suitability for other purposes) were distinct from resource-related attributes (cost; knowledge and skill requirements; required time and effort; and required cooperation with others), as indicated by their loading on separate factors in a factor analysis. As shown in Table 4.2, the analysis (Principal Components with Varimax rotation) yielded two factors with eigenvalues larger than one, which together explained 67% of the variance among the attribute scales.

Together the test results for H1a-H1d provide substantial support for the construct validity of the hazard adjustment attributes. That is, it appears that the respondents had meaningful perceptions of the hazard adjustments on both the hazard- and resource-related attributes.

Table 4.2

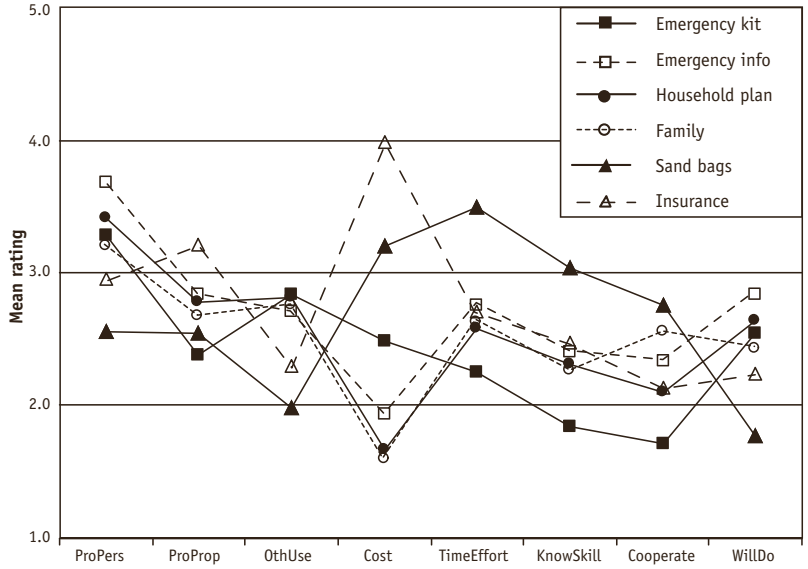
Factor analysis results

	Factor 1	Factor 2
Knowledge and skill	.86	
Time and effort	.79	
Cooperation	.73	
Costs	.69	
Protect property		.90
Protect persons		.87
Other uses		.78
Explained Variance [%]	35.0	32.0

Factor extraction: Principal Component Analysis
Factor rotation: Varimax with Kaiser Normalization
Factor loadings less than .30 are suppressed

Figure 4.2

Mean ratings of the hazard adjustments by attribute



Note:
Hazard-related attributes
ProPers = Perceived efficacy for the *Protection of Persons*
ProProp = Perceived efficacy for the *Protection of Property*
OthUse = Perceived *Utility for other Purposes*
Resource-related attributes
Cost = Perceived *Money* requirements
TimeEffort = Perceived requirements for *Time and Effort*
KnowSkill = Perceived requirements for *Knowledge and Skills*
Cooperate = Perceived requirements for *Cooperation from other Persons*
WillDo = *Behavioral Intention* towards taking a flood preparation

Predictive validity of the hazard adjustment attributes

H2a, which hypothesized that hazard-related attributes will be positively correlated and resource-related attributes will be negatively correlated with adoption intentions, was partially supported. As indicated in Table 4.3, the correlations of the hazard-related attributes with hazard adjustment intentions were positive and statistically significant but a substantial number of the correlations of the resource requirements with hazard adjustment intentions were statistically significant and positive (11/24, 46%), rather than negative (4/24, 17%), as hypothesized.

As indicated in Table 4.4, all but one of the standardized regression coefficients (Step 1) for the protection of persons (*Md* = .41, .35 ≤ β ≤ .43), protection of property (*Md* = .14, .05 ≤ β ≤ .21), and utility for other purposes (*Md* = .18, .15 ≤ β ≤ .22) were positive and statistically significant at p < .001. The one coefficient that was not significant was obtained for the degree to which sand bags were perceived to protect property against flood damage, which was due to high collinearity with the protection of persons (r_{ij} = .80).

In line with the obtained correlations, the regression coefficients of the resource requirements were sometimes not statistically significant or –in some cases– of the wrong sign. Of the 24 coefficients (four resource attributes * six hazard adjustments), only 9 (38%) were significantly negative, 8 (33%) were significantly positive, and 7 (29%) of the coefficients did not deviate significantly from zero. The negative coefficients were obtained for the perceived costs of collecting emergency information (β =-.04), sand bags (β = -.05), and taking out flood insurance (β = -.11), for knowledge & skill requirements of collecting emergency information (β = -.09) and sand bags (β = -.09), and for time & effort requirements of assembling an emergency kit (β = -.07), making a household plan (β = -.10) and family agreements (β = -.09), and taking out flood insurance (β = -.05). The perceived cooperation requirements attribute (*Md* = .07, .05 ≤ β ≤ .08) was responsible for five of the seven significantly positive coefficients.

Table 4.3
Intercorrelations among variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. WillDo		.48/.60	.39/.51	.33/.46	-.15/.13	-.10/.12	-.12/.09	.05/.18	.22/.34	.15/.18	-.03/.05	-.17/-.05	.00/-.09	-.17/-.06	-.06/.02
2. ProPers	.54		.47/.80	.33/.52	-.07/.07	-.03/.15	-.03/.17	.09/.20	.15/.32	.16/.21	-.17/-.04	-.13/-.04	-.01/-.10	-.14/-.04	-.06/14
3. ProProp	.47	.62		.37/.55	-.05/.22	-.07/.19	-.02/.14	.02/.24	.12/.21	.12/.23	-.21 .13	-.19/ .04	.00/-.12	-.16/ .04	.01/.15
4. OthUse	.44	.48	.46		-.09/.21	-.01/.14	-.07/.15	.09/.19	.12/.24	.12/.25	-.14/.04	-.18/-.11	-.03/-.11	-.14/-.07	.03/.13
5. Cost	.07	.04	.17	.13		.18/.45	.20/.49	.07/.34	.01/.14	-.03/.10	-.09/.18	-.27/-.04	.01/-.19	-.24/-.03	-.01/.05
6. KnowSkill	.05	.04	.10	.07	.34		.51/.61	.41/.57	.09/.16	-.01/.12	-.03/.20	-.09/-.03	.00/-.09	-.14/-.07	-.07/.05
7. TimeEffort	.06	.12	.12	.10	.25	.55		.36/.42	.10/.15	.03/.18	-.21/.03	-.02/.06	.02/-.07	-.06/-.01	-.09/.01
8. Cooperate	.13	.12	.19	.16	.31	.54	.38		.08/.16	.04/.17	-.22/.20	-.14/-.03	.00/-.10	-.20/-.06	-.02/.06
9. RiskPerc	.31	.27	.19	.21	.06	.14	.12	.14							
10. Gender	.16	.18	.15	.17	.07	.05	.12	.11	.20						
11. Age	.00	-.09	.05	-.09	.13	.00	-.13	.00	-.08	-.21					
12. Educ	-.11	-.08	-.11	-.12	-.22	-.06	.01	-.11	-.06	-.04	-.06				
13. Home	-.05	-.05	-.08	-.09	-.08	-.02	-.02	-.05	-.08	-.13	-.03	.14			
14. Income	-.10	-.07	-.09	-.10	-.16	-.10	-.05	-.13	-.11	-.22	-.13	.43	.33		
15. Risk area	-.02	.09	.11	.11	.03	.00	.00	.03	-.03	.00	-.03	.05	-.05	.04	

Note: median correlations in lower left off-diagonal; minimum/maximum in upper right off-diagonal)
r > .06 significant at p < .05 (2-tailed); r > .08 significant at p < .01 (2-tailed).

WillDo = Adoption intention, ProPers= Protection of Persons, ProProp = Protection of Property, OthUse = Utility for other Purposes,
Cost = Money requirements, KnowSkill = requirements for Knowledge and Skills, TimeEffort = requirements for Time and Effort, Cooperate = requirements for Cooperation from other Persons,
RiskPerc = Risk perception; Educ = Education; Home = homeownership

Thus, the more cooperation that was perceived as necessary for adopting flood hazard adjustments the higher were respondents' intentions of adopting those flood adjustments (all but the emergency kit). The three remaining positive coefficients were obtained for the perceived time and effort requirements of collecting emergency information (β = .07), the perceived knowledge and skill requirements of making a household plan (β = .05), and the perceived costs of making emergency agreements with family (β = .08).

Because of the unexpected finding that the resource requirements yielded many non-significant or positive regression coefficients (62%) but only few negative coefficients (38%), there was no point in formally testing H2b (hazard-related adjustment attributes will be more strongly correlated with adoption intentions than will be the resource-related adjustment attributes). However, it should be noted that –apart from the one non-significant regression coefficient of the protection of property by means of sand bags (see Table 4.4)– all regression coefficients of the hazard-related attributes were larger than were any of the negative coefficients of the resource requirements. Because the coefficients for the hazard-related attributes were strongly positive whereas those for the resource requirements were non-significant, H2b was completely supported.

There was weak support for H3a and H3b, that attribute importance would moderate the effect of the hazard adjustment attributes (efficacy and resource attributes) on hazard adjustment adoption intention. As indicated in Table 4.5, attribute importance moderated the effect of the suitability of hazard adjustments for other purposes, knowledge/skill requirements, and cooperation requirements on the adoption intentions in the expected directions. Consistent with H3a, for a given level of the perceived utility of hazard adjustments for other purposes, respondents who regarded suitability other purposes as an important attribute tended to have *higher* adoption intentions than those who did not consider this attribute important. Consistent with H3b, for a given level of the perceived requirements for knowledge/skill (and cooperation), respondents who regarded knowledge/skills (and cooperation) as an important attribute tended to have *lower* adoption intentions than those who did not regard this attribute important. However, the increment in R^2 was extremely small and attribute importance failed to moderate the effects of the remaining attributes (efficacy for protecting persons, efficacy for protecting property, cost requirements, and time/effort requirements) on adoption intentions.

Table 4.4
Regression analysis of adoption intentions

Predictors [(a)]	Emergency kit		Emergency info		Household plan		Family agreements		Sand bags		Flood Insurance	
	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2	Step 1	Step 2
Protect persons	.40***	.41***	.41***	.40***	.35***	.35***	.37***	.37***	.41***	.40***	.43***	.42***
Protect property	.15***	.14***	.12***	.12***	.21***	.20***	.21***	.20***	.05	.04	.13***	.13***
Other uses	.22***	.22***	.15***	.16***	.16***	.16***	.17***	.17***	.22***	.20***	.19***	.17***
Cost		.01		-.04*		.04		.08***		-.05*		-.11***
Knowledge & Skill		-.02		-.09***		.05*		-.01		-.09***		-.02
Time & Effort		-.07***		.07**		-.10***		-.09***		-.05		-.05*
Cooperation		.05		.08***		.06**		.06**		.07***		.08***
Multiple R	.63	.63	.57	.58	.61	.62	.62	.64	.58	.60	.64	.66
Adjusted R^2	.39	.39	.32	.32	.37	.37	.39	.39	.33	.35	.41	.42

[(a)] Cell entries are standardized regression coefficients
N = 1115; * p < .05; ** p < .01; *** p < .001

Table 4.5

Hierarchical regression analysis of adoption intentions onto the attributes and attribute importance (Step 1), and the interaction between attributes and their importance (Step 2)

	Efficacy attributes			Resource requirements	
	Step 1	Step 2		Step 1	Step 2
ProPers	.55***	.55***	Cost	.16***	.16***
Importance	.08**	.08**	Importance	.12***	.12***
Interaction		.00	Interaction		-.02
Δ Adj. R^2	.33	.00	Δ Adj. R^2	.04	.00
ProProp	.49***	.50***	KnowSkill	.13***	.13***
Importance	.08**	.08**	Importance	.09**	.09**
Interaction		-.01	Interaction		-.10**
Δ Adj. R^2	.27	.00	Δ Adj. R^2	.02	.01**
OthUse	.41***	.41***	TimeEffort	.10**	.10**
Importance	.11***	.11***	Importance	.05	.05
Interaction		.06*	Interaction		-.05
Δ Adj. R^2	.20	.00*	Δ Adj. R^2	.01	.00
			Cooperation	.22***	.22***
			Importance	.10**	.10**
			Interaction		-.06*
			Δ Adj. R^2	.05	.00*

* p < .05, ** p < .01, *** p < .001

Despite the modest support for a moderation effect, the attribute importance selection task supported the prediction that the respondents would regard the efficacy attributes as more important than the resource requirements. That is, the proportions of respondents that selected the efficacy attributes (protection of persons, 76%; protection of property, 54%; and suitability for other purposes, 55%) as important were substantially larger than the proportions that selected resource requirements (cost, 24%; knowledge/skill, 36%; time/effort, 34%; and cooperation requirements, 37%).

As predicted by H4a (see Table 4.3), risk perception (*Md* = .31, .22 ≤ r_{ij} ≤ .34) was significantly correlated with adoption intentions. In addition, there was support for H4b that the efficacy attributes would explain more variance in adoption intentions than would risk perception. As indicated in Table 4.3, the correlations of the efficacy attributes (*Md* = .54, .47 and .44) with adoption intention were substantially larger than the correlations of risk perception with adoption intention (*Md* = .31). It is therefore no surprise that the multiple *R* for the hazard attributes was greater than the correlation of risk perception

(see Table 4.4, results for Step 1). As one would expect from inspecting the zero-order correlations, the efficacy of protecting persons was the best predictor of adoption intentions (*Md* = .41, .35 ≤ β ≤ .43). The two remaining efficacy attributes, efficacy in protecting property (*Md* = .14, .05 ≤ β ≤ .21) and suitability for other purposes (*Md* = .18, .15 ≤ β ≤ .22) had smaller regression coefficients due the substantial level of multicollinearity among the three efficacy attributes (*Md* = .49, .33 ≤ r_{ij} ≤ .80). As Table 4.4 indicates, the addition of the resource requirements in Step 2 contributed only trivial increments to the multiple correlations.

Consistent with H5a, women had greater risk perceptions (r_{ij} = .20), whereas age (r_{ij} = -.08), education (r_{ij} = -.06), homeownership (r_{ij} = -.08), and income (r_{ij} = -.11) were negatively related to risk perception. Consistent with H5b, women rated the hazard adjustments higher on both the hazard- and resource-related attributes (hazard attributes, *Md* = .16, .12 ≤ r_{ij} ≤.25; resource attributes, *Md* = .09, -.03 ≤ r_{ij} ≤.18). However, the remaining predictions from H5b were only partially supported. Specifically, as predicted, homeowners generally gave lower ratings on the efficacy attributes (*Md* = -.07, -.12 ≤ r_{ij} ≤.00) and also on the resource requirements (*Md* = -.04, -.19 ≤ r_{ij} ≤.02), indicating that they were less convinced about the adjustments' effectiveness but also less concerned about the adjustments' costs. However, most these correlations (25/42, 60%) were statistically not significant. Age was also predicted to be negatively correlated with the hazard- and resource-related attributes (H5b), but older respondents gave both significantly lower (9/18, 50%) and higher (2/18, 11%) ratings on the hazard-related attributes (*Md* = -.07, -.21 ≤ r_{ij} ≤.13), and also both lower (7/28, 29%) and higher (8/28, 29%) ratings on the resource-related attributes (*Md* = -.01, -.22 ≤ r_{ij} ≤.20). We made no predictions about the two remaining socio-economic indicators, education and income. Results generally indicated negative correlations with the hazard-related attributes (education, *Md* = -.11, -.19 ≤ r_{ij} ≤.04; income, *Md* = -.10, -.16 ≤ r_{ij} ≤ .04) as well as with the resource requirements (education, *Md* = -.06, -.27 ≤ r_{ij} ≤.06; income *Md* = -.10, -.24 ≤ r_{ij} ≤ -.01).

Contrary to H6a, risk area risk area was uncorrelated with the conjoint measure of risk perception (r_{ij} = -.03, *ns*). However, considering the two risk perception components separately revealed that the river risk area residents had higher perceptions of flood likelihood (r_{ij} = .22) and lower perceptions of consequences (r_{ij} = -.38) than the coastal risk area residents. Additional analysis of the scale means revealed that in both risk areas perceived likelihood was rated below the scale midpoint (M_{river} = 2.42, t = -13.07, p < .001; M_{coast} = 1.97, t = -25.91, p < .001) indicating a low perception of flood likelihood. In the river area the mean rating of flood consequences did not deviate from the scale midpoint (M_{river} = 3.02, t = .05, *ns*) but the coastal risk area residents rated the flood consequences above the scale midpoint (M_{coast} = 3.82, t = 19.29, p < .001).

Consistent with H6b, risk area was correlated with efficacy for protecting persons (*Md* = .09, -.06 ≤ r_{ij} ≤ .14) and efficacy for protecting property (*Md* = .11, .01 ≤ r_{ij} ≤ .15), but not with the resource requirements. That is, among the efficacy attributes 83% (15/18) of the correlations were positive and statistically significant, whereas among the resource requirements 88% (21/24) of the correlations failed deviate from zero at p < .05. Unpredicted, however, risk area was also correlated with the perceived utility of hazard adjustments for other purposes (r_{ij} = .11, .03 ≤ r_{ij} ≤ .13).

Although not predicted in any of the hypotheses, risk perception was significantly correlated with the hazard-related attributes (*Md* = .24, .12 ≤ r_{ij} ≤ .32) and the resource-related attributes (r_{ij} = .13, .01 ≤ r_{ij} ≤ .15). As was the case with most other variables, the correlations of risk perception with the hazard-related attributes were greater than its correlations with the resource requirements.

4.5 DISCUSSION

Previous studies indicated PADM's construct validity in the context of seismic risk in the U.S. (Lindell et al., 2009; Lindell & Prater, 2002; Lindell & Whitney, 2000). The current study extended the construct validity of PADM's hazard adjustment attributes in the context of flooding risk in the Netherlands (H1a-H1d). That is, respondents appeared to have meaningful perceptions on the attributes because 1) there was no evidence of uniform distributions or central tendency on the attribute ratings, 2) their responses to the attributes supported the conceptual distinction between hazard-related (a hazard adjustments' efficacy in protecting persons; efficacy in protecting property; utility for other purposes) and resource-related (a hazard adjustments' requirements for money; knowledge and skills; time and effort, cooperation and help from others) attributes, and 3) they used these attributes to differentiate among the flood hazard adjustments (as indicated by the profiles in Figure 4.2). This is important because so far there has only been one other European study (Grothmann & Reusswig, 2006) that addressed citizens' flood hazard adjustment decisions, but which was unable to distinguish among the individual effects of flood hazard adjustment attributes.

The second aim of this study was to examine predictive validity of the hazard-related and resource-related attributes for citizens' flood hazard adjustment decisions, based on the model described in Figure 4.1. In addition to predicting adoption intentions from the hazard- and resource-related attributes the model included perceptions of risk and attribute importance. Moreover, risk area and demographic characteristics were used to predict perceptions of risk and hazard adjustment attributes. The results provided partial support for H2, H3, H5, and H6, and strong support for H4.

Specifically, H2a was supported because the hazard-related attributes were positively and strongly correlated with adoption intentions. Regression analysis showed that a hazard adjustment's efficacy in protecting persons during an evacuation or flood was the best predictor of citizens' flood adjustment intentions. Due to multicollinearity among the three hazard-related attributes the regression coefficients of an adjustments' efficacy in protecting property against (financial) damage and its utility for other purposes were somewhat lower than would be expected based on the zero-order correlations with adoption intentions. Contrary to H2a, the resource-related attributes yielded many (46%) positive correlations with adoption intentions and only few negative correlations (17%), as had been predicted. There is not one clear reason that explains these unexpected positive correlations. However, Lindell & Prater (2002) also reported both positive correlations (knowledge and skill, r_{ij} = .04; cooperation r_{ij} = .08) and negative correlations (cost, r_{ij} = -.03; time/effort, r_{ij} = -.01) of the resource attributes with seismic adjustment adoption intentions, but none of these correlations were statistically significant. Because of the larger sample size in the current study, correlations greater than |.06| were statistically significant. Still, the resource-related attribute correlations were small (-.15 ≤ r_{ij} ≤ .18) and therefore explained little variance in addition to the hazard-related attributes (see Table 4.4). Despite the positive correlations of the resource-related attributes, these results do support H2b that the hazard-related attributes would be more strongly correlated with adoption intentions than the resource requirements.

The most obvious reason for the small correlations of the resource requirements with adoption intentions would be that, although people may have meaningful perceptions of the resource requirements, they may find these attributes of little importance for their adoption decisions, as was previously suggested by Lindell et al. (2009) in relation to the adoption of seismic hazard adjustments. Indeed, this explanation was supported because the proportions of respondents that selected the resource requirements (between 24% and 37%) as important attributes of their adoption decisions were substantially smaller than the proportions of respondents that selected hazard attributes as important (between 54% and 76%). However, the specific mechanism by which attribute importance influences adoption decisions remains unclear. Contrary to H3a and H3b, the results only weakly supported the predicted moderation effects of attribute importance. That is, the interaction between attribute outcome expectancy and their valences (i.e., judged importance) was statistically significant and in the expected direction on only three attributes– utility of hazard adjustments for other purposes, knowledge & skill requirements, and cooperation & help requirements. Moreover, these effects failed to explain substantial amounts of variance in adoption intentions.

An alternative explanation for the resource-related attributes' low correlations with adoption intentions may be found in these variables' small variances (i.e., high levels of interrater agreement, as shown in Table 4.1). Variance restriction is a known source of correlation attenuation (Cohen, Cohen, West, & Aiken, 2003; Nunnally & Bernstein, 1994). Indeed, Table 4.3 indicates that the resource-related attributes not only had smaller correlations with adoption intentions than did the hazard-related attributes, they also had smaller correlations with risk perception, gender, and risk area. Thus, the high levels of agreement on the resource requirements provides a better explanation for the low correlations than does measurement, which is a more common explanation for low correlations. Although the high level of interrater agreement suggests the resource requirements are meaningful to the respondents, it does not explain the absence of clear moderation effects on the hazard attributes. A possible explanation concerns the measurement of attribute importance. The selection task used in this study allowed respondents to tick off any attributes they regarded important to their adjustment decisions. Although the selection task yielded clear differences in importance ratings among attributes, future studies might use rating scales (e.g., 1-5) in stead of the current dichotomous measure in order to make interaction effects easier to detect.

There was strong support for H4a/b that risk perception was correlated with adoption intentions (H4a) and that each of the hazard-related attributes (efficacy in protecting persons, efficacy in protecting property, utility for other purposes) individually explained more variance in adoption intentions (H4b). Nevertheless, risk perception remains important since it reflects how people respond to the risk context, including risk management and people's personal experiences with the risk (Terpstra, in preparation), and their perceived personal responsibility in risk management (Terpstra & Gutteling, 2008; Terpstra & Kok, in preparation). In addition, perceived risk functions to motivate people in thinking about the protective actions they can take in order to reduce their personal risk (e.g., see Lindell & Perry, 2004; Rogers & Prentice-Dunn, 1997). Understanding the sources of people's responses to the hazard and the hazard adjustments both help researchers and risk managers to further investigate and develop risk communication programs.

H5a and H5b predicted that demographic characteristics would be correlated with risk perception and the hazard adjustment attributes. However, most of the correlations were small (i.e., 80% had a $r_{ij} < .15$) and were primarily confirmed due to the large sample size (n = 1115). Gender revealed relatively larger correlations, indicating that (as predicted) women had slightly greater risk perceptions than men ($r_{ij} = .20$), and that women were more convinced of the efficacy of hazard adjustments ($.12 \leq r_{ij} \leq .25$) but were generally also more concerned about their resource requirements ($-.03 \leq r_{ij} \leq .18$). The absence of substantial correlations and consistent patterns of the remaining demographic variables with risk perceptions and hazard adjustment attributes makes it difficult to use demographics for audience segmentation, in order to target risk communication to distinct groups.

Although the two risk areas did not differ in their overall risk perceptions as predicted by H6a, river risk area residents differed significantly from the coastal risk area residents when considering the risk components "flood likelihood" and "flood consequences" separately. That is, the residents from both areas perceived low flood likelihood –with coastal risk area residents being significantly lower than the river risk area residents– but only the coastal risk area residents perceived high flood consequences. Although the difference in flood likelihood is consistent with the fact that the coastal risk area is better protected than the river risk area, this explanation seems implausible because technical information about the actual flood protection standards is not actively communicated to the public and some research suggests that detailed technical information has little impact on people's risk perceptions (Terpstra et al., 2009). People are often ill informed and unable to utilize probability information (Camerer & Kunreuther, 1989; Kunreuther, 1976; Slovic, Kunreuther, & White, 1974). Rather, local differences in perceived flood likelihood and perceived flood consequences originate from people's personal experiences with flood hazard and their levels of trust in flood risk management (Terpstra, in preparation). Although there were also statistically significant differences between the two risk areas in their perceptions of the hazard-related attributes (as predicted under H6b), the correlations were generally small (all had $r_{ij} \leq .15$). This is most likely due to the fact that adjusting to flood risk privately is a new element in Dutch flood risk management and people probably have given little attention to the question "What can I do to protect myself, my family and my property from floods?" This also becomes evident from the profiles in Figure 4.2 and effect sizes that indicate the degree of central tendency– that is, the hazard-related attributes deviated less from their scale midpoints than did the resource attributes. In other words, the hazard-related attributes revealed more central tendency than did the resource-related attributes presumably because risk area residents find it easier judging the hazard adjustments relative to their personal resources about which they have much information than judging the hazard adjustments relative to the flood hazard about which they have little information.

It is important to acknowledge that this study has its limitations. First, although samples were drawn from two relative large geographic locations and the total sample size had adequate power to detect even small correlations (i.e., $r_{ij} \geq .06$, $p < .05$), the response rate was low (overall, 11%)– which raises questions about the generalizability of the results. Moreover, comparing the two risk area samples' gender distribution, age, and income with the NRM2004 database showed that both samples overrepresented males, older ages, and higher income classes. These biases were identical in the two risk areas, so there

is no net effect on differences between the river and coastal risk area in mean responses. In addition, these biases are only problematic to the extent that demographic variables are correlated with risk perception, the hazard adjustment attributes, and adoption intentions. However, both age and income mostly produced small ($r_{ij} \leq .15$) and sometimes even inconsistent (i.e., both positive and negative) correlations with risk perception, hazard adjustment attributes and adoption intentions, making any controls for these variables arbitrary. Gender was somewhat higher correlated to these variables ($.12 \leq r_{ij} \leq .25$), which likely caused small underestimations in the population means of risk perception, hazard adjustment attributes, and adoption intentions. Finally, as noted earlier, correlation coefficients are resistant to mean bias so tests of the predictive validity of the hazard adjustment attributes and risk perception for adoption intentions can be taken at face value. Second, this study –like all cross-sectional designs– has limited ability to draw conclusive causal inferences. However a previous longitudinal study by Terpstra et al. (2009) suggested that flood risk perceptions in the Netherlands were remarkably stable. If future studies are able to extend these results to the stability in perceptions of hazard adjustment attributes as well, local hazard managers could have greater confidence in the usefulness of these results for designing flood risk communication programs.

Notwithstanding the sample's limitations, this study does have some theoretical and practical implications. First, the behavioral intentions of adopting the flood hazard adjustments were low but the hazard-related attributes were rated somewhat higher (see Figure 4.2). Moreover, regression analysis showed that the variances in these low adoption intentions were explained to a substantial degree (32% to 41% of the variance) by the hazard-related attribute ratings but the resource requirements hardly explained any variance in the adoption intentions (see Table 4.4). Also moderation of attribute importance failed to increment the amounts of explained variance, whereas risk perception only added about 5% to 11% to the amounts of explained variance in adoption intentions. Thus, there should be other variables that have contributed to the low adoption intentions but which were not measured in the current study. Future research should therefore investigate the role of any other potential barriers inhibiting the adoption of hazard adjustments. For instance, Terpstra & Gutteling (2008) reported that 50% of their respondents perceived flood emergency preparedness as their personal responsibility. Moreover, higher levels of responsibility correlated with more favorable attitudes towards private flood preparedness. Other variables may be uncovered using a mental modeling approach (Atman, Bostrom, Fischhoff, & Morgan, 1994; Bostrom, Atman, Fischhoff, & Morgan, 1994; Bostrom, Fischhoff, & Morgan, 1992; Lindell, Buchanan, & Prater, 2008).

Second, the hazard adjustment profiles in Figure 4.2 replicate previous studies by confirming the low level of adoption intentions for hazard insurance (Lindell et al., 2009; Lindell & Whitney, 2000). In the U.S., but also in many other countries, this unpopularity of hazard insurance is a public policy problem because prospective homeowners are attracted to floodplains by amenities –such as housing structure characteristics, neighborhood quality, accessibility, and environmental amenities– and are deterred by hazard proximity to the extent that they perceive a significant flood risk (Lindell & Hwang, 2008; Zhang, Hwang, & Lindell, 2009). Hazard insurance could be an economically effective way to send market signals to those who are locating in hazardous areas and building structures that are unlikely to survive disaster impacts (Kunreuther, 1998; Zahran, Weiler, Brody, Lindell, & Highfield, 2009). However, it will only have this effect if it is required (as is the case for U.S.100-year flood plains) or if it is sufficiently attractive to consumers that they will purchase it voluntarily. Currently, the Netherlands lacks a flood insurance arrangement. However, this study investigated citizens' responses to flood insurance should it become available in the future. In fact, the possibilities for introducing flood insurance are currently being studied (e.g., Botzen & van den Bergh, 2008; Jongejan & Barrieu, 2008). The profile in Figure 4.2 reveals the poor image that hazard insurance has with risk area residents. Specifically, hazard insurance has one of the lowest levels of adoption intentions, apparently because it is only high in protecting property. Moreover, it is only about average on skill, effort, and cooperation requirements, but is near the bottom in protecting persons, other uses, and is by far the highest on cost. Although the measurement of hazard insurance was hypothetical in this study, many other studies have confirmed its unpopularity among risk area residents (e.g., Kunreuther, 1996; Bouwer, Huitema, & Aerts, 2007). Unless insurance companies can correct any misperceptions of hazard insurance, and indeed, Kunreuther, Ginsberg et al. (1978) found that there were misperceptions, or the terms of insurance coverage are changed, hazard insurance is unlikely to fulfill its economic potential.

Third, future studies should investigate whether the flood hazard adjustments used in this study are actually effective in coping with (imminent) flooding. Currently, risk communication in the Netherlands especially promotes the adoption of an emergency kit, including a battery powered radio, a flashlight, a first aid kit, matches, candles, blankets, basic tools, and a whistle. Moreover, people are advised to extend their emergency kit by for instance including a roadmap and a list of addresses should they need to evacuate[3]. However, it is not at all clear how useful these contents are in case of flooding. In the Netherlands it is often argued that the most densely populated areas along the Dutch coast should not evacuate in case of imminent floods from the North Sea because warning times are limited and the risk of traffic jams during evacuation is high. This is not actively communicated to coastal area residents, however. Moreover, only a severe storm surge can cause an imminent flood threat along the Dutch coast. Under these conditions informing citizens by means of crisis communication may be extremely difficult due to communication channel

[3] From: http://denkvooruit.nl/noodpakket, accessed June 14, 2009.

problems– for instance, the storm could damage mobile phone networks and internet could be overloaded. However, in the river area circumstances are very different due to a more accurate prediction of water levels as well as their timing which increases the chances for timely and safe evacuation. Moreover, high river discharges are not correlated with the occurrence of high wind speeds. Thus, the actual effectiveness of flood hazard adjustments depends on the local characteristics of the risk (e.g., warning times, flooding speed, patterns, and depths) and the physical possibilities for evacuation. It is unlikely that one set of hazard adjustments as used in this study can be applied to prepare citizens in areas that share little of these risk characteristics.

Finally, and connected with the previous point, communicating flood hazard adjustments that appeal to people because they are tuned to the local flood characteristics likely leads to more favorable ratings on the hazard-related attributes which seems the most effective mechanism to increase people's flood preparedness behavior. In this regards, providing citizens with emergency information –including information about the potential flood depths in their neighborhood, safe evacuation routes, and high buildings that are accessible during imminent floods– seems to have the most promising effect. That is, intentions to search for emergency information were the highest because respondents viewed this hazard adjustment as the most effective in protecting people. Moreover, it was perceived as low in costs and on average in required knowledge and skill, and cooperation from others. However, respondents perceived somewhat higher time and effort requirements for searching emergency information, presumably, because people may not know where to find such information. A possible solution is to include such maps in the emergency kit, because the emergency kit was rated extremely low on all resource requirements. Moreover, this may increase the attractiveness of the emergency kit.
However, future studies should investigate how to design such maps because previous studies have indicated that people have difficulties with interpreting them, arising from features such as map scale, coding, color, and size (e.g., Arlikatti, Lindell, Prater, & Zhang, 2006; Zhang, Prater, & Lindell, 2004).

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4.7 REFERENCES

Adeola, F. O. (2000). Endangered community enduring people - toxic contamination, health, and adaptive responses in a local context. *Environment and Behavior, 32*(2), 209-249.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Arlikatti, S., Lindell, M. K., Prater, C. S., & Zhang, Y. (2006). Risk area accuracy and hurricane evacuation expectations of coastal residents. *Environment and Behavior, 38*(2), 226-247.

Atman, C. J., Bostrom, A., Fischhoff, B., & Morgan, M. G. (1994). Designing risk communications - Completing and correcting mental models of hazardous processes .1. *Risk Analysis, 14*(5), 779-788.

Bostrom, A., Atman, C. J., Fischhoff, B., & Morgan, M. G. (1994). Evaluating risk communications - Completing and correcting mental models of hazardous processes. 2. *Risk Analysis, 14*(5), 789-798.

Bostrom, A., Fischhoff, B., & Morgan, M. G. (1992). Characterizing mental models of hazardous processes - A methodology and an application to radon. *Journal of Social Issues, 48*(4), 85-100.

Botzen, W. J. W., & van den Bergh, J. (2008). Insurance against climate change and flooding in the Netherlands: Present, future, and comparison with other countries. *Risk Analysis, 28*(2), 413-426.

Bouwer, L. M., Huitema, D., & Aerts, J. C. J. H. (2007). *Adaptive Flood Management: The Role and Compensation in Europe*. Amsterdam: Institute for Environmental Studies, VU University.

Camerer, C. F., & Kunreuther, H. (1989). Decision-processes for low probability events - Policy implications. *Journal of Policy Analysis and Management, 8*(4), 565-592.

Cascio, W. F., & Aguinis, H. (2004). *Applied Psychology in Human Resource Management* (6 ed.). Englewood Cliffs NJ: Prentice Hall.

Goudappel Coffeng (2004). NRM-basisbestand 2004. Delft: Dienst Verkeer en Scheepvaart.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied Multiple Regression/ Correlation Analysis for the Behavioral Sciences* (3rd ed.). Mahwah NJ: Erlbaum.

Converse, P. E. (1970). Attitudes and non-attitudes: Continuation of a dialogue. In E. R. Tufte (Ed.), *The Quantitative Analysis of Social Problems* (pp. 168-189). Reading MA: Addison-Wesley.

Curtin, R., Presser, S., & Singer, E. (2000). The effects of response rate changes on the index of consumer sentiment. *Public Opinion Quarterly, 64*, 413-428.

Egli, T. (2002). *Non Structural Floodplain Management. Measures and Their Effectiveness*. Sankt Augustin: International Commission for Protection of the Rhine (ICPR).

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention and Behavior*. Reading, MA: Addison-Wesley.

Floyd, D. L., Prentice-Dunn, S., & Rogers, R. W. (2000). A meta-analysis of research on protection motivation theory. *Journal of Applied Social Psychology, 30*(2), 407-429.

Fothergill, A. (1996). Gender, risk, and disaster. *International Journal of Mass Emergencies and Disaster, 14,* 33-56.

Fothergill, A., Maestas, E. G. M., & Darlington, J. D. (1999). Race, ethnicity and disasters in the United States: A review of the literature. *Disasters, 23*(2), 156-173.

Fothergill, A., & Peek, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. *Natural Hazards, 32*(1), 89-110.

Grothmann, T., & Reusswig, F. (2006). People at risk of flooding: Why some residents take precautionary action while others do not. *Natural Hazards, 38*(1-2), 101-120.

Harding, D. M., & Parker, D. J. (1974). Flood hazard at Shrewsbury, United Kingdom. In G. White (Ed.), *Natural Hazards* (pp. 43 - 52). New York: Oford University Press.

James, L. R., & Brett, J. M. (1984). Mediators, moderators, and tests for mediation. *Journal of Applied Psychology, 69*(2), 307-321.

James, L. R., Demaree, R. G., & Wolf, G. (1993). r_{WG} - An assessment of within-group interrater agreement. *Journal of Applied Psychology, 78*(2), 306-309.

Janis, I., & Mann, L. (1977). *Decision Making: A Psychological Analysis of Conflict, Choice and Commitment*. New York: The Free Press.

Jongejan, R., & Barrieu, P. (2008). Insuring large-scale floods in the Netherlands. *Geneva Papers on Risk and Insurance-Issues and Practice, 33*(2), 250-268.

Keeter, S., Miller, C., Kohut, A., Groves, R. M., & Presser, S. (2000). Consequences of reducing nonresponse in a national telephone survey. *Public Opinion Quarterly, 64,* 125-148.

Krasovskaia, I. (2005). *Perception of Flood Hazard in Countries of the North Sea region of Europe* (No. FLOWS WP2A-1). Oslo: Norwegian Water Resources and Energy Directorate.

Kunreuther, H. (1976). Limited knowledge and insurance protection. *Public Policy, 24*(2), 227-261.

Kunreuther, H. (1996). Mitigating disaster losses through insurance. J*ournal of Risk and Uncertainty, 12*(2-3), 171-187.

Kunreuther, H. (1998). Insurability conditions and the supply of coverage. In H. Kunreuther & R. J. Roth (Eds.), *Paying the Price: The Status and Role of Insurance against Natural Disasters in the United States* (pp. 17-50). Washington DC: Joseph Henry Press.

Kunreuther, H., Ginsberg, R., Miller, L., Sagi, P., Slovic, P., Borkan, B., et al. (1978). *Disaster Insurance Protection: Public Policy Lessons*. New York: Wiley.

Lindell, M. K., Arlikatti, S., & Prater, C. S. (2009). Why people do what they do to protect against earthquake risk: Perceptions of hazard adjustments and their attributes. *Risk Analysis, 29*(8), 1072-1088.

Lindell, M. K., & Brandt, C. J. (1997). Measuring interrater agreement for ratings of a single target. *Applied Psychological Measurement, 21*(3), 271-278.

Lindell, M. K., Buchanan, B., & Prater, C. S. (2008). *Local Officials' Mental Models of Hurricane Evacuation*. College Station TX: Texas A&M University, Hazard Reduction & Recovery Center.

Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis, 28*(2), 539-556.

Lindell, M. K., & Perry, R. W. (1991). Understanding evacuation behavior: An editorial introduction. *International Journal of Mass Emergencies and Disasters, 9,* 133-136.

Lindell, M. K., & Perry, R. W. (1992). *Behavioral Foundations of Community Emergency Planning*. Washington, D.C.: Hemisphere Publishing Corporation.

Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard - A review of research. *Environment and Behavior, 32*(4), 461-501.

Lindell, M. K., & Perry, R. W. (2004). *Communicating Environmental Risk in Multiethnic Communities*. Thousand Oaks, California: Sage Publications, Inc.

Lindell, M. K., & Prater, C. S. (2002). Risk area residents' perceptions and adoption of seismic hazard adjustments. *Journal of Applied Social Psychology, 32*(11), 2377-2392.

Lindell, M. K., & Whitney, D. J. (2000). Correlates of household seismic hazard adjustment adoption. *Risk Analysis, 20*(1), 13-25.

Lindell, M. K. w., Alesch, D., Bolton, P. A., Greene, M. R., Larson, L. A., Lopes, R., et al. (1997). Adoption and implementation of hazard adjustments. *International Journal of Mass Emergencies and Disasters Special Issue 15*(3), 327-453.

Linnerooth-Bayer, J., & Amendola, A. (2003). Introduction to special issue on flood risks in Europe. *Risk Analysis, 23*(3), 537-543.

Ministry of Transport, Public Works, and Water Management (2008). *National Water Plan (draft) (in Dutch: Ontwerp Nationaal Waterplan)*. The Hague: Ministry of Transport, Public Works and Water Management.

Mulilis, J. P., & Duval, T. S. (1995). Negative threat appeals and earthquake preparedness - A person-relative-to-event (PrE) model of coping with threat. *Journal of Applied Social Psychology, 25*(15), 1319-1339.

Mulilis, J. P., & Duval, T. S. (1997). The PrE model of coping and tornado preparedness: Moderating effects of responsibility. *Journal of Applied Social Psychology, 27*(19), 1750-1766.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.

Perry, R. W., Lindell, M. K., & Greene, M. R. (1981). Evacuation Planning in Emergency Management. Lexington, MA: Heath-Lexington.

Munich Re (2000). *Topics 2000: Natural Catastrophes–The Current Position*. Munich: Munich Re.

Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory. In D. S. Gochman (Ed.), *Handbook of Health Behavior Research* (pp. 113-132). New York: Plenum.

Schuman, H., & Kalton, G. (1985). Survey methods. In G. Lindzey & A. Aronson (Eds.), *Handbook of Social Psychology* (pp. 635 - 698). New York: Random House.

Siegrist, M., & Gutscher, H. (2008). Natural hazards and motivation for mitigation behavior: People cannot predict the affect evoked by a severe flood. *Risk Analysis, 28*(3), 771-778.

Slovic, P., Kunreuther, H., & White, G. F. (1974). Decision processes, rationality, and adjustment to natural hazards In G. F. White (Ed.), *Natural Hazards: Local, National, and Global* (pp. 207-232). New York: Oxford University Press.

Terpstra, T. (in preparation). Emotions, trust, and perceived risk: Affective and cognitive routes to flood preparedness behavior.

Terpstra, T. & Kok, M. (in preparation). What determines whether Dutch citizens are willing to purchase flood insurance?

Terpstra, T., & Gutteling, J. M. (2008). Households' perceived responsibilities in flood risk management in the Netherlands. *International Journal of Water Resources Development, 24*(4), 555-565.

Terpstra, T., Lindell, M. K., & Gutteling, J. M. (2009). Does communicating (flood) risk affect (flood) risk perceptions? Results of a quasi-experimental study. *Risk Analysis. 29*(8), 1141-1151.

Tinsley, H. E. A., & Weiss, D. J. (1975). Interrater reliability and agreement of subjective judgments. *Journal of Counseling Psychology, 22,* 358 - 376.

Weinstein, N. D. (1993). Testing four competing theories of health-protective behavior. *Health Psychology, 12*(4), 324-333.

Zahran, S., Weiler, S., Brody, S. D., Lindell, M. K., & Highfield, W. E. (2009). Modeling national flood insurance policy holding at the county scale in florida, 1999-2005. *Ecological Economics, 68*(10), 2627-2636.

Zhang, Y., Hwang, S. N., & Lindell, M. K. (in press). Hazard proximity or risk perception? Evaluating environmental hazards' effects on housing value. *Environment & Behavior.*

Zhang, Y., Prater, C. S., & Lindell, M. K. (2004). Risk area accuracy and evacuation from hurricane Bret. *Natural Hazards Review, 5,* 115-120.

Chapter 5

WHAT DETERMINES WHETHER DUTCH CITIZENS ARE WILLING TO PURCHASE FLOOD INSURANCE?

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Submitted

ABSTRACT

Many countries have flood insurance arrangements. The Netherlands lacks such arrangement. However, the introduction of flood insurance is currently a matter of political and scientific debate. This study investigated citizens' willingness to voluntarily take out flood insurance when it was provided as well as the determinants of their intentions. Performing a questionnaire survey in three flood risk areas (n = 1443) indicated that Dutch citizens have much confidence in the flood defences, perceive little likelihood of flooding, and worry little about floods. However, citizens perceive large damage consequences of floods. Unexpectedly, none of these perceptions explained respondents' insurance purchase intentions. That is, 67% of the respondents intended to purchase flood insurance. This is a remarkable finding because another recent study has reported low purchase intentions. Most likely, the current study revealed high intentions because the questionnaire explained that purchasing flood insurance would be a voluntary choice but that the government would not compensate flood damages in the future anymore (in the past the Dutch government compensated the flood damages). It seems that respondents felt that they were left no choice other than to purchase flood insurance in order to cover for potential flood damages. This was supported by the findings that although 70% perceived flood insurance as useful, 76% regarded the government as (primarily) responsible for potential flood damages and 67% of the respondents held negative attitudes towards the introduction of a private flood insurance arrangement. An important practical implication of this study is that, if the government decides to introduce a flood insurance arrangement, whether voluntary or mandatory, it would be wise to involve the public in its decision.

KEYWORDS

flood
insurance
responsibility
risk perception
affect

5.1 INTRODUCTION

Worldwide, the economic costs of floods have increased dramatically in recent decades (Linnerooth-Bayer & Amendola, 2003; Munich Re, 2000). To deal with these losses, many countries have implemented arrangements for flood insurance, and almost all these arrangements are in the form of a public-private partnership. The Netherlands, however, lacks such arrangements. Although citizens are in theory personally responsible for flood damages, past practices have shown that the government (i.e., the general taxpayer) often pays for flood damages through the 1998 Calamities Compensation Act (WTS). Several committees that have advised about the current un-insurability of floods have stressed that this way of dealing with flood damage is undesirable (Disasters and Calamities Compensation Committee, 2004; Water Advisory Council, 2006). First, personal responsibility is a key value within Dutch society and is a starting point in civil law. It has been stressed that the notion of personal responsibility should also apply to flood damages. Second, compensation based on the WTS is a government decision that is made after the disaster. There are concerns that the government might make this decision under regional pressure and that decisions might be inconsistent ('a flood of 10 houses is personal responsibility; a flood of 100 houses is a disaster'). The design of a flood insurance arrangement in the Netherlands is therefore a matter of political and scientific debate.

However, designing a feasible insurance arrangement for low-probability, high-consequence flood risk is not easy. In the Netherlands, there is a high variety of flood risks. Along the main rivers and coasts, flood probability is very low, as the protection standards of flood defences range from 1/1,250 per year along the main rivers to 1/10,000 per year along the coast. If insurance companies were to provide private flood insurance to households, they would face a highly variable pattern of flood damage. But in the Netherlands we have also many levees along small canals. Failure of these levees results in relatively small scale flood events. Therefore, a single flood may cause damages ranging from several tens of millions of euros to possibly tens of billions of euros (Ministry of Transport, Public Works, and Water Management, 2005) and the amount of insured flood damages could in one year easily exceed the premium incomes and capital of the regionally operating insurance companies. This is also the primary reason that the organisation of Dutch insurers officially prohibited its members to continue offering flood insurance after the 1953 flood disaster, which claimed 1,836 victims and caused tremendous damage.

Research has been carried out to overcome the technical difficulties for designing a flood insurance arrangement (e.g., see Botzen & van den Bergh, 2009; Jongejan & Barrieu, 2008; Kok, 2005). However, until now, issues relating to the demand side have scarcely been addressed. Such issues include whether

risk area residents are willing to voluntarily take out flood insurance when provided and the determinants of their intentions.

5.2 THEORY AND HYPOTHESES

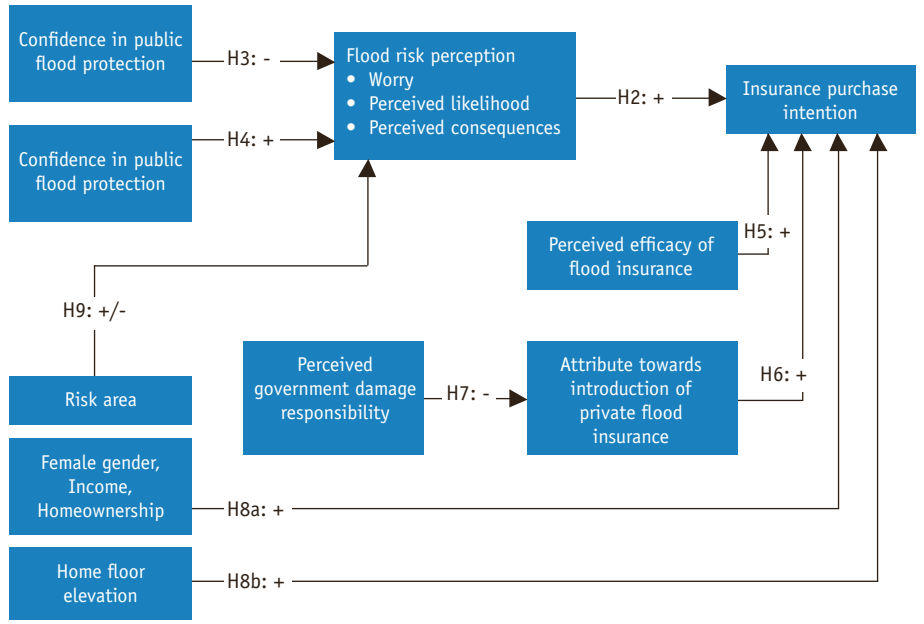
Because flood insurance is currently unavailable in the Netherlands, we are unable to study actual insurance purchase behaviour. Therefore, we study people's behavioural intentions for purchasing flood insurance instead. These intentions will be studied by applying the model depicted in Figure 5.1. This model contains all of the variables under study as well as their expected interrelations (reflected in the arrows).

The presented model reflects that people's decisions to purchase flood insurance can be viewed as a sequential process. In 1976, Kunreuther stated that a person '... is reluctant to take any protective action unless he has passed through a sequence of steps which alert him to the dangers of the hazard and the availability of insurance' (p. 244). Such a stepwise conceptualisation is also recognised in other theories of protective action, including Protection Motivation Theory (PMT, Rogers & Prentice-Dunn, 1997) and the Protective Action Decision Model (PADM, Lindell & Perry, 2000, 2004).

Two aspects of these models are important. First, these models consider people's perceptions of the hazard as well as people's perceptions of the hazard adjustments. In particular, the models assert that one first requires appraising a threat before one engages in appraising potential coping behaviours. Second, with regard to the variables within these models, people's insurance purchase decisions depend on whether they are high or low on predictor variables and on how these predictors are correlated with insurance purchase behaviour. For instance, Kunreuther (1976) proposed that 'Only if a person is aware of the hazard is he likely to investigate protective actions such as purchasing insurance' (p. 244). Thus, if a person remains below a certain awareness-threshold, he/she will not engage in any self-protective behaviour. Of course, this is only true to the extent that low awareness is correlated with behaviour. Therefore, in addition to the means of variables, it is important to study how strong variables are correlated.

Recently, Terpstra & Lindell (in preparation) provided partial support for the model shown in Figure 5.1. Their results indicate that low flood insurance purchase intentions are predicted to some extent by people's hesitations to view flood insurance as an effective strategy for reducing the financial impacts of flooding and by their risk perceptions. However, in contrast to the model shown in Figure 5.1, these authors used an overall risk perception measure. The current study aims to provide a more detailed explanation for insurance purchase intentions by explicitly taking the Dutch flood risk management context into account.

Figure 5.1
Model predicting flood insurance adoption intentions and risk perceptions



Perceptions of hazard

Although the model in Figure 5.1 shares similarities with models such as PMT and PADM, it contains a number of additional variables that have shown to be important in the context of flood risk in the Netherlands. As with PMT and PADM, hazard perceptions are reflected in citizens' risk perceptions. In addition, our model tests the effects of citizens' confidence in public flood protection and the effects of their prior flood hazard experiences. The validity of these variables was recently indicated by Terpstra (in preparation) in relation to flood emergency preparedness (e.g., searching for information about evacuation routes).

Specifically, Terpstra (in preparation) reported that low levels of perceived flood likelihood and low levels of worries about floods hampers people's flood preparedness intentions. Similarly, with regard to flood insurance, Kunreuther and Slovic (Kunreuther, Ginsberg et al., 1978; Slovic, Fischhoff, Lichtenstein, Corrigan, & Combs, 1977) stressed that people fail to insure against low probability risks. Still, perceived flood consequences may also affect insurance purchase decisions. For instance, Sjöberg (1994, 1999) concluded that people's valuations of their home insurance were primarily determined by how they

perceived the consequences of non-natural, more every-day types of risks, such as burglary, assault, and home fire risk. Regarding earthquake risk, Palm (1999) presented empirical evidence that a combination of both perceived likelihood and consequences shape people's insurance purchase decisions, with perceived likelihood being the more important dimension. This argument is also supported by a study on flood insurance purchase in Poland (Tyszka, Zaleskiewicz, Domurat, Konieczny, & Piskorz, 2002). The question is to what extent perceived flood likelihood, perceived flood consequences, and worries about floods explain citizens' insurance purchase intentions in the Netherlands.

Next to risk perception, there is evidence that the extent to which the government provides flood protection influences people's risk perceptions and the adoption of flood hazard adjustments. Terpstra (in preparation) reported that Dutch citizens' large confidence in flood protection decreases their perceptions of flood likelihood and their fear of floods, therefore indirectly reducing preparedness intentions. Similar effects of confidence in flood protection were reported by Grothmann & Reusswig (2006) in a sample of German citizens located along the river Rhine. Figure 5.1 proposes that confidence in flood protection also indirectly reduces insurance purchase intentions.

Finally, the literature provides much evidence for increases in insurance purchases after the experience of floods. Thieken, Petrow, Kreibich, & Merz (2006) found that German households with flood insurance more often reported flood experience (18%) as compared to households without flood insurance (12%), which suggest that experiences, to some extent, increase flood insurance purchases. Similar findings were reported for flood insurance purchase in the U.S. by Browne & Hoyt (2000). Studies by Baumann & Sims (1978), Kunreuther (1976), Laska (1990), and Zahran, Weiler, Brody, Lindell, & Highfield (2009) have also reported significant correlations between flood experience and flood insurance purchasing. Moreover, Lindell & Hwang (2008) found in their study that the effects of flood hazard experience on insurance purchase are partially mediated by perceived risk. According to these authors, the finding of a partially mediated effect may suggest there are other mediating variables that interfere between experience and the adoption of hazard adjustments, such as outrage factors. Indeed, Zaleskiewicz, Piskorz, & Borkowska (2002) reported that after the 1997 flood, people were more likely to buy flood insurance if they experienced fear while thinking about floods. Loewenstein, Weber, Hsee, & Welch (2001) also suggested that a strong negative affect resulting from flood experiences may play a role in people's insurance purchase behaviour.

In the Netherlands, the last big flood occurred in 1953. Most likely, few Dutch citizens have recently experienced flood damage. However, in 1993 and 1995, communities in the river area witnessed extremely high river discharges and narrowly escaped flooding. Terpstra (in preparation) revealed that these (near) floods indirectly –through perceptions of flood likelihood and fear of floods– influence people's flood preparedness intentions, but only to the extent that these events evoke affective reactions in people. That is, negative affect (e.g., fear and uncertainty) increases risk perceptions and preparedness intentions, whereas positive affect (e.g., feelings of compassion and solidarity) reveal the opposite effect. Similarly, Siegrist & Gutscher (2008) reported more precautionary behaviour among flood victims who had experienced strong negative emotions after a recent flood event. The model depicted in Figure 5.1 therefore proposes that affective reactions associated with (near) flood events indirectly influence insurance purchase intentions.

Perceptions of hazard adjustment

With regard to how people appraise hazard adjustments for reducing their personal risk, PADM measures a hazard adjustments' efficacy in protecting persons and property, which is similar to PMT's response efficacy. Because the purpose of flood insurance is to mitigate the financial impact of floods, our model measures a flood insurance's 'perceived efficacy in reducing the financial impact of floods'. As noted previously, the results reported by Terpstra & Lindell (in preparation) support the hypothesis that the perceived efficacy of flood insurance correlates to insurance purchase intentions.

Two other variables may be important, given how responsibilities are currently divided between citizens and the government in flood risk management. That is, because flood protection is publicly provided in the Netherlands, households have no responsibility for flood prevention other than to pay a compulsory tax to their local water board. These boards spend these taxes (roughly € 50 per household) mainly on maintenance activities. The government's plan to introduce a flood insurance arrangement would mean that people are confronted with a new responsibility of which they were previously unaware. There may be little public support for the introduction of a private insurance arrangement because purchasing flood insurance may be in conflict with Dutch citizens' culturally based perception that 'the government should take care of flooding risk'. Indeed, Botzen, Aerts, & van den Bergh (2009) found that Dutch citizens' willingness to take flood damage mitigation measures in exchange for premium discounts on a hypothetical flood insurance policy decrease if they perceive the government as responsible for flood damage or adequate protection against floods. Moreover, Terpstra & Gutteling (2008) found that about 73% of the residents in a coastal risk area regard the government (rather than the residents) as primarily responsible for flood damage. However, their results failed to show significant correlations of perceived responsibility with behavioural intentions of adopting flood hazard adjustments, which contradicts previous findings in the U.S. on earthquake (Lindell & Whitney, 2000; Mulilis & Duval, 1995) and tornado preparedness (Mulilis & Duval, 1997). These studies showed that the more a person perceives himself or herself responsible for self-protective

behaviour, the more likely he or she is to adopt hazard adjustments. However, Lindell & Perry (2004) suggested that the effects of responsibility may vary depending on the context and the hazard agent involved. Our model therefore proposes that perceiving the government (rather than the resident) as responsible for flood damage predicts citizens' attitudes towards the government's plan to introduce a private flood insurance arrangement. Moreover, it is expected that citizens with less favourable attitudes towards the introduction of a private flood insurance arrangement will be less likely to buy flood insurance should it become available in the future. As shown in Figure 5.1, the manner in which citizens perceive the efficacy of flood insurance for reducing financial consequences is regarded as a separate predictor of their purchase intentions.

Background variables

Demographic characteristics are often correlated with perceptions of risk (Fothergill, 1996; Fothergill & Peek, 2004; Fothergill, Maestas, & Darlington, 1999; Lindell & Hwang, 2008) and perceptions of hazard adjustments (Lindell, Arlikatti, & Prater, 2009); however, their effects are generally small and sometimes even inconsistent (Lindell, Arlikatti, & Prater, 2009; Terpstra & Lindell, in preparation). This study is limited to the correlations of demographic characteristics with insurance purchase intentions. In line with the correlations obtained by Terpstra & Lindell (in preparation), the model in Figure 5.1 predicts that the female gender correlates with higher purchase intentions. In addition, these authors reported a non-significant correlation between income and insurance purchase intentions. However, many studies have found that higher income is correlated with higher insurance purchase rates (Baumann & Sims, 1978; Browne & Hoyt, 2000; Tyszka, Zaleskiewicz et al., 2002), most likely because yearly premiums are more affordable to higher-income groups. A similar effect may be expected for home-ownership because home-owners have more at stake than tenants. Finally, Terpstra & Lindell (in preparation) found differences between risk areas in their mean risk perceptions (i.e., in perceptions of flood likelihood and consequences) but not in mean insurance purchase intentions.

Summary of hypothesises

Regarding the variable means, this study is investigating the following hypothesises, that:

H1: On average, Dutch citizens will have much confidence in flood protection, will worry little about flooding risk, and perceive low flood likelihood and high flood consequences. In addition, citizens will regard flood damage as a government responsibility and will hold negative attitudes towards the introduction of a flood insurance arrangement. Finally, they will have low insurance purchase intentions. Regarding the correlations among variables, this study hypothesises that (see Figure 5.1):

H2: Citizens' worries about flooding risk, and their perceptions of flood likelihood and flood consequences will be positively correlated with flood insurance adoption intention.

H3: Higher confidence in the public flood defences will be correlated with lower risk perceptions, i.e., less worries, and lower levels of perceived flood likelihood and flood consequences.

H4: A stronger negative affect (as opposed to positive affect) associated with prior flood hazard experience will correlate with more worries, and higher levels of perceived flood likelihood and flood consequences).

H5: A higher perceived efficacy of flood insurance will be correlated with higher insurance purchase intentions.

H6: Less favourable attitudes towards the introduction of a flood insurance arrangement will be correlated with lower flood insurance purchase intentions.

H7: Higher levels of perceived damage responsibility on the part of the government will correlate with less favourable attitudes towards the introduction of flood insurance.

H8: Female gender, income, and home-ownership will be correlated with higher insurance purchase intentions.

H9: There will be differences between risk areas in risk perceptions (i.e., worry, perceived likelihood and consequences), but not in insurance purchase intentions.

5.3 METHOD

Study areas, samples, and procedures

The proposed model was tested in three risk areas, using an internet-based questionnaire survey: a coastal risk area, a river risk area, and a lake risk area. Samples of 8,000 (coastal risk area), 5,000 (river risk area), and 5,000 (lake risk area) household addresses were drawn at random from a telephone book. Sample members were sent a letter explaining our research and inviting them to participate in our internet survey. Each letter contained a URL and a password needed to take the questionnaire. All invitations were sent in December 2007, followed by a reminder about six weeks later. The questionnaire entries were closed on February 19, 2008. The overall response rate was 9%, which is lower than desired and might raise questions about sample representativeness. We will return to this issue in the discussion.

Questionnaire

All questionnaire items were measured on five-point Likert type scales, unless stated otherwise. The part of the questionnaire that addressed flood insurance was introduced with the following text: 'Currently, it is not possible to

insure your property against flood damage. However, the government is studying the possibilities of making flood damage insurable. Implementing flood insurance would mean that flood damage would no longer be compensated by the government from tax money. Instead, insurance companies will compensate flood damages to those people who have bought flood insurance.'

Flood insurance adoption intention was measured by asking the respondents 'Suppose you could insure your property against flood damage for a premium of 25 euros per year. Would you do that?' (scale: *certainly not - certainly*). The premium of 25 euros reflects the average expected flood damage per household per year over a number of risk areas (Kok, 2005).

Perceived efficacy of flood insurance for reducing the financial impact of flooding was measured using the statement, 'If the government will not compensate future flood damages (caused by a failure of the flood defences), I find it useful to have flood insurance' (scale: *strongly disagree - strongly agree*).

Respondents rated their *attitude towards the introduction of a flood insurance arrangement* on two separate statements (scale: *strongly disagree - strongly agree*); 'I am against the introduction of a private flood insurance arrangement: flood damage should be compensated by the government from tax money' and 'I am in favour of the introduction of a private flood insurance arrangement: people should pay for their own flood damage'. The two statements formed a reliable scale (Cronbach's alpha = .80). The first item was reverse coded so that higher values reflect a more favourable attitude towards the introduction of a flood insurance arrangement.

Perceived damage responsibility was measured using two items; 'To what extent do you regard flood damage to your possessions as your personal responsibility?' and 'To what extent do you regard flood damage to your possessions as the government's responsibility?' (scale: *to a very small extent – to a very large extent;* Cronbach's alpha = .72). The first item was reverse coded so that higher values reflect perceiving flood damage as more of a government responsibility.

Risk perceptions. Participants reported how much they *worry* about flood risk ('Compared to other risks that you face in daily life, how much do you worry about the risk of flooding?' scale: *much less – much more*) and they reported their perceptions of *flood likelihood* ('How likely do you find major flooding in your area to be within the next 10 years?' scale: *very unlikely – very likely*). Perceptions of flood consequences were measured by presenting participants with a map of their dike ring, showing the location of the dikes protecting their area from floods. The map also indicated two different and imaginary breach[1] locations. Respondents estimated the *flooding depths in their own neighbourhood* separately for each location if the dikes at those locations were to fail due to a storm surge (coastal and lake risk area questionnaires) or high river discharge (river risk area questionnaire). The response scale comprised six categories: *the water will not reach my neighbourhood* (0), *less than one meter* (1), *between one and two meters* (2), *between two and three meters* (3), *between three and four meters* (4), *more than four meters* (5). In addition, the questionnaire tapped respondents' perceptions of *flood damage consequences* ('How likely do you expect major damage to your home / possessions to be in the case of flooding?' scale: *very unlikely – very likely*).

Confidence in public flood protection (scale: *very little – very much*) was measured by three items including perceptions about the quality of flood defences, the quality of their maintenance, and the financial arrangements for future dike strengthening in the case that it is necessary (e.g., 'How much confidence do you have that the dykes in your area are well maintained?' Cronbach's alpha = .86).

Previous flood experience was measured by first asking respondents whether they had ever experienced flooding. The respondents who indicated flood experience successively indicated whether they had suffered *damage* (*no* = 0, *yes* = 1) and rated their *feelings (very negative feelings* = 1, *slightly negative feelings* = 2, *neither negative nor positive feelings* = 3, *slightly positive feelings* = 4, *very positive feelings* = 5) when recalling their experiences.

Demographic and household characteristics. Respondents reported their sex (*male* = 0, *female* = 1), age (*in years*), home-ownership status (*tenant* = 0, *homeowner* = 1), and income (*less than € 13,000* = 1, *between € 13,000* and *€ 20,000* = 2, *between € 20,000* and *€ 34,000*= 3, *between € 34,000* and *€ 56,000* = 4, and *more than € 56,000* = 5). In addition, we coded the risk areas (*coastal risk area* = 1, *river risk area* = 2, *lake risk area* = 3).

Samples

The resulting samples, which consisted of 563 (coastal risk area), 396 (river risk area), and 485 (lake risk area) questionnaires, were similar with respect to the distribution of gender (Kruskal-Wallis, $\chi^2_2 = 1.26$, *ns*), mean age ($F_{2, 1437} = 1.27$, *ns*), and income (Kruskal-Wallis, $\chi^2_2 = .74$, *ns*). Overall, 77% were males, their mean age was 53.6 years (*SD* = 12.9), and the median income was between € 34,000 and € 56,000 per year (before taxes). However, there were slightly more home-owners (Kruskal-Wallis, $\chi^2_2 = 26.2$, $p < .001$) in the lake risk area sample (86%) as compared to the coastal (73%) and river (77%) risk area samples. Of this group, four persons failed to report their age, and an additional 14 persons failed to answer the questions about home-ownership and income. In addition, 180 (12%) respondents reported personal flood experience; among them, 58 (4% of all respondents) reported flood damage. Recalling their flood experiences caused (strong) negative feelings in 104 respondents (58% of those who reported experience), 60 (33%) respondents reported to experience neither negative nor positive feelings when recalling their flood experiences, and 16 (9%) respondents reported positive feelings.

Analysis

Hypothesis 1 was tested by assessing the deviation of scale means from the scale midpoint (3) using single-sample t-tests. Hypotheses 2 to 8 (see Figure 5.1) were evaluated by means of Spearman correlations. Finally, hypothesis 9 (regarding the differences between the three risk areas) was evaluated by performing non-parametric Kruskal-Wallis tests on each of the scales.

5.4 RESULTS

Variable means

The results of the single-sample t-tests are presented in Table 5.1. First, there was strong support for H1, that citizens have much confidence in public flood protection and worry little about flood risk and that their perceptions of flood likelihood are low but that their perceptions of flood consequences are high. Second, also in support of our expectations, 66.9% of the respondents held negative attitudes towards the government's plan to compensate future flood damages through a private insurance arrangement, and a majority of 76.4% regarded the government as (primarily) responsible for potential flood damages (rather than themselves, only 8.4%).

Table 5.1
Single-sample t-tests

	Difference from scale mean (3)	t
1. Adoption intention	.81	26.21***
2. Perceived efficacy	.91	28.77***
3. Attitude towards insurance (against – for)	-.87	-26.21***
4. Perceived damage responsibility (self - government)	1.03	42.67***
5. Perceived flood likelihood	-.61	-21.75***
6. Perceived damage consequences	.83	26.55***
7. Worry	-.91	-29.94***
8. Confidence in public flood defences	.64	30.35***

Note: df = 1443

*** p < .001(two-tailed)

However, instead of the predicted low insurance purchase intentions, respondents revealed high intentions to purchase flood insurance should it become available–a majority of 66.5% of the respondents indicated that they would 'probably' or 'certainly' purchase flood insurance. Moreover, 70.3% regarded having flood insurance as (very) useful. These findings contradict the previously reported low intentions to adopt damage mitigation measures (Terpstra & Lindell, in preparation). There are two likely related explanations for this discrepancy: 1) the introductory statement explained that if flood insurance became available, the government would no longer compensate flood damages, which may have reduced potential adverse selection effects; and 2) the questionnaire measured insurance purchase intentions provided that the yearly premium would be 25 euros, which may have been regarded as inexpensive. In the discussion, we will further elaborate on these results.

Correlations

Table 5.2 presents the correlations among variables. As expected for H2, all risk perception variables were statistically significant and positively correlated with flood insurance purchase intention–however, most correlations were small (perceived flood likelihood, r_{ij} = .08; worry, r_{ij} = .14; perceived flood damage consequences, r_{ij} = .13; perceived flood depth, r_{ij} = .09).

There was strong support for H3, that more confidence in flood protection reduced flood risk perceptions; that is, both perceived flood likelihood (r_{ij} = -.47) and worry (r_{ij} = -.38) revealed negative correlations with the amount of confidence in the flood defences. However, confidence in the flood defences was not correlated with perceived flood damage consequences (r_{ij} = -.05) or expected flood depth (r_{ij} = .04). In addition, we found a small but significant correlation suggesting that more confidence in the flood defences reduced insurance purchase intentions (r_{ij} = -.10). However, controlling the correlation for perceived flood likelihood or worry resulted in a non-significant partial correlation (r_{ij} = -.04 and r_{ij} = -.03, respectively). Thus, the effect of confidence in flood defences on insurance purchase intention was a mediated rather than a direct effect.

The correlations also supported H4, that a stronger negative affect correlated with higher perceptions of perceived flood likelihood (r_{ij} = .22), more worries about flood risk (r_{ij} = .17), and a higher perception of flood damage consequences (r_{ij} =.15). Although we made no predictions regarding the effects of flood experience on other variables, Table 5.2 indicates that stronger negative affect attached to previous flood experiences correlated with less confidence in flood defences (r_{ij} = -.22), more negative attitudes towards the implementation of a private flood insurance arrangement (r_{ij} = .18), and a lower perceived personal responsibility for flood damage (r_{ij} = -.32).

There was strong support for H5, that perceived efficacy of flood insurance for reducing the financial consequences of floods was correlated with respondents' insurance purchase intentions (r_{ij} = .52). Additionally, regarding H6, respondents who held a less favourable attitude towards the introduction of a private flood insurance arrangement revealed lower insurance purchase intentions (r_{ij} = .17).

Table 5.2

Intercorrelations among variables (n = 1443)

	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Adoption intention	3.81	1.17	–										
2. Perceived efficacy	3.91	1.20	.52	–									
3. Attitude towards insurance (against – for)	2.13	1.26	.17	.17	–								
4. Perceived responsibility (self – government)	4.03	.92	.01	.03	-.42	–							
5. Perceived flood depth	2.76	1.37	.09	.06	-.05	.09	–						
6. Perceived damage consequences	3.82	1.18	.13	.07	-.05	.07	.43	–					
7. Perceived flood likelihood	2.39	1.07	.08	.02	.00	.01	-.02	.09	–				
8. Worry	2.09	1.15	.14	.04	.00	.06	.06	.15	.53	–			
9. Confidence in flood defences	3.64	.81	-.10	-.03	.03	-.09	.04	-.05	-.47	-.38	–		
10. Flood damage experience	.04	.20	.01	-.01	-.03	.07	.04	.02	.04	.02	-.04	–	
11. Flood experience, negative affect a	2.20	.98	.03	-.01	-.18	.32	-.01	.15	.22	.17	-.22	.10	–
12. Gender	.23	.42	-.04	-.02	.05	-.02	-.05	-.10	.21	.06	-.16	-.01	.15
13. Age	53.62	12.88	.15	.14	-.03	.10	.03	.03	.03	.12	.04	-.07	-.12
14. Home-ownership	.21	.41	.08	.08	.00	.00	.01	.04	.07	-.12	-.07	.09	-.06	-.18
15. Income	3.78	1.05	.12	.08	.02	-.04	-.02	.01	-.17	-.14	.11	-.05	-.13

Note: (a) n = 180

$r > .05$, significant at $p < .05$ (two-tailed); $r > .07$, significant at $p < .01$ (two-tailed).

Finally, there was support for H7, that respondents who regarded the government as responsible for flood damages (and themselves less responsible) were more strongly opposed to the introduction of a private flood insurance arrangement (r_{ij} = .42). Moreover, perceived damage responsibility was neither correlated to perceived efficacy of flood insurance (r_{ij} = -.03) nor to insurance adoption intention (r_{ij} = -.01).

The correlations provided mixed results for H8. Higher income classes revealed slightly higher insurance adoption intentions (r_{ij} = .12), but there was no support for the prediction that females or home-owners were more inclined to purchase flood insurance. Table 5.3 supports that there were statistically significant differences in risk perceptions among the three risk areas (H9). The lake area respondents revealed a much lower perception of flood likelihood and were much less worried about flood risk, but they estimated a higher flood depth than did residents from the river and coastal risk areas. Specifically, as shown in Figure 5.2, about 50% of the lake area respondents estimated that the flood depth in their neighbourhood would be higher than three meters. In contrast, only 22% of the coastal and river risk area residents estimated flooding depths to be higher than three meters. In addition, although this was not predicted, the lake risk area residents had more confidence in the flood defences than the residents from the coastal and river risk areas. Finally, insurance purchase intentions did not differ between the three risk areas, but the coastal risk area residents felt more responsible for flood damage and revealed a somewhat less negative attitude towards the introduction of a private flood insurance arrangement than did residents from the lake risk area and river risk area.

Table 5.3

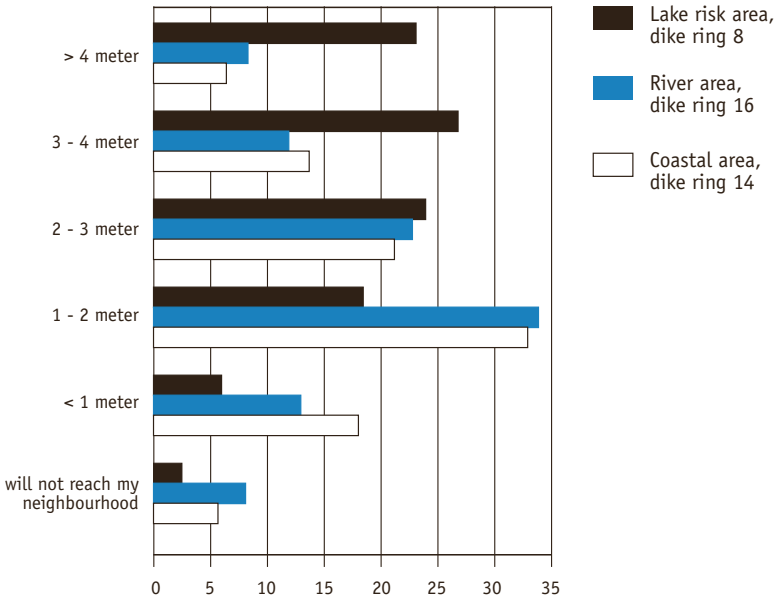
Tests of differences between risk areas (Kruskal-Wallis tests)
Deviating cells are shaded

Scales	Lake area	Coastal area	River area	χ^2_2
Insurance purchase intention	3.75	3.83	3.84	*ns*
Utility	3.92	3.89	3.91	*ns*
Attitude (against – for)	2.04	2.25	2.09	10.50 **
Responsibility (government - self)	1.85	2.14	1.87	33.75 ***
Flood likelihood	1.95	2.62	2.59	126.49 ***
Worry	1.78	2.27	2.22	57.71 ***
Damage consequences	3.85	3.95	3.61	12.70 **
Perceived flood depth	3.36	2.45	2.47	142.97 ***
Confidence in flood defences	3.89	3.48	3.58	72.27 ***

** p < .01, *** p < .001

Figure 5.2

Estimated flood depths in the three risk areas (in percentages of the total number of respondents, n = 1444)



5.5 DISCUSSION

Many countries have flood insurance arrangements. The Netherlands lacks such arrangement. However, the introduction of flood insurance is currently a matter of political and scientific debate. Although many studies have been performed in various countries to explain people's flood insurance purchasing behaviour resulting in the identification of many potential predictors, there are no recent studies that have investigated the influence of these predictors simultaneously. This study therefore proposed a model explaining Dutch citizens' intentions to purchase flood insurance should the government decide to introduce a private flood insurance arrangement in the near future by explicitly taking the risk management context into account. This was done by considering citizens' perceptions of the hazard (i.e., risk perceptions, confidence in the collective flood defences, prior flood hazard experiences) and their perceptions of the hazard adjustment (i.e., perceived efficacy of flood insurance, attitudes towards introduction of private flood insurance, flood damage responsibility, insurance purchase intentions).

We proposed nine hypotheses regarding variable means (H1) and variable correlations (H2 to H9). To test predictions, a survey was performed among residents in three risk areas–a lake risk area, a river risk area, and a coastal risk area. Regarding the variable means (H1), this study replicated previous findings that Dutch citizens have much confidence in the flood defences, perceive flooding as unlikely, and worry little about flooding risk. In addition, the majority (about 68%) expected to suffer damage should flooding occur in their risk area. Moreover, 76% regarded the Dutch government as primarily responsible for potential flood damages, and 67% were against the introduction of a private flood insurance arrangement. Most remarkable therefore, and against H1, about 70% regarded having flood insurance as an effective strategy to protect themselves against flood damage. Moreover, many respondents (67%) intended to purchase flood insurance should it become available in the future.

To explain citizens' high insurance purchase intentions, we performed correlation analysis (H2 to H9, see Figure 5.1). Although the correlations supported H2, that citizens' risk perceptions, i.e., their worry, perceived flood likelihood, and perceived flood consequences, correlated with insurance purchase intentions, these correlations were small and explained little variance in purchase intentions. The low levels of worry and perceived flood likelihood were, to some extent, explained by citizens' high levels of confidence in collective flood protection (H3). Moreover, of the respondents who reported flood experiences (12%), those who experienced negative emotions when thinking about their experiences worried more about floods, perceived greater flood likelihood, and greater flood consequences (H4). The finding that citizens' perceptions of floods had little impact on their insurance purchase intentions conflicts with the argument that citizens insure on the basis of probability, as has been argued previously (Kunreuther, Ginsberg et al., 1978; Slovic, Fischhoff, et al., 1977), but it also conflicts with the argument that people insure on the basis of perceived consequences (Sjoberg, 1994, 1999). Rather, our study indicated that (H5) a high level of perceived efficacy of flood insurance was the most important predictor of citizens' high insurance purchase intentions. Moreover, the large magnitude of the correlation (r_{ij} = .52) between perceived efficacy and purchase intention replicates the results obtained by Terpstra & Lindell (in preparation). In addition, the correlations supported the hypothesis that citizens who perceived a stronger government responsibility for flood damage held more negative attitudes towards the governments' plan to introduce a private flood insurance arrangement (H6), which in turn slightly lowered their insurance purchase intentions (H7). There was little support for H8, that females and home-owners would be more inclined to purchase flood insurance. However, we observed a small but significant correlation between income and purchase intention. Finally, as expected (H9), risk areas did not differ in their average insurance purchase intentions, but we found differences between areas in their

average risk perceptions–the lake risk area residents perceived lower flood likelihood and worried less about floods but perceived greater flood consequences (i.e., flood depths) than did residents in the coastal and river risk areas.

The higher perception of flood depth in the lake risk area is in line with potential flood depth differences between areas; the lake risk area is a rectangular polder that is located up to six meters below the surrounding lake water level. Most likely, the residents in this area are aware of their vulnerable position. In contrast, however, citizens in the lake risk area were extremely low in their estimations of flood likelihood and rated flood likelihood and their worries about flood risk much lower than did citizens in the coastal and river risk area. However, the low level of perceived flood likelihood does not fit with the differences in protection levels between risk areas; although the protection level of the lake risk area is two times higher as compared to the safety level in the river risk area, it is 2.5-times lower than the safety level in the coastal area. The lower estimations of flood likelihood are partially the result of higher levels of confidence in the flood defences surrounding the lake risk area. For risk managers, this implies that they might need to put more effort in explaining why the adoption of hazard adjustments in their area is important, even despite the high level of flood protection.

There are two other notable findings from this study that deserve further attention. First, the data unexpectedly revealed that people's affective responses to their prior flood hazard experiences correlated with their perceived responsibility for flood damage and their attitudes towards the implementation of a private flood insurance arrangement. In particular, a higher negative affect correlated with the perception of greater government responsibility for flood damage and more negative attitudes towards the implementation of a private flood insurance arrangement. Thus, the data suggest that *negative affect* indirectly *lowered* insurance purchase intentions, via people's preferences for a large government responsibility in flood risk policy. Interestingly, however, Zaleskiewicz, Piskorz, & Borkowska (2002) reported that *fear* resulting from prior flood experiences correlated with *increases* in insurance purchase behaviour. A possible explanation for these seemingly contradictive effects on people's insurance purchase decisions may be found in the hypothesis that different discrete emotions of the same valence may have different effects on judgment and behaviour. For instance, although anger and fear are both negative emotions, fear is especially known to result in increased risk perceptions. Anger, on the other hand, which is associated with the experience of a negative event of which someone else was perceived to be in control, increases people's tendencies to attribute greater responsibility to other parties (e.g., Lerner & Keltner, 2000; Lerner & Tiedens, 2006). Indeed, Terpstra (in preparation) found that citizens sometimes described their negative feelings associated with prior flood experiences as 'angry', although 'fear' was reported most often. Nevertheless, this may be a plausible explanation because,

in the Netherlands, flood risk management is mainly a government responsibility, and there is little that citizens can do individually to prevent floods. Asking citizens to what extent they perceive themselves as personally responsible for flood damage likely goes against their culturally based perception that 'the government should take care of flood risk' and may have instigated 'anger', especially in those individuals who have experienced (near) floods. Future studies should further investigate the effects of discrete emotions on people's flood risk perceptions and their hazard adjustment decisions.

Second, this study found that insurance purchase intentions were high, whereas Terpstra & Lindell (in preparation) found low insurance purchase intentions. This discrepancy between the two studies is most likely the result of how the questionnaires in the two studies introduced flood insurance. First, Terpstra & Lindell (in preparation) measured insurance purchase intentions among other flood hazard adjustments. In contrast, the current study explicitly explained that purchasing flood insurance would be a voluntary choice but that future flood damages would not be compensated by the government from tax money. In addition, it was stressed that only those who have flood insurance will be compensated for flood damages by their insurance company. It seems that the introductory statement made it very clear that flood insurance was the only way to reduce the risk of flood damage. This was supported by the finding that flood insurance was perceived as highly useful and was strongly correlated with purchase intentions. Moreover, the questionnaire gave respondents a rather easy way out because they were asked to rate their purchase intentions if flood insurance would be offered against a yearly premium of 25 euros, which may have been regarded as inexpensive.

It is important to acknowledge that this study, like all cross-sectional designs, has limited ability to draw conclusive causal inferences. Only longitudinal studies and especially experimental research designs can provide such conclusive evidence. A second limitation concerns the low response rate (overall, 9%), which raises questions about the generalisability of the results. Indeed, a comparison of the respondents from each risk area to the NRM2004[2] database showed that the sample identically over-represented males, home-owners, and older residents in each risk area, so there is no net effect on differences between the river, coastal, and lake risk area in mean responses. Moreover, the over-representation of some demographic categories will produce bias in psychological variables only to the degree to which the latter are correlated with demographic variables. Such correlations are generally low (Lindell & Perry, 2000). In addition, this study found only minor correlations of gender, age, and income with perceptions of flood risk and flood insurance. Reports by Curtin, Presser, & Singer (2000), Keeter, Miller, Kohut, Groves, & Presser (2000), and Lindell & Perry (2000) indicated that low response rates do not appear to bias estimates such as means and proportions. Moreover, correlation coefficients are resistant to mean

[2] The NRM2004 database (Goudappel Coffeng, 2004) provides information about the demographic characteristics of the Dutch population on the level of zip codes within predefined flood risk areas (so-called dike rings). The primary sources of NRM are the demographic population characteristics from Statistics Netherlands, which is the Dutch organization that is responsible for collecting and processing data in order to publish statistics to be used in practice, by policymakers, and for scientific research.

bias, so tests of the correlations among the variables can be taken at face value.

The study findings have an important practical implication. At first sight, it may be tempting for risk managers to promote flood insurance by stressing its efficacy in reducing potential flood damages. However, this could have a boomerang effect. The high level of confidence in flood protection suggests that people are generally rather satisfied with the current level of flood protection. Moreover, in the absence of recent big floods, many Dutch citizens are likely unable and unmotivated to imagine that failure of the flood defences is still possible. Currently, citizens have no responsibility in flood risk management other than to pay a mandatory tax to their local water board, and it is only recently that the government has begun motivating citizens to prepare for floods, for instance, by adopting an emergency kit. However, although a substantial number of people support private flood preparedness, the large majority (about 75%) of the Dutch population reject personal responsibility for flood damage (see also Terpstra & Gutteling, 2008). Moreover, about 70% hold negative attitudes towards the introduction of a private flood insurance arrangement. Such disagreement, when ignored, could lead to crumbling faith in and scepticism towards risk managers. Therefore, if decisions are made by the government to introduce a flood insurance arrangement, whether voluntary or mandatory, it would be wise to involve the public in this decision.

5.6 ACKNOWLEDGEMENTS

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5.7 REFERENCES

Baumann, D. D., & Sims, J. H. (1978). Flood insurance: Some determinants of adoption. *Economic Geography, 54*(3), 189-196.

Botzen, W. J. W., Aerts, J. C. J. H., & van den Bergh, J. C. J. M. (2009). Willingness of homeowners to mitigate climate risk through insurance. *Ecological Economics, 68*(8-9), 2265-2277.

Botzen, W. J. W., & van den Bergh, J. (2009). Bounded rationality, climate risks, and insurance: Is there a market for natural disasters? *Land Economics, 85*(2), 265-278.

Browne, M. J., & Hoyt, R. E. (2000). The demand for flood insurance: Empirical evidence. *Journal of Risk and Uncertainty, 20*(3), 291-306.

Calamities Compensation Act (1998). *Law of 25 May 1998, Containing Rules on the Compensation of Damage and the Costs in case of Floods by Fresh Water, Earthquakes or other Disasters and Severe Accidents* (in Dutch: Wet van 25 mei 1998, houdende regels over tegemoetkoming in de schade en de kosten in geval van overstromingen door zoet water, aardbevingen of andere rampen en zware ongevallen (Wet Tegemoetkoming Schade bij Rampen en Zware Ongevallen, WTS)). The Hague.

Curtin, R., Presser, S., & Singer, E. (2000). The effects of response rate changes on the index of consumer sentiment. *Public Opinion Quarterly, 64,* 413-428.

Disasters and Calamities Compensation Committee (2004). (in Dutch: Commissie Tegemoetkoming Rampen en Calamiteiten). *Tactful Solidarity (in Dutch: 'Solidariteit met beleid')*. The Hague.

Fothergill, A. (1996). Gender, risk, and disaster. *International Journal of Mass Emergencies and Disaster, 14,* 33-56.

Fothergill, A., Maestas, E. G. M., & Darlington, J. D. (1999). Race, ethnicity and disasters in the United States: A review of the literature. *Disasters, 23*(2), 156-173.

Fothergill, A., & Peek, L. A. (2004). Poverty and disasters in the United States: A review of recent sociological findings. *Natural Hazards, 32*(1), 89-110.

Goudappel Coffeng, G. (2004). *NRM-basisbestand 2004.* Delft: Dienst Verkeer en Scheepvaart.

Grothmann, T., & Reusswig, F. (2006). People at risk of flooding: Why some residents take precautionary action while others do not. *Natural Hazards, 38*(1-2), 101-120.

Jongejan, R., & Barrieu, P. (2008). Insuring large-scale floods in the Netherlands. *Geneva Papers on Risk and Insurance-Issues and Practice, 33*(2), 250-268.

Keeter, S., Miller, C., Kohut, A., Groves, R. M., & Presser, S. (2000). Consequences of reducing nonresponse in a national telephone survey. *Public Opinion Quarterly, 64,* 125-148.

Kok, M. (2005). *Flood insurance in the Netherlands: Feasible and desirable? (in Dutch: 'Een waterverzekering in Nederland: Mogelijk en wenselijk?')*. Lelystad: HKV Lijn in water.

Kunreuther, H. (1976). Limited knowledge and insurance protection. *Public Policy, 24*(2), 227-261.

Kunreuther, H., Ginsberg, R., Miller, L., Sagi, P., Slovic, P., Borkan, B., Katz. N. (1978). *Disaster Insurance Protection: Public policy lessons.* New York: Wiley.

Laska, S. B. (1990). Homeowner adaptation to flooding: An application of the general hazards coping theory. *Environment and Behavior, 22*(3), 320-357.

Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition & Emotion, 14*(4), 473-493.

Lerner, J. S., & Tiedens, L. Z. (2006). Portrait of the angry decision maker: How appraisal tendencies shape anger's influence on cognition. *Journal of Behavioral Decision Making, 19*(2), 115-137.

Lindell, M. K., Arlikatti, S., & Prater, C. S. (2009). Why people do what they do to protect against earthquake risk: Perceptions of hazard adjustments and their attributes. *Risk Analysis, 29*(8), 1072-1088.

Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis, 28*(2), 539-556.

Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard: A review of research. *Environment and Behavior, 32*(4), 461-501.

Lindell, M. K., & Perry, R. W. (2004). *Communicating Environmental Risk in Multiethnic Communities*. Thousand Oaks, California: Sage Publications, Inc.

Lindell, M. K., & Whitney, D. J. (2000). Correlates of household seismic hazard adjustment adoption. *Risk Analysis, 20*(1), 13-25.

Linnerooth-Bayer, J., & Amendola, A. (2003). Introduction to special issue on flood risks in Europe. *Risk Analysis, 23*(3), 537-543.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127*(2), 267-286.

Ministry of Transport, Public Works, and Water Management (2005). *Flood Risks and Safety in the Netherlands (FLORIS): Full report*. The Hague: Ministry of Transport, Public Works and Water Management.

Mulilis, J. P., & Duval, T. S. (1995). Negative threat appeals and earthquake preparedness: A person-relative-to-event (PrE) model of coping with threat. *Journal of Applied Social Psychology, 25*(15), 1319-1339.

Mulilis, J. P., & Duval, T. S. (1997). The PrE model of coping and tornado preparedness: Moderating effects of responsibility. *Journal of Applied Social Psychology, 27*(19), 1750-1766.

Palm, R. (1999). Perceived risk and the earthquake insurance purchase decision: A commentary on a paper by Lennart Sjoberg. *Journal of Risk Research, 2*(4), 289–294.

Munich Re (2000). *Topics 2000: Natural Catastrophes–The Current Position*. Munich: Munich Re.

Rogers, R. W., & Prentice-Dunn, S. (1997). Protection motivation theory. In D. S. Gochman (Ed.), *Handbook of Health Behavior Research* (pp. 113-132). New York: Plenum.

Siegrist, M., & Gutscher, H. (2008). Natural hazards and motivation for mitigation behavior: People cannot predict the affect evoked by a severe flood. *Risk Analysis, 28*(3), 771-778.

Sjoberg, L. (1994). *Perceived Risk vs. Demand for Risk Reduction*. (No. 18). Stockholm: Center for Risk Research, Stockholm School of Economics.

Sjoberg, L. (1999). Consequences of perceived risk: Demand for mitigation. *Journal of Risk Research, 2*, 129-149.

Slovic, P., Fischhoff, B., Lichtenstein, S., Corrigan, B., & Combs, B. (1977). Preference for insuring against probable small losses: Insurance implications. *Journal of Risk and Insurance, 44*(2), 237-258.

Slovic, P., Kunreuther, H., & White, G. F. (1974). Decision processes, rationality, and adjustment to natural hazards In G. F. White (Ed.), Natural hazards: Local, *National, and Global* (pp. 207-232). New York: Oxford University Press.

Terpstra, T. (in preparation). Emotions, trust, and perceived risk: Affective and cognitive routes to flood preparedness behavior.

Terpstra, T., & Gutteling, J. M. (2008). Households' perceived responsibilities in flood risk management in the Netherlands. *International Journal of Water Resources Development, 24*(4), 555-565.

Terpstra, T., & Lindell, M. K. (in preparation). Citizens' perceptions of flood hazard adjustments: An application of the protective action decision model.

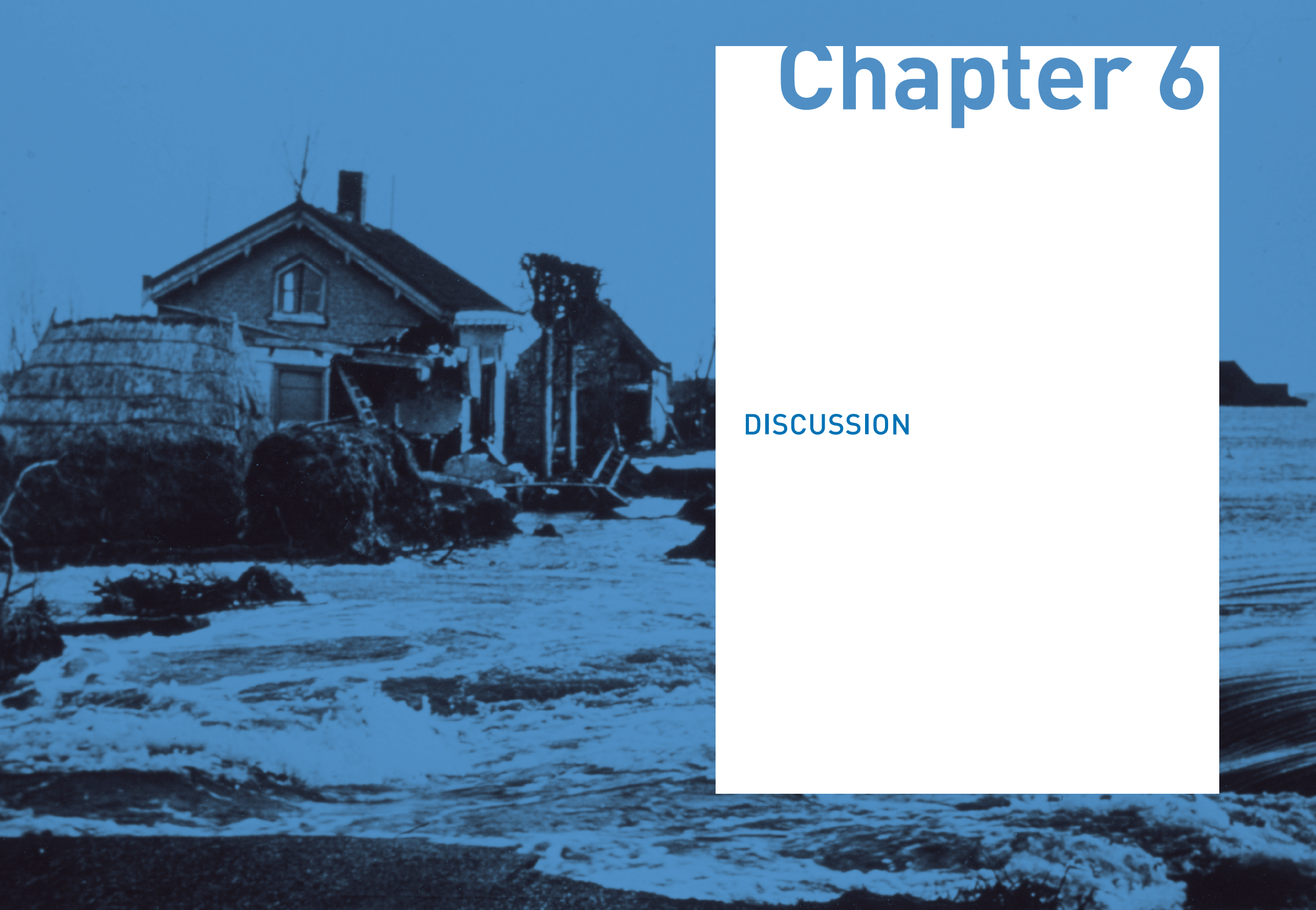
Thieken, A. H., Petrow, T., Kreibich, H., & Merz, B. (2006). Insurability and mitigation of flood losses in private households in Germany. *Risk Analysis, 26*(2), 383-395.

Tyszka, T., Zaleskiewicz, T., Domurat, A., Konieczny, R., & Piskorz, Z. (2002). *When are people willing to buy insurance?* Paper presented at IAREP/SABE conference, Stability and Dynamics of Power, Turku, Finland.

Water Advisory Council (2006). *Recommendations of the Water Advisory Board Concerning the Insurance of Flooding (in Dutch: 'Aanbevelingen van de Adviescommissie Water inzake verzekeren en wateroverlast')*. The Hague: Water Advisory Council.

Zahran, S., Weiler, S., Brody, S. D., Lindell, M. K., & Highfield, W. E. (2009). Modeling national flood insurance policy holding at the county scale in Florida, 1999-2005. *Ecological Economics, 68*(10), 2627-2636.

Zaleskiewicz, T., Piskorz, Z., & Borkowska, A. (2002). Fear or money? Decisions on insuring oneself against flood. *Risk, Decision and Policy, 7*, 221-233.



Chapter 6

DISCUSSION

DISCUSSION

This final chapter briefly reviews the study background and the research objectives of the present work (6.1). Subsequently, we discuss the determinants of citizens' behavioural intentions (6.2), the differences between risk areas (6.3), some methodological issues (6.4), and the implications for risk communication and research (6.5). Finally, some personal remarks from the author are provided (6.6).

6.1 BACKGROUND AND OBJECTIVES

In the Netherlands, flood risk management has historically focused on the prevention of floods. Disaster preparedness has long been an underexposed topic. The river floods that almost occurred in 1993 and 1995, as well as the flooding of New Orleans in 2005, created awareness among the Dutch authorities that their society is underprepared for large-scale floods. Important first steps toward preparing regional and national authorities for floods were recently set by the Flood Management Taskforce. At the level of individual households, the Ministry of the Interior and Kingdom Relations has developed the Denk Vooruit (Think Ahead) communication campaign, which aims to increase the disaster preparedness of citizens for a number of risks (e.g., terrorism and pandemic flu), including floods.

It will be a great challenge to promote flood preparedness among Dutch citizens. Few Dutch citizens have ever experienced floods, and few have taken any measures to prepare themselves for floods. The responsibility for flood risk management has historically been located within the government. Therefore, individual citizens are likely unaware that taking some actions to prepare for floods might be a wise decision. This thesis is aimed at increasing the understanding of Dutch citizens' intentions in flood preparation. Up to this point, research has barely addressed the determinants of citizens' flood preparedness intentions. However, this knowledge is greatly needed for developing effective (risk) communication with citizens to facilitate their flood preparedness decisions.

We applied the Protective Action Decision Model (PADM; Lindell & Perry, 2000, 2004) to study the flood preparedness intentions of people (see Figure 1.2 of the Introduction). In particular, we studied PADM variables that appeared to be relevant predictors of flood preparedness intentions, in the context of Dutch flood risk management, and that could be related to the five PADM 'decision stages'. The five decision stages reflect the steps that people typically take before adopting hazard adjustments. These stages are reflected in five successive questions: 1) Is there a real threat that I need to pay attention to? 2) Do I need to take protective action? 3) What can be done to achieve protection? 4) What is the best method of protection? and 5) Does protective action need to be taken now? Of course, the conceptualisation of people's decisions in separate stages is a simplification of reality because people do not always proceed through all five

stages to arrive at a decision. In addition, they do not always follow the exact order in which the stages are presented herein. However, as stressed by Lindell and Perry (2004, p.48) with regard to risk communication:

> *"The important lesson is that (…) the more stages in the PADM that they [risk communicators] neglect, the more ambiguity there is likely to be for message recipients. In turn, greater ambiguity is likely to lower compliance and cause warning recipients to spend more time in seeking and processing information rather than preparing for and implementing protective action." (text between brackets is from the author)*

Thus, the Dutch authorities responsible for flood preparedness communication should address all of these five stages, to help people prepare for floods.

6.2 THE DETERMINANTS OF DUTCH CITIZENS' FLOOD PREPAREDNESS INTENTIONS

Three questionnaire surveys were performed to collect data from various dike ring areas, including areas along the Dutch coast, the main rivers, and the lake area in the heart of the country (n = 3559). Figure 1.3 of the Introduction presents the variables that are analyzed in Chapters 2 to 5 and showed how these variables were expected to relate to the behavioural intentions of people. Moreover, it showed how they were related to the five PADM decision stages. Figure 6.1 contains Figure 1.3 as well as the expected relationships that were and were not empirically supported.

Before turning to the variables that explain the behavioural intentions of citizens, we will first discuss *the extent* to which Dutch citizens intend to adopt flood hazard adjustments. Within the PADM, this is reflected in the fifth stage: 'Does protective action need to be taken now?'.

6.2.1 *Stage 5: Protective action implementation (behavioural intentions)*

The behavioural intentions of citizens in adopting flood hazard adjustments were studied in all chapters of this thesis. Moreover, we studied the intentions in different dike ring areas and for different types of hazard adjustments. In general, citizens revealed low intentions toward adopting flood hazard adjustments. However, the results obtained in Chapters 2 and 4 indicate that the intentions to adopt emergency preparedness actions were higher than the intentions to adopt damage mitigation actions. Searching for flood emergency information –concerning flood consequences such as expected flood depths, evacuation routes, and safe/high places in the neighbourhood– was clearly the most popular emergency preparedness action (see Chapter 4). Nearly 30% of the interviewed citizens intended to search for such information in the near future, while only 4% were interested in buying sand bags to mitigate flood damage.

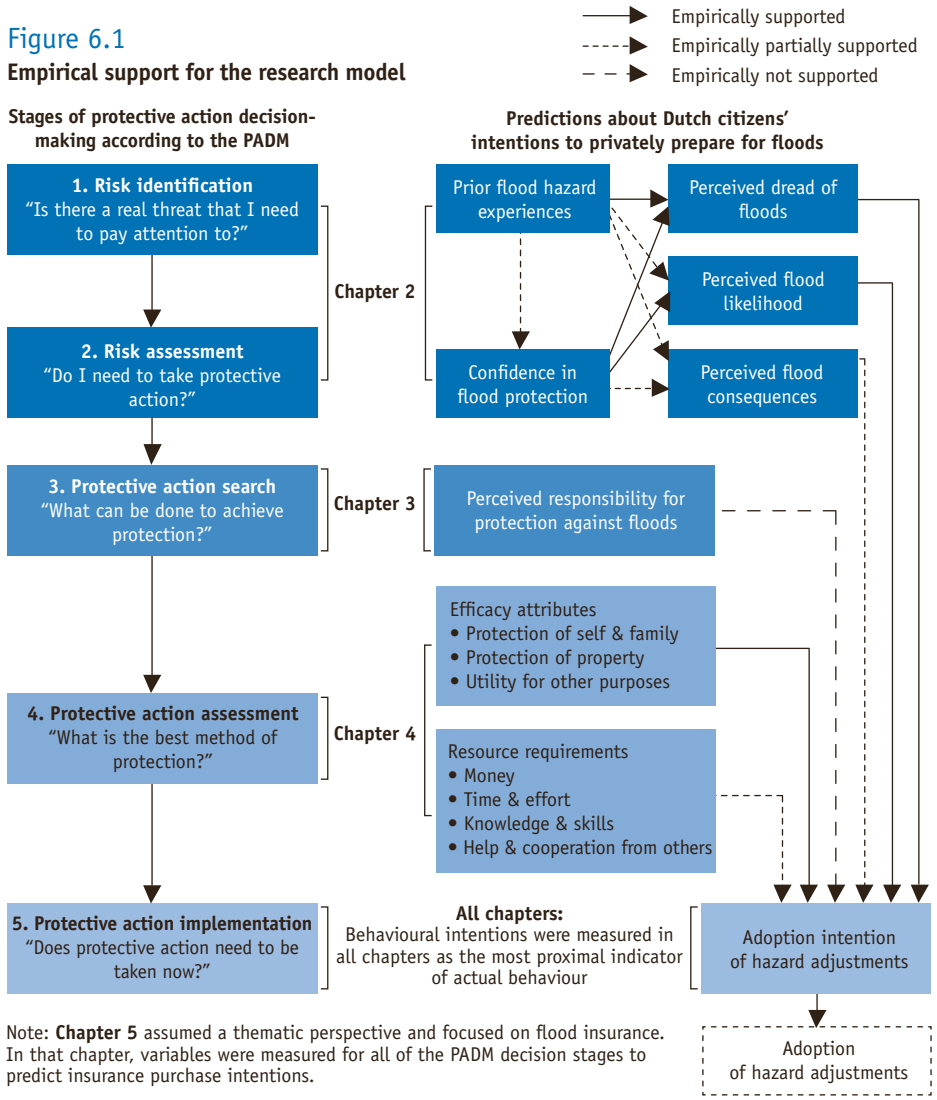
In addition, there was a notable discrepancy in the results for flood insurance between Chapters 4 and 5. As shown in Chapter 4, only 14% of the citizens were interested in purchasing flood insurance, while Chapter 5 shows that 67% were interested in purchasing flood insurance, should it become available in the future. In Chapter 5, we explained this discrepancy by discussing how the questionnaires from the two studies introduced flood insurance. That is, in Chapter 5 the questionnaire explicitly explained that purchasing flood insurance would be a voluntary choice, but that future flood damages will not be compensated from tax money by the government (through the 1998 Calamities Compensation Act). It seems that the introductory statement made it very clear that flood insurance was the only way to reduce the risk of flood damage. This was supported by the finding that, although 70% of the respondents perceived flood insurance as useful in this situation, 76% still regarded the government as being primarily responsible for taking care of potential flood damages. A total of 67% of the respondents held negative attitudes towards the government's plan to introduce a private flood insurance arrangement in the future.

So, apart from the insurance purchase intentions that were reported in Chapter 5, citizens' behavioural intentions towards taking flood preparations were low. The important question is: why? To answer this question, we turn to the first four stages of the protective action decision-making process.

6.2.2 *Stage 1: Risk identification*

Whether citizens are willing to prepare for floods will first depend on whether they have identified the flood risk as a threat that requires their attention. At this stage of the protective action decision-making process, people typically ask themselves 'Is there a real threat that I need to pay attention to?'. Most likely, many Dutch citizens have low flood preparedness intentions because they do not consider that their exposure to a flood risk is a real threat that requires their attention. That is, measurements revealed that only a minority (13%) of all 3,559 respondents regarded flooding as a likely event within the next ten years. In addition, average citizens perceived little dread (fear-related feelings) when thinking about flooding. To some, these may be remarkable findings, given that hardly any citizens have taken any measures to prepare themselves for floods while, without primary flood defences, two-thirds of the country would be regularly flooded by the sea or by major rivers.

Figure 6.1
Empirical support for the research model



Note: **Chapter 5** assumed a thematic perspective and focused on flood insurance. In that chapter, variables were measured for all of the PADM decision stages to predict insurance purchase intentions.

However, within the context of Dutch flood risk management, these findings are less startling. First, over the past 60 years, Dutch flood risk management has been focused above all on the prevention of floods. This has resulted in flood protection standards that are among the highest in the world (e.g., along the Dutch coast, flood defences are designed to withstand water levels that have a statistical probability of 1/10,000 per year). Second, because the primary flood defences have not failed since 1953, few Dutch citizens have personally experienced the consequences of flooding. Third, in their communications, the flood risk management authorities have always emphasised that the government takes care of flooding risks. These arguments are supported because results indicate that citizens greatly trust in the authorities' ability to build and maintain the collective flood defences. Specifically, Chapters 2 and 5 show that the high level of trust in flood protection is strongly correlated with low levels of perceived flood likelihood and dread among citizens. Together, these variables explain up to 26% of the variance in citizens' low flood preparedness intentions.

So, in terms of the PADM, people have received few environmental cues over the past sixty years reminding them of their vulnerability to floods. The public has also been unlikely to receive socially-transmitted communication messages that motivate them to privately prepare for potential flood disasters. An important lesson for future flood risk communications is to focus first on the fact that, although flooding is unlikely in the Netherlands, it is still possible. Even though this may sound like an open door to many of us, stressing the possibility of flooding is contradictory to the traditional method of flood prevention. Moreover, citizens should be taught to identify the risk of floods in their own regions. Without a *threat belief*, people are unlikely to proceed to the next stage in the protective action decision-making process.

6.2.3 *Stage 2: Risk assessment*

The next question in the protective action decision-making process addresses whether people that have identified flooding as a potential threat expect to be *personally* at risk of death, injury, or damage, should flooding occur. Data from surveyed risk areas generally indicated that people expect large damage to public facilities (e.g., road infrastructure), as well as to their homes and possessions, and generally expect that their daily routines will be disturbed for a long period after a flood has occurred. However, people are less certain about the extent to which a flood will pose a threat to their lives. Overall, 67% of all 3,559 respondents thought they would likely suffer consequences if flooding were to occur in their dike ring.

Despite the generally high perception of flood consequences, especially with regard to expected damage, people largely remain unmotivated to prepare for floods. The results from Chapter 2 indicate that, in the river area (Land van Heusden/de Maakskant and the Island of Dordrecht), perceived flood damage consequences explained similar amounts of variance in preparedness intentions as did people's perceptions about flood likelihood and their perceived dread of floods. However, in two coastal areas (i.e., in Zeeland on the North Sea coast and Friesland on the Wadden Sea coast), the perceived flood consequences were not significant predictors of the flood emergency preparedness intentions of the public.

Thus, most people currently fail to provide an affirmative answer to the question 'Do I need to take protective action?' because the overall dominant predictors of their low preparedness intentions are their perceptions that flooding is unlikely as well as their low levels of perceived fear when considering floods. Their perceptions of large flood consequences play an inferior role in their protective action decisions.

To increase levels of protection motivation, risk communicators should address both affective (emotional) and cognitive (informational) factors in the protective action decisions of citizens. This is because emotional reactions and cognitive evaluations typically work in concert to guide decision-making. According to the risk-as-feelings hypothesis (Loewenstein, Weber, Hsee, & Welch, 2001), when emotional reactions diverge from cognitive evaluations, the emotional reactions often exert a dominating influence on behaviour. The use of fear-appeal should be considered in developing risk communications. According to the Extended Parallel Process Model (Witte, 1992), fear-appeals in risk communication is critical because fear motivates a person to process the content of a message carefully and makes distraction less likely. However, the extent to which fear contributes to adaptive behaviour (e.g., taking flood preparations) subsequently depends on how people evaluate the threat presented in the communication message, as well as the perceived efficacy of potentially adaptive behaviours. Fear appeals are more likely to increase threat perceptions and change behaviour if they are personally relevant and convincing. For instance, experimental studies by Meijnders, Midden & Wilke (2001a; 2001b) found that fear-inducing communication messages about climate change resulted in more favourable attitudes towards purchasing energy-efficient light bulbs. Moreover, intermediate levels of fear, as induced by risk communication, worked only if they were accompanied by convincing arguments about the efficacy of light bulbs, whereas high levels of induced fear seemed to bypass cognitive information processing, resulting in a direct effect on the attitudes of subjects towards purchasing energy-efficient light bulbs. However, high levels of fear may also result in maladaptive responses (i.e., denial or avoidance of information; see, for instance, Brown & Locker, 2009; Jepson & Chaiken, 1990). In addition, from a moral perspective, the use of fear-appeal is sometimes regarded as undesirable.

Taken together, risk communications for flood preparedness are more likely to be effective if the communication messages are able to arouse some extent of fear. Research should be carried out on how levels of fear can be induced and how different levels of fear (moderate or high) influence flood preparedness behaviour. In addition, fear-appeals should be accompanied by relevant information on how to prepare for floods. Such information can only be relevant if it is tailored to the *local consequences* of floods in an individual's region. The effects of scale size in explaining the local consequences (e.g., a whole dike ring, a city, or only a neighbourhood) of a flood should also be subjected to research. In addition, the communication messages should convince people that the recommended flood preparedness actions are effective in dealing with the local consequences of flooding. Section 6.2.5 discusses the issue of perceived efficacy in greater detail.

6.2.4 *Stage 3: Protective action search*

In addition to helping people identify the local risk of flooding in their area and stimulating their protection motivation, risk communications should also clarify that flood preparedness is a shared responsibility between the government and citizens. The notion of a *shared* responsibility has implications for both. The government should facilitate flood preparedness by recommending locally effective flood preparedness measures to people and providing assistance to those who require help in preparing for floods. Citizens should take responsibility by spending resources (e.g., time, effort, and money) on flood preparations.

Regarding the level of perceived personal responsibility, Chapter 3 indicates that about 50% of the respondents on the Wadden Sea coast viewed emergency preparedness (e.g., knowing evacuation routes) as a shared responsibility between themselves and the government. A total of 18% even viewed this as their personal responsibility. This is an important finding because it deviates from what many flood risk managers would have expected. It indicates that large parts of the population are open to the suggestion that they should undertake some personal action to prepare for a flood disaster. However, the picture is different with regard to flood damage. About 75% of the public regards the government as primarily or even completely responsible for potential flood damage (see Chapters 3 and 5).

Despite this clear distinction between how citizens perceive their responsibility for emergency preparedness and flood damage, our results failed to confirm that perceived responsibility is correlated with citizens' behavioural intentions for taking flood preparations. This might suggest that perceived responsibility plays an unimportant role in the flood preparedness decisions of the public. However, we find it premature to draw this conclusion because studies on earthquake (Lindell & Whitney, 2000; Mulilis & Duval, 1995) and tornado preparedness (Mulilis & Duval, 1997) have found that higher levels of perceived personal responsibility correlate with higher preparedness intentions as well as actual preparedness behaviour. Moreover, a growing amount of literature has demonstrated how perceptions of responsibility shape the relationships between individual citizens and institutions in the context of risk management (e.g., Bickerstaff, Simmons, & Pidgeon, 2008; Freudenburg, 1993; Harrison, Burgess, & Filius, 1996; Lorenzoni & Pidgeon, 2006). According to Eden (1993), there are different forms of responsibility, which can be distinguished as 'moral responsibility' or 'actionable responsibility'.

In the Netherlands, flood risk management has mainly been the responsibility of the government. The act of asking citizens to what extent they perceive they are personally responsible for flood damage likely goes against their culturally based perception that the government should take care of flood risk. Framing responsibility in this way shows the perception of collective flood protection as a moral obligation of the government, reflecting moral intuitions about right and wrong. As defined by Eden (1993), perceptions of moral responsibility are independent of one's personal behavioural context. This may explain the non-significant correlation between perceived responsibility and behavioural intentions for taking damage mitigation and flood preparedness actions.

On the other hand, 'actionable responsibility' refers to the extent to which people perceive opportunities to take action personally. For instance, the results of Mulilis, Duval, & Rombach (2001) showed that college students attribute greater responsibility to themselves and government (i.e., a shared responsibility) for tornado preparedness if they feel committed to their responsibility and perceive greater choice in how to prepare for tornadoes. Correlations reported by Paton, Smith, Daly, & Johnston (2008) indicate that people tend to accept greater responsibility for volcano preparedness when they believe that their relationship with risk management authorities is fair and empowering (e.g., when agencies are perceived as trustworthy, as acting in the interest of community members). The same is true when individuals have positive expectations about their ability to cope with the consequences of volcanic eruptions. Similarly, qualitative research reported by Bickerstaff, Simmons, & Pidgeon (2008) suggested that people accept a larger personal responsibility if risks are perceived as being under greater personal control (e.g., mobile phone use, consumption of foods containing genetically modified ingredients), compared to risks that are regarded as requiring collective responses (e.g., climate change). The correlations reported in Chapter 3 are consistent with these studies because citizens who perceived less control over their safety, in the case of flooding, accepted less personal responsibility for flood preparedness and damage mitigation and they attributed greater responsibility to the government. Lalwani & Duval (2000) labelled this mechanism as 'defensive attribution'.

Taken together, the arguments from these studies imply that Dutch flood risk management authorities should inform citizens that the government will keep working to maintain flood safety (their 'moral' responsibility), but that, in addition to flood prevention, there will also be investments in better disaster preparedness that will require citizen participation. This should be a shared responsibility between local authorities and citizens. Locally responsible authorities for risk communication have the duty to provide citizens with alternative flood preparedness actions (choice) that are effective, given the local characteristics of the population at risk and the local characteristics of flood consequences (efficacy).

This also means that a requirement for performing risk communication is the differentiation between target groups.

6.2.5 *Stage 4: Protective action assessment*

Thus far, we have recommended that risk communication should help people identify the local risk of flooding in their area, stimulate their protection motivation, stress that flood preparedness is a shared responsibility, and recommend locally effective flood preparedness measures. In addition, risk communicators should consider three aspects of the flood preparedness actions they recommend to people.

First, it is important that recommended flood preparedness actions are *perceived* as effective. The PADM defines three so-called efficacy attributes, including the perceived efficacy of protective actions for protecting people, the perceived efficacy of protective actions for protecting property, and their utility for other purposes. The PADM predicts that higher levels of perceived efficacy will contribute to higher behavioural intentions as well as actual preparedness behaviour. Chapter 4 tested the predictive validity of the efficacy attributes for six different flood preparations, including: (1) an emergency kit (e.g., battery powered radio, food and water supplies, first aid materials, etc.); (2) emergency information (flood consequences, evacuation procedures, and safe shelters); (3) a household emergency plan (list of things to do in the case of flooding or evacuation); (4) agreements with family/relatives, friends, and neighbours regarding how to help each other during an evacuation or flood; (5) sandbags and/or flood skirts; and (6) flood insurance. Regression analysis showed that the three efficacy attributes are most important determinants of the behavioural intentions of people; together, they explain between 32% and 41% in people's intentions of taking the various flood preparations. In particular, the regression analysis indicated that perceived *efficacy of flood preparations in protecting persons* was the best predictor of the flood preparedness intentions of citizens. Moreover, 76% of the respondents stated that the efficacy of a flood preparation in protecting people would be an important ingredient in their preparedness decisions. However, with respect to this efficacy attribute, only one flood preparedness action received majority support. More specifically, 68% of the respondents perceived emergency information as effective for increasing their safety in the case of flooding or evacuations. Making a household plan and assembling an emergency kit, both of which have been promoted in the Think Ahead campaign, were perceived as effective preparations for protecting people, by small majorities of 55% and 51%, respectively. Sand bags received the least support. Only 26% of the respondents regarded sand bags as effective in protecting people. *Protection of property and suitability for other purposes* were regarded as important attributes by 54% and 55% of respondents, respectively.

However, only minorities perceived the six flood preparations as effective in protecting their property and useful for other purposes. Flood preparations with the highest support on these efficacy attributes were flood insurance and the emergency kit. That is, a total of 47% of the respondents perceived flood insurance as an effective way to protect their property against flood damage, while 34% perceived the emergency kit as useful for other purposes. Thus, providing people with information about flood consequences, evacuation routes, and safe shelters is the most promising way to prepare people for evacuation and floods. This was the only flood preparation that was supported by a clear majority of the people. The five remaining flood preparations were supported by small majorities, but mostly by minorities of the respondents.

Second, people should perceive themselves as being capable of taking flood preparedness actions. In terms of the PADM, people's behavioural intentions may be lowered because they perceive themselves as having insufficient resources to implement their intentions. The resource requirements defined by the PADM include the perceived requirements for money, time/effort, and knowledge/skills, as well as the perceived requirements for cooperation from other persons to take preparedness actions. The PADM predicts that a higher level of perceived resource requirements lowers the preparedness intentions of the public. Chapter 4 showed that, compared to efficacy attributes, resource requirements were regarded as much less important. Only 24% of the respondents selected a flood preparation's cost as an important attribute of their preparedness decision, while knowledge/skill, time/effort, and cooperation requirements were selected by 35% of the respondents. This may also partly explain why the resource-related attributes had little effect on the preparedness intentions of citizens. Alternatively, effects may have been small because the resource attributes suffered from low rating variances, which are a known source of correlation attenuation (Cohen, Cohen, West, & Aiken, 2003; Nunnally & Bernstein, 1994). Therefore, the unpopularity of flood insurance may be partly explained because 76% of the respondents perceived associated high costs. The unpopularity of sand bags may be partly explained because they were also perceived as being high in cost by 43% of the respondents. In addition, preparing oneself for floods by means of sandbags was perceived as requiring large knowledge and skills by 39% of the respondents, and 57% of the respondents perceived that collecting sand bags takes much time and effort.

Third, it is important to note that, although the *perceived* resource requirements of flood preparations inhibit people's behavioural intentions, it is the *actual* resource requirements of flood preparations that will intervene between people's behavioural intentions and their actual preparedness behaviour. This has important implications for risk communications. For instance, as prescribed by the European Floods Directive (2007), EU Member States require the production of flood hazard maps (showing the likelihood and flow of potential flooding) and flood risk maps (showing the flood impact) by the end of 2013. These maps will be used to inform the public (European Union, 2007). However, it remains to be seen whether these maps will serve their public purpose. Previous studies have indicated that people have difficulties interpreting maps that are constructed using features such as map scale, coding, colour, and size (e.g., Arlikatti, Lindell, Prater, & Zhang, 2006; Zhang, Prater, & Lindell, 2004). In addition, the different consequences of floods in different flood risk areas in the Netherlands (i.e., dike rings) justify the recommendation of different flood preparations, so that people not only *perceive* that they are prepared, but that they *actually* are prepared. In this regard, the current Think Ahead campaign fails to meet these demands because it recommends the same preparations for different risks. Moreover, it pays too little attention to how flood risks manifest themselves locally. Paton et al. (2008) reported two studies demonstrating that the credibility of information about volcano hazards was compromised and trust in the communication sources was reduced when risk information insufficiently addressed the concerns and needs of the public. An important requirement of risk communication is that it provides people with information about flood risk and flood preparedness, such that it connects with the needs of local audiences. As argued in the previous section, if risk communication fails to meet these demands, people are unlikely to accept responsibility for flood preparedness.

6.3 DIFFERENCES BETWEEN DIKE RING AREAS

The data revealed differences in risk perceptions between dike ring areas. Chapter 4 indicated that respondents from Zeeland (coastal risk area) perceived a much lower flood likelihood, but much higher flood consequences, compared to respondents from the Land van Heusden/de Maaskant region (river risk area). Indeed, flood protection standards in Zeeland (1/4,000 per year) are higher than those in Land van Heusden/de Maaskant (1/1,250 per year). However, in Chapter 5 the differences in risk perception were inconsistent with the differences in flood protection because perceptions of flood likelihood were lower in Flevoland (lake risk area) compared to Alblasserwaard en Vijfheerenlanden (river risk area) and Delfland (coastal risk area). However, flood protection is highest in the coastal risk area (1/10,000 per year) and lowest in the river area (1/2,000 per year), with the lake risk area falling in between (1/4,000 per year). Moreover, it seems implausible that flood protection levels would translate directly into levels of risk perception. This is because people are often unable to utilise probability information (Camerer & Kunreuther, 1989; Kunreuther, 1976; Slovic, Kunreuther, & White, 1974) and some research suggests that detailed

technical information has little impact on people's risk perception (Terpstra, Lindell, & Gutteling, 2009).

More likely than the actual protection levels, risk perceptions are shaped by *perceptions* of flood protection. Our surveys found that citizens generally expressed great confidence in the primary flood defences. Indeed, citizens from Zeeland and Flevoland who perceived the lowest flood probabilities also expressed the highest levels of confidence in flood protection. The research data did not provide further empirical evidence to explain the relative differences in risk perceptions between dike ring areas. However, the surveys presented in this thesis assessed risk perceptions in three coastal areas (Friesland, Delfland, Zeeland), three river risk areas (Land van Heusden/de Maaskant, Alblasserwaard & Vijfheerenlanden, Eiland van Dordrecht), and one lake risk area (Flevoland). We found that residents in all risk areas, on average, perceived high levels of trust in flood protection, low levels of flood likelihood, and large flood consequences. Any risk area that deviates from this general profile may therefore be regarded as an exception.

6.4 METHODOLOGICAL ISSUES

Lindell & Perry (2000) identified four methodological issues that may threaten the validity of the survey results, including vulnerability to random and systematic sampling errors as well as to random and systematic response errors. In addition, we paid attention to the issue of causal inference in cross-sectional designs.

Random sampling error may arise in the obtained samples from chance differences between the members of the population included and excluded from the sample. Chance differences are less likely as the sample size increases. Sample sizes of N > 400 already have sufficient power to detect population correlations of r_{ij} = .10, which corresponds to an explained variance of only 1%. Our samples were substantially larger ($N_{Survey\ 1}$ = 658, $N_{Survey\ 2}$ = 1444, $N_{Survey\ 3}$ = 1457) and therefore had adequate power to detect small but meaningful population correlations (e.g., r_{ij} > .10).

Systematic sampling error (sampling bias) may arise from the method used for sample selection. The three surveys presented in this thesis utilised identical procedures for the data collection. Each survey was prepared by drawing samples of household addresses at random from relatively large geographical areas. Subsequently, sample members were sent a letter explaining this research project and inviting them to participate in the Internet survey. Each invitation letter contained the Internet address and a password for taking the questionnaire. Because the first survey yielded a low response percentage of 13%, a reminder followed the invitation letter for the second survey after six weeks had passed.

The invitation letter for the third survey was followed by reminders after three and five weeks. Despite these additional reminders, however, the second and third surveys did not yield higher response rates (about 10%). In particular, low response rates make the representativeness of a sample uncertain because non-response might be systematic rather than random. Collecting responses through the Internet may have produced low response rates. However, in 2008, 86% of Dutch households were connected to the Internet, which is among the highest rates of Internet penetration in Europe (Statistics Netherlands, 2008). In addition, comparison of the samples' demographic characteristics with population demographic characteristics in risk areas revealed that all three survey samples overrepresented males, older ages, and higher income classes, similar to samples from the United States (e.g., Lindell & Hwang, 2008; Lindell, Arlikatti, & Prater, 2009). About 68% to 77% were male, with a mean age ranging from about 50 to 55 years and a median income between € 34,000 and € 56,000 per year (before taxes). However, because these biases were similar in all three surveys, only small net effects may have been incurred in the differences in mean responses between the sample areas. In addition, biases in demographic variables were only problematic to the extent that these variables were correlated with the psychological variables under study. Studies on earthquake hazards in the U.S.A. have shown that such correlations are generally low (Lindell & Perry, 2000). Moreover, our data revealed that the psychological variables under study (i.e., the public's perceptions of risk, responsibility, hazard adjustments in terms of efficacy attributes and resource requirements, as well as their behavioural intentions) were mostly marginal ($r_{ij} \leq .10$). Sometimes they correlated inconsistently (both positive and negative) with demographic variables, making any controls for these variables arbitrary (e.g., see Chapters 4 and 5). Finally, correlation coefficients are resistant to mean bias, so tests of the predictive validity of the antecedents of behavioural intentions for adoption flood preparedness actions can be taken at face value.

Systematic response errors (response bias) may be produced when questionnaire respondents provide socially desirable answers. Response bias may also be produced when there is a tendency among respondents to answer similarly to successive items in a questionnaire, even when there is no true correlation between those items in the population. When using structural equation modelling, these systematic response errors can be detected by analysing whether the error terms of construct indicators are correlated. Correlated error terms indicate that construct indicators have something in common other than the latent constructs that are represented in the model and that the specific nature of the shared 'something' is unknown (an unanalysed association). Chapter 2 applies structural equation modelling to study the effects of trust and risk perceptions on preparedness intentions, but the results provide no evidence for unacceptable correlations among indicator error terms.

In addition, the possibility that common method variance has contaminated correlations among the measures can be ruled out if there is evidence of discriminant validity among the constructs in the questionnaire. Chapter 4 supported the discriminant validity of PADM's efficacy attributes (i.e., efficacy in protecting persons, efficacy in protecting property, and utility for other purposes) and resource-related attributes (i.e., requirements for money, knowledge and skills, time and effort, as well as cooperation and help from others) by showing that respondents used these attributes to differentiate among the flood hazard adjustments, as indicated by the profiles in Figure 4.2. Altogether, the existence of systematic response errors in our data is unlikely.

Random response errors (unreliability) may be produced when using single items for measuring a psychological construct. In our research, we used single indicators to measure emotions associated with prior flood hazard experiences, perceived flood likelihood, perceived responsibility, and perceptions of efficacy and resource-related attributes for each hazard adjustment. Random response error can be reduced by developing multi-item scales and calculating a numerical estimate of the reliability of each construct (e.g., Cronbach alpha). It can also be reduced by performing confirmatory factor analysis on a measurement model and reporting construct factor loadings and model fit indices (see Chapter 2). It will be especially helpful to develop a 'Flood Preparedness Scale' (similar to Mulilis-Lippa Earthquake Preparedness Scale; Mulilis, Duval, & Lippa, 1990) that allows for the clustering of flood preparations. Potential but unknown unreliability in single item measurements may have increased the error variance, resulting in underestimated population correlations between these measures and the flood preparedness intentions of the public. However, as noted above, our samples had adequate statistical power to detect even small correlations (i.e., $r_{ij} < .10$). Therefore, it is unlikely that, among the measured variables in the three surveys, important antecedents of flood preparedness intentions were overlooked.

Causal direction of correlations. Last but not least, the focus of this research was on quantitative rather than qualitative data. This enabled the statistical testing of mechanisms involved in the protective action decision-making process. Although this process involves several successive stages and thus temporal ordering, the cross-sectional data obtained in our field surveys could not identify temporal order. In other words, if two variables were correlated, these data would not lead to a conclusion as to whether A caused B, or vice versa (Lindell & Hwang, 2008; see also James, Mulaik, & Brett, 1982). Although hypotheses about causality have been carefully derived from the literature, additional research will be required to provide conclusive evidence in support of such hypotheses. This could be carried out, for instance, by the application of longitudinal designs and laboratory experiments.

6.5 IMPLICATIONS

In the previous sections, we provided many implications for developing risk communications and for further research. This section will therefore summarise only the most important implications.

6.5.1 *Implications for (risk) communication*

1 *People's flood preparedness decisions should be regarded as a process consisting of several stages. To be effective, risk communication should address all of those stages and, most importantly, risk communication should be tailored to the local needs of the people at risk.*
This may sound like a simple and obvious recommendation. However, one should be aware that risk communication practice currently follows a generic approach for different types of risk and fails to address each of the decision stages properly.

2 *In order to establish a threat belief among citizens with regard to flooding risks, stimulating flood awareness is imperative.*
Most Dutch citizens fail to identify flood risk as a threat that should be heeded. Risk communication is unlikely to draw people's attention toward flood preparedness. That is unless it at least emphasises, much more than in current practice, that flooding is and remains to be a possibility, despite primary Dutch flood defences being strong. Local risk communication practitioners should point out the location of the primary flood defences in local regions and clearly explain under which conditions floods are likely to occur (e.g., high river discharges).

3 Citizens are unfamiliar with having a personal responsibility in flood preparedness. Risk communication messages should explain that flood preparedness requires citizen participation. To establish a protection motivation, risk communication should use a combination of fear appeal, information about local flood consequences, and locally effective flood preparations that require few individual resources.

a. Communication messages should at least explain that flood risk management authorities will keep working to maintain flood safety (their 'moral' responsibility), but that, in addition to flood prevention, there will also be investments in better disaster preparedness that will require citizen participation.

b. Although citizens generally expect large flood consequences, thinking about floods arouses little fear in people. Some emotional reaction when thinking of floods is instrumental in catalysing motivation toward preparing for floods. Risk communication should not avoid fear appeal if its potential side effects can be minimised.
c. If communications arouse fear but fail to recommend multiple protective actions that are perceived as effective, people may become disappointed and deny their personal responsibility. They may become saddled with the burden of anxiety or lose their faith in risk communicators. Fear-arousing messages should be developed such that they motivate people to reduce their emotional reaction by taking locally effective flood preparations.
d. Citizens will only take flood preparations if they perceive those preparations as effective means to deal with the local consequences of floods. People are most interested in flood preparations that increase their safety during evacuation and floods, but largely decline to take responsibility for flood damage. The distribution of information about flood consequences, evacuation routes, and safe shelter locations within individual neighbourhoods is a relatively popular flood preparedness action because people perceive this as the most effective preparation for increasing their safety.
e. If recommended, when flood preparations are perceived as costing a lot of money, as well as requiring great effort, high skills, and a large amount of cooperation from other people, individuals are likely to postpone their decisions. Our results indicate that citizens perceived relatively few resource requirements in connection with emergency preparedness actions. Although this is a good sign, underestimations of the actual resource requirements may hold people back from actually taking flood preparedness actions. It would be wise to study how information about flood risk and flood preparedness (e.g., maps showing flood depths and evacuation routes) can be designed, such that it is easy to comprehend.

4 *Flood insurance*

The majority of Dutch citizens hold a negative attitude towards the introduction of a private flood insurance arrangement. They regard flood damage protection as a collective responsibility rather than their private responsibility. The government is seen as having the knowledge of local terrain and is highly trusted in maintaining flood safety. Moreover, people generally expect high flood consequences and have little faith in their personal abilities to mitigate flood damage. If risk management authorities decide to introduce flood insurance, but do not reckon with the

mechanisms that involve how people perceive the division of responsibilities in flood risk management, they may do so at the expense of losing credibility.

6.5.2 *Implications for research*

1 *Development of fear-appeal messages*

Future studies should further investigate how risk communication messages can be used to induce affective responses to flood risk and flood preparedness actions, such that people are motivated to adopt flood preparedness actions. In particular, one of the most important determinants of emotional reactions to future outcomes of risks is the vividness with which those outcomes are described or represented mentally (Loewenstein et al., 2001). This was also supported by the findings of Chapter 2, in which the results indicated that people associated their prior flood hazard experiences with negative (e.g., feelings of fear and uncertainty) and positive emotions (e.g., feelings of solidarity and unity). The negative emotions contributed to higher levels of self-reported fear when considering floods, while positive emotions had the opposite effect. An important extension of these findings would be to investigate how risk communication can be employed to simulate the vividness of local flood consequences resulting in affective reactions that create a sense of urgency for self-protection against floods.

2 *Study the actual efficacy of flood preparations, given the local flood circumstances*

Currently there is a great lack of knowledge about the true efficacy of flood preparedness actions in the Netherlands. Moreover, there are complex interdependencies between collective disaster response plans and people's individual opportunities to prepare for flood disasters. How should an individual prepare for flood disasters if evacuation of the local population is not feasible? For instance, high river discharges can be monitored upstream, so water levels and their timing are easily predictable several days in advance. However, along the Dutch coast, warning times are much less generous, likely amounting to less than one day. Moreover, floods along the Dutch coast are accompanied by hurricane-force winds, making evacuation difficult if not impossible, especially in the most densely populated areas. There may also be differences in flooding depths and speeds between areas, as well as in the availability of safe locations to seek shelters during floods (such as high buildings). All of these factors form restrictions for collective

disaster response strategies. These, in turn, determine the opportunities for individual flood preparations. Finally, this has great implications for the content of both risk and crisis communications. Herein lies an important challenge for future research.

3 *Test risk communication in pilot studies*

Last but not least, we recommend that risk communication be tested in pilot studies. These studies should be designed such that they test the effects of risk communication on people's threat belief, protection motivation, attribution of responsibility, assessment of protective actions, and finally on coping responses. These coping responses should include the adoption of flood preparedness actions as well as the information-searching behaviour of individuals. This can be done in a laboratory setting. However, messages should ultimately be tested in the field, taking into account the previously explained differences in risk areas and the implications these have for individual preparedness opportunities. Flood risk communication is currently being performed using the same message, which recommends the same flood preparedness actions (e.g., an emergency kit), for different populations in different risk areas. This method fails to meet with people's local needs in the case of an imminent flood disaster and is unlikely to increase flood preparedness behaviour. Performing these pilot studies should be a joint effort between the national and local authorities responsible for performing flood risk communication, and should also include researchers.

6.6 FINAL REMARKS

Through the questionnaires that were employed in this research, many citizens were permitted to speak out about flood preparedness. Many individuals used this opportunity and were willing to respond to the many questions asked. This allowed us to test the psychological theory to explain their flood preparedness decisions. The results of this thesis are in some ways rather sobering. Few people indicated that they intended to take flood preparations, for various reasons. They had great confidence in flood prevention and perceived few flood preparations that would enable them to deal with the locally-expected consequences of floods.

Does this mean that citizens are satisfied with the 'old' flood risk management methods that focus solely on flood prevention? By no means! For instance, in Zeeland, respondents were asked to select one out of three statements that best reflected their thoughts about flood prevention, disaster management, and communication.

Table 6.1
Support for disaster management and communication in Zeeland (n = 561)

Disaster management and (risk) communication are unimportant; the government should best spend the entire available budget on flood defences	5%
Disaster management and (risk) communication are important; however, the government should invest in disaster management and communication only if all flood defences meet their legal flood safety standards	24%
Disaster management and (risk) communication are important; the government should invest in disaster management and communication even though some flood defences do not yet meet their legal flood safety standards	71%

Table 6.1 shows that the large majority of persons supported disaster management and communication (71%), while only a small minority (5%) chose that the government should invest solely in flood prevention. In addition, we received many comments from all of the surveyed areas. In these comments, many citizens underlined the need for communication, for instance:

- *"I would be very glad to receive information about the height of flood water levels, in the first hours, on my home location, or about the upper and lower margins of flood water levels in case of flooding from the Wadden Sea."*

- *"Gladly I would like that inhabitants of this province receive information by mail regularly, about the condition of our flood defences and things that can be improved. Also, I find it very important that citizens receive information about how to prepare for potential floods…"*

If all of us, including politicians, policy makers, scientists, and citizens, find that disaster preparedness and communication should play an important role in flood risk management, then all of us should take individual responsibility. Social scientists should take responsibility by showing how communication can be developed such that it contributes toward better-informed citizens and higher levels of flood preparedness. Their expertise on the terrain of psychology and communication is indispensable and is much needed in supporting the local authorities responsible for performing communication with citizens, but who typically have limited resources. Last but not least, if national authorities are aiming for well-founded risk communication, they should take responsibility and support such initiatives.

6.7 REFERENCES

Arlikatti, S., Lindell, M. K., Prater, C. S., & Zhang, Y. (2006). Risk area accuracy and hurricane evacuation expectations of coastal residents. *Environment and Behavior, 38*(2), 226-247.

Bickerstaff, K., Simmons, P., & Pidgeon, N. (2008). Constructing responsibilities for risk: Negotiating citizen-state relationships. *Environment and Planning A, 40*(6), 1312-1330.

Brown, S., & Locker, E. (2009). Defensive responses to an emotive anti-alcohol message. *Psychology and Health, 24*(5), 517-528.

Calamities Compensation Act (1998). Law of 25 May 1998, Containing Rules on the Compensation of Damage and the Costs in case of Floods by Fresh Water, Earthquakes or other Disasters and Severe Accidents (in Dutch: Wet van 25 mei 1998, houdende regels over tegemoetkoming in de schade en de kosten in geval van overstromingen door zoet water, aardbevingen of andere rampen en zware ongevallen (Wet Tegemoetkoming Schade bij Rampen en Zware Ongevallen, WTS)). The Hague.

Camerer, C. F., & Kunreuther, H. (1989). Decision-processes for low probability events - policy implications. *Journal of Policy Analysis and Management, 8*(4), 565-592.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied Multiple Regression/ Correlation Analysis for the Behavioral Sciences* (3rd ed.). Mahwah NJ: Erlbaum.

Eden, S. E. (1993). Individual environmental responsibility and its role in public environmentalism. *Environment and Planning A, 25*(12), 1743-1758.

European Union (2007). Directive 2007/60/ec of the European Parliament and of the Council of 23 October 2007 on the Assessment and Management of Flood Risks (pp. 28-34): Official Journal of the European Union.

Freudenburg, W. R. (1993). Risk and recreancy - weber, the division-of-labor, and the rationality of risk perceptions. *Social Forces, 71*(4), 909-932.

Harrison, C. M., Burgess, J., & Filius, P. (1996). Rationalizing environmental responsibilities - a comparison of lay publics in the UK and the Netherlands. *Global Environmental Change-Human and Policy Dimensions, 6*(3), 215-234.

James, L. R., Mulaik, S. A., & Brett, J. M. (1982). *Causal Analysis: Assumptions, Models and Data*. Beverly Hills: Sage.

Jepson, C., & Chaiken, S. (1990). Chronic issue-specific fear inhibits systematic processing of persuasive communications. *Journal of Social Behavior and Personality, 5*(2), 61-84.

Kunreuther, H. (1976). Limited knowledge and insurance protection. *Public Policy, 24*(2), 227-261.

Lalwani, N., & Duval, T. S. (2000). The moderating effects of cognitive appraisal processes on self-attribution of responsibility. *Journal of Applied Social Psychology, 30*(11), 2233-2245.

Lindell, M. K., Arlikatti, S., & Prater, C. S. (2009). Why people do what they do to protect against earthquake risk: Perceptions of hazard adjustments and their attributes. *Risk Analysis, 29*(8), 1072-1088.

Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis, 28*(2), 539-556.

Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard. A review of research. *Environment and Behavior, 32*(4), 461-501.

Lindell, M. K., & Perry, R. W. (2004). *Communicating Environmental Risk in Multiethnic Communities*. Thousand Oaks, California: Sage Publications, Inc.

Lindell, M. K., & Whitney, D. J. (2000). Correlates of household seismic hazard adjustment adoption. *Risk Analysis, 20*(1), 13-25.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127*(2), 267-286.

Lorenzoni, I., & Pidgeon, N. F. (2006). Public views on climate change: European and USA perspectives. *Climatic Change, 77*(1-2), 73-95.

Meijnders, A. L., Midden, C. J. H., & Wilke, H. A. M. (2001a). Role of negative emotion in communication about CO2 risks. *Risk Analysis, 21*(5), 955-966.

Meijnders, A. L., Midden, C. J. H., & Wilke, H. A. M. (2001b). Communications about environmental risks and risk-reducing behavior: The impact of fear on information processing. *Journal of Applied Social Psychology, 31*(4), 754-777.

Mulilis, J.-P., Duval, T. S., & Lippa, R. A. (1990). The effects of a large destructive earthquake on earthquake preparedness as assessed by an earthquake preparedness scale. *Natural Hazards, 3*, 357-371.

Mulilis, J. P., & Duval, T. S. (1995). Negative threat appeals and earthquake preparedness: A person-relative-to-event (PrE) model of coping with threat. *Journal of Applied Social Psychology, 25*(15), 1319-1339.

Mulilis, J. P., & Duval, T. S. (1997). The PrE model of coping and tornado preparedness: Moderating effects of responsibility. *Journal of Applied Social Psychology, 27*(19), 1750-1766.

Mulilis, J. P., Duval, T. S., & Rombach, D. (2001). Personal responsibility for tornado preparedness: Commitment or choice? *Journal of Applied Social Psychology, 31*(8), 1659-1688.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.

Paton, D., Smith, L., Daly, M., & Johnston, D. (2008). Risk perception and volcanic hazard mitigation: Individual and social perspectives. *Journal of Volcanology and Geothermal Research, 172*(3-4), 179-188.

Slovic, P., Kunreuther, H., & White, G. F. (1974). Decision processes, rationality, and adjustment to natural hazards In G. F. White (Ed.), *Natural hazards: Local, National, and Global* (pp. 207-232). New York: Oxford University Press.

Statistics Netherlands (CBS) (2008). Media Products More Often Through the Internet (*Dutch:* Mediaproducten steeds meer via internet). Press release pb08-071, October 28.

Terpstra, T., Lindell, M. K., & Gutteling, J. M. (2009). Does communicating (flood) risk affect (flood) risk perceptions? Results of a quasi-experimental study. *Risk Analysis, 29*(8), 1141-1155.

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs, 59*(4), 329-349.

Zhang, Y., Prater, C. S., & Lindell, M. K. (2004). Risk area accuracy and evacuation from hurricane Bret. *Natural Hazards Review, 5*, 115-120.

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Dit onderzoek is uitgevoerd bij de afdeling Psychologie en Communicatie van Gezond en Risico (PCGR) van de Faculteit Gedragswetenschappen aan de Universiteit Twente. Professor Erwin Seydel, het hoofd van deze afdeling, was tevens mijn promotor. Erwin, Jan Gutteling en jij boden mij de kans om zonder vooropleiding in de psychologie dit onderzoek uit te voeren. Mijn dank daarvoor. Jan Gutteling is Universitair Hoofddocent aan de afdeling PCGR. Jan, wij hebben in de afgelopen vijf jaar geprobeerd om het onderwerp risicoperceptie en risico-communicatie op de kaart te zetten binnen de waterwereld. Voor jou was de waterwereld nieuw, voor mij gold dat voor het onderwerp risicoperceptie en communicatie. Onze kracht was dat we als duo opereerden. In het Ontwerp Nationaal Waterplan worden deze begrippen nu omarmd, en dat is mede onze verdienste. Ik heb ontzettend veel geleerd en plezier beleefd aan onze samenwerking.

Govert Geldof stond aan de wieg van dit onderzoek. Hij introduceerde mij bij Jan Gutteling. Door Govert raakte ik ook betrokken bij het Interreg project FLOWS (2004-2006), een internationaal project waarin overheden en onderzoekers uit Groot Britannië, Duitsland, Nederland, Noorwegen en Zweden strategieën ontwikkelden om beter te leren leven met overstromingsrisico's. In FLOWS zette ik mijn eerste onderzoeksstappen. In deze periode werkte ik nauw samen met Bert Kappe die destijds voor de provincie Flevoland werkte. De vele ritjes die we maakten op weg naar onze projectpartners werden veelal begeleid door goede muziek en filosofische discussies over dit onderzoek en andere relevante wereldproblemen.

In de zomer van 2005 namen we deel aan de eerste verkennende gesprekken die werden georganiseerd door het kennis impulsprogramma Leven met Water, en die zouden leiden tot de oprichting van het PROmO-project (Perceptie en Risicocommunicatie bij het Omgaan met Overstromingsrisico's). Eén van die gesprekken vond plaats aan de vooravond dat hurricane Katrina New Orleans trof. In het jaar daarop kwam Al Gore met zijn documentaire ' An Inconvenient Truth' waarmee hij de klimaatproblematiek aan de kaak stelde, in 2007 gevolgd door de wereldwijde aandacht voor het Fourth Assessment Report van het Intergovernmental Panel on Climate Change (IPCC). Deze gebeurtenissen zijn zonder twijfel van invloed geweest op het debat rond overstromingsrisico's in Nederland. Onbedoeld is mijn onderzoek daardoor eveneens in de schijnwerpers terecht gekomen.

Het PROmO-project werd uitgevoerd in de periode 2006-2009. Aan het PROmO-project namen onderzoekers deel uit verschillende disciplines, en van verschillende universiteiten en instituten. PROmO was op de achtergrond betrokken bij het beleidstraject Water Veiligheid 21ste eeuw en de Taskforce Management Overstromingen (TMO). De samenwerking en gesprekken met onderzoekers en beleidsmedewerkers met verschillende achtergronden en belangen hebben mijn blik verruimd.

Ik dank alle betrokkenen die ik in deze projecten ben tegengekomen, in het bijzonder Herman van der Most (projectleider, Deltares), Sten de Wit (TNO), Aad Correljé (TU Delft) en Anne van der Veen (ICT).

PROmO also provided me with the opportunity to visit Michael K. Lindell, Professor at the Department of Landscape Architecture and Urban Planning at Texas A&M University. Mike, from December 2007 through April 2008 we cooperated on the Protective Action Decision Model, and we applied the model to flood preparedness in the Netherlands (Chapter four of this thesis). Thanks for contributing to my research. Above all, thank you for the good time in College Station and for borrowing your race bike. Special thanks also go to Carla Prater, Walter Peacock, Jody Naderi, Logan Wagner and his wife Patricia.

In 2007 en 2008 namen we deel aan een tweede 'Leven met Water project' dat was opgezet door HKV$_{\text{Lijn in water}}$. Het rapport 'Publieke percepties van overstromingen en wateroverlast' schreef ik in College Station, aan de keuken-tafel van Jody Naderi. Het rapport leidde tot een paginagrote publicatie in Trouw, en een tv-interview op Omroep Flevoland. Hoofdstuk vijf van dit proefschrift is het wetenschappelijk resultaat van de bijzonder prettige samen-werking met Matthijs Kok. Graag dank ik eveneens Durk Klopstra (projectleider), en de leden van de begeleidingscommissie voor hun input bij het ontwikkelen van de vragenlijsten en hun kritische blik op de resultaten.

In dit dankwoord kan ik veel mensen niet persoonlijk bedanken; een volledige lijst zou de dikte van dit proefschrift meer dan verdubbelen. Dat is niet in de laatste plaats te danken aan de bijna 4000 respondenten die de internet-vragenlijsten invulden. Van enkelen, die niet over internet beschikten, ontving ik zelfs handgeschreven brieven waarin zou hun mening gaven over het waterveilig-heidsbeleid in Nederland.

Wanneer je als ingenieur begint aan een promotie-onderzoek in de sociaal-psychologie, dan is dat zonder meer een avontuur. Alles wat je onderweg tegenkomt is nieuw en interessant. Het is de kunst op koers te blijven. Om te zorgen dat ik op de goede weg bleef, heb ik velen gebruikt als klankbord, waarschijnlijk zonder dat zij dat zelf direct doorhadden. Ik dank hiervoor mijn collega's bij PCGR.

Carola, dit dankwoord is geschreven op woensdag 25 november 2009. Afgelopen weekend sneden we 450 juten omslagen, samen met Jurjen, Loniek, Karen en Sonja. Gisteren is de titel gezeefdrukt, en deze week wordt het binnen-werk voltooid. Dit boek is uniek, in alle opzichten. Dank voor de vele, vele uren die je hier in hebt gestoken. Het prachtige ontwerp komt volledig op jouw conto.

Jurjen en Gilles, een promovendus mag zich laten bijstaan door slechts twee paranymfen. Ik ben er trots op dat jullie mij terzijde staan. Oja, het Oktoberfest begint op 18 september 2010. Schrijf maar vast op in jullie agenda's.

Pa en Ma, dit avontuur zit erop. Dank voor jullie eeuwige support. Karen, wij leerden elkaar kennen twee dagen nadat ik terugkeerde uit de VS. Het grootste deel van dit proefschrift bestond toen nog niet (alleen hoofdstuk drie was geschreven). Avonturen worden gekenmerkt door pieken en dalen. Beide heb ik met je kunnen delen. Lieverd, bedankt voor alles, en nu gaan we eindelijk op vakantie (een 'echt' avontuur)!

CURRICULUM VITAE

1978

Teun Terpstra was born on 29 January 1978, in a small Frisian town called Makkum on the coast of Lake IJssel. Just after his eighth birthday he moved with his family to Hoorn on the opposite side of Lake IJssel, where he finished his VWO at the age of eighteen.

1996

In 1996 he took courses in Shipbuilding at the Hogeschool Haarlem, and in 1997 he continued with Civil Engineering and Management at the University of Twente. In his major 'water engineering and management' he combined courses from physics and coastal- and river basin management. During his training period, he focused on flood safety of the Dutch river system.

2004

In March 2004 he graduated on his master thesis 'In a Bar under the Sea' which focused on the effects of large scale sand extractions on flood safety and the benthic ecosystem just off the coast of Zeeland. Two months later he accepted a research position at the department of Psychology and Communication of Health and Risk at the University of Twente that allowed him to study flood safety from a psychological and communicative perspective. During his research he participated in the European Interreg project FLOWS and in several Dutch research projects. In 2007 he visited the Hazard Reduction and Recovery Center at Texas A&M University to cooperate with Professor M.K. Lindell.

2010

In 2010 Teun will join forces with the Disaster Management group at HKV$_{\text{Lijn in water}}$ where he will continue with his mission to improve flood disaster management, in particular flood risk- and crisis communication.