

# How to Motivate People to Assume Responsibility and Act upon Their own Protection from Flood Risk in the Netherlands if They Think They are Perfectly Safe?

M. Bočkarjova

*VU University Amsterdam, Department of Spatial Economics, de Boelelaan 1105, 1081 HV Amsterdam, The Netherlands, and ITC - International Institute for Geo-Information Science and Earth Observation, Department of Urban and Regional Planning and Geo-Information Management, PO Box 6, 7500 AA Enschede, The Netherlands.*

A. van der Veen

*ITC - International Institute for Geo-Information Science and Earth Observation, Department of Urban and Regional Planning and Geo-Information Management, PO Box 6, 7500 AA Enschede, The Netherlands, and University of Twente, Faculty of Civil Engineering, PO Box 217, 7500 AE Enschede, The Netherlands*

P.A.T.M. Geurts

*University of Twente, School of Management and Governance, PO Box 217, 7500 AE Enschede, The Netherlands.*

**ABSTRACT:** The aim of this paper is to investigate the issue of cognitive perception of flood risk and the readiness of individuals to undertake protective action in the Netherlands. The focal point of the discussion in this context is the designated shift of responsibility on flood protection from belonging exclusively to the public domain to the situation when the responsibility and risks are shared between public and private actors. To identify those triggers that should be used to effectively communicate risk and motivate people to undertake protective action, we apply the combined protection motivation theory (PMT) and transtheoretical stage change model (TTM), which are borrowed from the health care literature but have also effectively been applied in the natural hazard context.

## 1 INTRODUCTION

The aim of this paper is to investigate the issue of cognitive perception of flood risk and the readiness of individuals to undertake protective action in the Netherlands. This research is motivated by the emerging change in thinking from flood probability to flood risk in the Netherlands which will have important implications for flood management policy in the country. In the face of this change, risk governance will be affected at various levels, and will interlude the administrative, social and economic perspectives. The question that governs current debate as in academic as in policy-making circles is: Should people be assumed responsible for their undergoing flood risk, or should this responsibility lie with the government of the country under flood risk?

The focal point of our discussion in this context is the designated shift of responsibility on flood protection from belonging exclusively to the public domain to the situation when the responsibility and risks are *shared* between public and private actors. Essentially, in order to ensure this transition, there is a need to create a broad platform of support among the general public for the new mode of dealing with floods in the Netherlands. This means that some questions have to be answered. First, how can public awareness of flood risk be raised? And, more

specifically, how to communicate flood risks effectively to the Dutch population, while at the moment a broad belief exists that the government will guarantee flood safety? Second, for how far individuals would be ready to act upon protecting themselves from flood risk in addition to flood safety measure taken by the government?

A number of issues surface as we proceed. For example, the knowledge of the current state of public risk perception is imperative to starting a broad campaign on raising risk awareness. A report from the two Dutch ministries (MVW & MBZ 2007) has recently become available sketching an overall picture of flood risk perceptions in the Netherlands. The evidence points at the fact that on average Dutch population would not be concerned about flood risk in the country. Furthermore, while the Dutch government is striving to improve flood risk awareness, the report argues that the raise of risk awareness on its own might not have much sense if it does not lead to a desirable shift in behaviour pattern among the public. This finding offers a direct implication for our inquiry, as it means that not only we should look at the perceptions of flood risk and their determinants *per se*, but rather, given specific level of risk perception, provide a link to the factors that trigger individuals to protect themselves from a hazard.

To examine individual cognitive perception of risk and the decision readiness to undertake individual or group action, and to identify those triggers that should be used to effectively communicate risk, we apply in this study the combined protection motivation theory (PMT) and transtheoretical stage model (TTM), which are borrowed from health psychology literature but have also been effectively applied in the natural hazard context (see for example Block & Keller 1998, and Martin et al. 2007). We expect that the majority of the Dutch public would be found in the precontemplative decision stage with moderate to low risk knowledge level. If this expectation is supported by data of a large-scale survey (the first results are expected by summer 2008), the communication strategy would require focusing on vulnerability-promoting information; or targeted risk severity promotion if we find that contemplatives are present (in particular in combination with high knowledge level).

## 2 CURRENT STATE OF FLOOD MANAGEMENT POLICY IN THE NETHERLANDS

### 2.1 *The wind of change...*

During the past decade more explicit discussions of issues related to flood safety have taken place in the Dutch policy-making realm and the society at large. The return of flood protection on the political agenda was secured by the (near) floods and evacuations in 1993 and 1995 in the Meuse, which were recently intensified by the flooding following hurricane Katrina in New Orleans, US in 2005. The latter made such questions rise as: Could a major flood be a reality in the Netherlands? And: What would be the consequences of such a major flooding? The debate on 'giving room for the river' keeping low profile before Katrina provided a signal of change in water management philosophy from keeping water outside to a more 'natural' approach where water began to be seen not solely as a threat, but also as an opportunity. Thus, coming to friendly terms with water would mean allowing it to go 'its way', for which special retention areas were selected that could be used for controlled flooding aiming at preventing uncontrolled flooding elsewhere in case threatening river discharges are detected. Although this policy has not received broad public support (for example, this measure was fiercely opposed by the inhabitants of Nijmegen), it has marked a new era in the Dutch flood protection and water management, when public began to be involved in water-related decision-making. This meant consequently that top-down way of centralised policy-making and measure implementation, that was practiced for the last decades (sealed by a public mandate, when after the

flood disaster of 1953 the government made a promise to take care of flood protection in the Netherlands and do everything to prevent another disaster), has to be changed, and in fact has already begun to change<sup>1</sup>. Inclusion of a spectrum of stakeholders on the local level (like inhabitants of a respective area, representatives of interest groups and business) required from local governments and water boards new skills of flood risk communication, and from the involved stakeholders – new skills of conscious risk assessment and decision-making under the conditions of uncertainty. While in some cases this new sort of public involvement in decisions around flood safety was a success, it proved that important insights were still missing with respect to the extent of risk awareness among the public and risk communication (strategies). More recent documents from the Dutch government (De Boer et al. 2003; DGW/WV 2006; MVW & MBZ 2007) witness higher concentration of attention on the issue of flood risk communication and raising flood risk awareness of the general public, which can be interpreted as an important sign of a shifted focus in flood management in the Netherlands from public domain to public-private mix and goes together with the shifted attention from controlling flood probability to flood risk management (including both the probability and the consequences of a flood).

### 2.2 *In which direction..?*

Furthermore, while the shift in water management that we are sketching (that is remarkable by itself) is yet slow, we notice an important aspect that yet needs to be found, which is pointed out by MVW & MBZ (2007, p.37): an overarching, recognisable strategy in flood risk communication. Furthermore, it has been repeatedly reported that a strategy cannot be formulated without a clear statement of the purpose that risk communication should serve. This means that first of all, a well-specified flood management philosophy or a policy goal should be identified, on which risk communication strategy will hinge. This way, desirable outcomes can be targeted, such as particular changes in individual and/or collective behaviour that would facilitate the implementation of a designated policy.

Two important notes are at place here. First, at the moment, we may observe a situation in the Netherlands, when government has not yet formed or expressed a particular goal which flood risk communication should serve. For example, MNP & RIVM (2004), as well as DGW/VW (2006), MVW

---

<sup>1</sup> For a more detailed description of Dutch water management policy in the past century, see for example, Bockarjova, Steenge and Hoekstra (forthc.), Wesselink (2007).

& MBZ (2007) mention two potential purposes: a) creating a platform for conscious public support for the implementation of government flood protection measures; and b) increasing the coping ability of the public (resilience) in case of a flood event. It is interesting to note that in fact such possibility as stimulating individuals to engage in private flood protection activities in addition to the measures taken by the government on the basis of shared responsibility for flood safety in the Netherlands is not explicitly considered. The issue is not straightforward: the question whether the responsibility for flood protection should lie within the (central) government or private actors, or should be shared between the two, is one of the points of heated debate within academic and professional circles. On the official level, much caution is exercised with respect to the option of shared responsibility, and it seems that for the time being flood protection responsibility will remain in the hands of the government, while careful steps are intended to be taken in the direction of involving the general population to this topic. An essential warning should be expressed here that in case risk communication does take place without a prespecified purpose, the message of the campaign might not be focused, and therefore it might lead to unforeseen (unexpected or even undesirable) results, like panic, ignoring the message altogether or taking overproportional protection actions.

The second issue is that alongside with risk communication, other ways of raising risk awareness are currently considered by the Dutch government as well, such as financial incentives (like taxes and subsidies) and regulation (by means of rules and laws). Each of the three – communication, financial incentives and regulation – can be chosen as a basic strategy; or all of them can be used complimentary to each other in a mix of measures. Before the decision is made, however, various options should be studied, and in this contribution we will focus on the exploration of risk communication line.

### 3 THEORETICAL BACKGROUND

We shall start with the issue of risk perception. Following the literature, risk perceptions influence risk acceptance and attitude, and consequently the formation of individual decision-making related to risk. Two main theories are often used to analyse risk perceptions, namely, the cultural theory (CT) and psychometric paradigm (PsP). The latter, psychometric model founded by Slovic (1989), emphasises such risk characteristics as novelty and catastrophic potential (as opposed to chronic nature of events) in addition to the often mentioned qualities of voluntariness, severity, familiarity,

immediacy and controllability. Alternatively, the former, cultural theory (introduced by Douglas & Wildavsky in 1982), applied to risks includes the inequitable distribution of risks and benefits, artificiality of risk source (with respect to nature, history and justifiability of risk), (potential for) blame, and distinguishes between personal and institutional control, alongside with voluntariness, familiarity, dread. Empirical studies using these frameworks have shown that risk perceptions, and in particular the determinants of risk perceptions do influence individual valuation of risk. However, they vary significantly across various risk contexts, so neither framework was in fact empirically verified to offer a stable prediction pattern. We could conclude from these observations that, although the CT and PsP theories provide important insights in determinants of individual perception, we would ultimately need a broader theoretical framework for the analysis of issues related not only to risk perception, but rather to risk communication and change in behaviour as a result of risk communication. However, before dismissing the CT and PsP theories we propose that a reflection on risk context at hand (flood risk) is a necessary precondition for our further analysis in the face of method transferability. We feel that without thorough understanding of the nature of flood risk, methods from other risk contexts may not be directly applicable for the problems we have at hand.

#### 3.1 *The role of risk perception*

The importance of accounting for qualitative risk characteristics is advocated by Gaskell and Allum (2001), where it is concluded that “the concept of risk means more to people than an estimate of its probability of occurrence; it is much more complex than this. Hence the widely accepted method of measuring risk magnitudes in terms of the number of fatalities per year is argued to be inadequate (Royal Society 1983; Slovic 1987), as it fails to capture the way people actually understand the term.” We observe that the authors make a crucial difference stating that qualitative characteristics of risk are essential for the *understanding* of risk. Thus, other characteristics of risk in addition to quantitative representation of probabilities should contribute to obtaining a better grasp on a particular risk as well as help us explain it to the public. This finding may be especially relevant for the flood risk research in the Netherlands, where the probabilities of a flood in various dike ring areas are very low (ranging from 1/500 to 1/10.000), and probabilities of a fatality due to flooding are indeed tiny (from 1/1.000.000). Some authors (e.g. Dickie & Gerking 2001) argue that general public has difficulty in assessing (changes in) probabilities adequately that are smaller than one in a thousand. Adopting such an

assumption would then justify the relevance of illuminating additional risk characteristics if we want to combat a survey study of flood risk valuation in the Netherlands.

We shall briefly reflect on our findings from an explorative analysis of a number of recent studies and overviews of flood perceptions in the Netherlands (MNP & RIVM 2004; MVW & MBZ 2007; Terpstra & Gutteling 2007) based on risk characteristics stemming from psychometric paradigm and the cultural model. We could preliminarily conclude that flood risk in the Netherlands is perceived as relatively involuntary (judging on risk voluntariness as a common PsP and CT characteristic), which however may be biased by the historically developed lock-in effect<sup>2</sup>. With respect to another PsP/CT risk characteristic, risk severity, the Dutch population is suggested to have a moderate dread perception, and while more inquiry is needed in this direction, for now this outcome can be considered adequate. Similarly, better understanding should be gained with respect to immediacy of effects (PsP variable), as it might affect personal valuation of flood risk costs and benefits in decision-making processes. Two CT characteristics were considered corresponding to our expectation and were deemed adequate, which are the distribution of risks and benefits (perceived as fair) and the potential for blame (perceived to lay within the government as the provider of flood safety).

Further, the following risk features were identified with expectedly most divergent expected and observed perceptions, which will form the basic points of attention for the design of our risk perception questionnaire and risk valuation questionnaire: 'risk controllability', 'familiarity/knowledge' (both PsP/CT characteristics) and 'risk exposure' (PsP risk dimension) where we noticed a serious clash between the private and public factors in recognising and dealing with risk; 'periodicity', 'novelty' (PsP characteristics), 'risk dynamics' and 'source of risk' (CT variables), which describe the (changing) environment of flood risk itself. According to the taxonomic model of Raaijmakers et al. (forthc.), low knowledge (or what they call 'awareness') in combination with low control (or, what they call 'preparedness') and high worry may lead to the demand for more protection; however, low knowledge together with low worry and high hazard control implies, as we might consequently suggest, - an (ignorant) safety feeling. We see this combination of risk perception factors - currently observed in the Netherlands - as alarming and

suggest to treat them carefully in designing flood risk communication strategy.

In the next section we shall continue with building up a framework for a profound analysis of flood risk perceptions in the Netherlands in relation to the motivation of people to undertake protective action and studying consequent behavioural change.

### 3.2 *Perception of risk and motivation to act upon a hazard*

As we have outlined in the beginning of this paper, our current inquiry is aiming at exploring individual flood risk perception in the Netherlands in conjunction with raising awareness and motivating some desired behaviours of the Dutch public towards flood risk protection. So far we have provided an explorative analysis of flood risk perceptions based on two theories of cognitive perception. We have noticed that these frameworks, although helpful in identifying perception 'bottlenecks', do not offer wide theoretical grounds for the systematic study of a problem at hand. This means that we need to adopt a different approach that would be able to connect risk perception and action upon protection. Unfortunately, natural hazard literature does not present us with a ready solution; studies of natural phenomena characterised as low probability - high consequence events are even less abundant. However, a variety of theories explaining human decision-making and behaviour under conditions of risk and uncertainty are found on the edge of such fields as health care, environmental studies, natural hazards, psychology and economics. One of the promising candidates is a combined approach applied to the analysis of individual motivation to protect themselves against wildfires in the US (Martin et al. 2007), which was borrowed from health care literature (Block & Keller 1998).

In fact, clinical psychology, health education and health risk communication studies offer a wide variety of theories and approaches to study risk perceptions, motivation and action. Among others, such theories circulate as Health belief model (HBM) by Becker (1974), Rosenstock (1974); the theory of planned behaviour and reasoned action (TRA) by Ajzen & Fishbein (1980), Ajzen (1988, 1991); Protective action decision model (PADM) by Lindell & Perry (1992, 2000); Person-relative-to-event model (PrE) by Mulilis et al. (1990), Mulilis & Lippa (1990), Mulilis & Duval (1995); Subjective expected utility (SEU) by Savage (1954); Protection motivation theory (PMT) by Rogers (1975), Bandura (1977); Maddux & Rogers (1983); Weinstein (1989); and Trans-theoretical model (TTM) by

---

<sup>2</sup> More on the lock-in effect see among others Woerdman (2004).

Prochaska & DiClemente (1982); Weinstein et al. (1998).

The listed models have a lot in common, for example, Health belief model (HBM) is based on four main constructs of susceptibility and severity of risk, benefits and barriers of protective actions, to which self-efficacy was added later on to improve the predictive capacity of the model in explaining health behaviours. The five elements are very similar to the vulnerability, severity, self-efficacy and response-efficacy alongside with costs and benefits of protective action elicited by the Protection motivation theory (PMT), which examines the impact of information on the elicitation of both risk appraisal and coping techniques. The theory of reasoned action (TRA) intends to explain the discrepancy between attitude to risky activities and behaviour, and proposes that intention is a best predictor of behaviour, which is in turn influenced by three factors: individual attitude towards a specific behaviour, subjective norms and perceived behavioural controls. This approach is conceptually close to the subjective expected utility model in the sense that it inspects the subjective side of perception of a risky activity. Person-relative-to-event (PrE) theory predicts the emergence of protective action under conditions of increased fear at the presence of sufficient resources relative to the magnitude of threat, which are similar to the vulnerability, severity and response-efficacy elements of PMT. The subjective expected utility (SEU) model put forward by Savage back in 1954 describes decision-making in the presence of risk and is based on the perceived individual utility that is maximised based on the perceived costs and benefits of a risky activity. The implementation of the method is deemed tedious (as well as TRA), and consistency of individual utility remains a problem. Yet, the principle of weighing the costs of protective action against the benefits it might bring, central to SEU, is also present in other models such as HBM, PTM, TRA and PADM. In the latter approach, the protective action decision model, actions in response to threats can be defined by a series of stages like detection/warning, psychological preparation, logistical preparation, and protective action selection/implementation. Finally, the transtheoretical model (TTM) representing decision stage theories is a behavioural change model that emerged from clinical psychology. TTM identifies six stages of what is called 'successful self-change', or the degrees of readiness to act upon danger, which are shown to influence individual motivation and intention to protect themselves from a risk. These ordered stages are pre-contemplation, contemplation, preparation, action, maintenance and termination, however only three of them are usually included in empirical studies (pre-contemplation,

contemplation and action). The important implication of TTM is that depending on the decision-making stage with which a group of individuals is identified, an effective communication strategy can be designed in order to stimulate their progressive 'movement' from one stage of action to another.

The combination of the protection motivation theory with the transtheoretical model (first suggested by Block & Keller in 1998 in health-related context and followed up by Martin et al. in 2007 applied in the context of natural hazards) offers an elegant theoretical mix for addressing the problems of risk communication in conjunction with shifts in actual protective behaviour using risk information and risk perception dimensions on the one hand and stage readiness for action on the other hand. Both Block & Keller (1998) and Martin et al. (2007) provide a detailed conceptual background on the methods and also succeed in applying the new combined approach to their case studies. Essentially, this methodology not only provides explanation for individual engagement into protective behaviours, but lends itself to extract implications for *influencing* individuals in performing desirable protective behaviours. The combined PMT-TTM approach assumes the existence of varying motivations to act on risk depending on the decision-making stage. Further, it assumes that transition between the action stages borrowed from TTM can be influenced by the four cognitive processes described by PMT; namely, literature has repeatedly confirmed the finding that the degree of perceived risk severity, vulnerability, self-efficacy and response efficacy are key motivators to make people move through the stages of precontemplation, contemplation and action. As Martin et al. (2007, p. ...) put it, "Strong beliefs in severity, vulnerability, self efficacy and response efficacy will arouse the motivation to protect oneself and one's property and result in a change in the adoption rate of risk reduction behaviors." In particular, state-of-the-art in risk behaviour research has shown that the stress on the perception of vulnerability among the precontemplatives proves effective to make them move to the contemplative stage; while strengthening the perception of severity of danger would stimulate contemplatives to turn to action. Finally, it appears that improved response-efficacy and the perception of self-efficacy would help those who are already found in the action stage remain engaging in protective behaviours.

#### 4 THE SURVEY

We apply a survey to explore cognitive perceptions of flood risk in the Netherlands and to provide an advice with regard to communication strategy

aiming at improving hazard response in acting upon flood risk protection. The design of the survey will consist of a testing stage in the form of a small-scale pilot study (Mar-Apr 2008) and a final large-scale survey (Aug-Sep 2008), expectedly to be distributed among about a thousand Dutch households located in flood-prone areas as along the coast, as along the riverside, with varying levels of protection (legal standards prescribe the following overtopping probabilities for the intended dike ring areas: 1/10.000 yrs; 1/4.000 yrs; 1/2.000 yrs; 1/1.250 yrs).

The questions in our survey are divided into 10 blocks. Blocks 1 to 3 deal with threat assessment: block 1 includes vulnerability scale (8 measures), block 2 – severity scale (6 measures), block 3 – extrinsic and intrinsic rewards scales (5 measures). Blocks 4 to 7 include the coping factors, such as: block 4 – self-efficacy scale (4 measures), block 5 – response efficacy, including individual- and group-based, as well as public measures; block 6 – costs scale (7 measures); block 7 – knowledge (6 measures). Essentially, block 8 is an extension of the previous block 7, knowledge, where the questions regarding the flood risk context in the Netherlands are asked. Namely, they are directed at exploring the perceived division of responsibilities with regard to flood protection that is found on the nexus of private-public domains. Block 9 attempts to identify the intention stage to act upon risk reduction, and block 10 closes with some questions on demographic characteristics.

## 5 SUMMARY AND EXPECTED RESULTS

Based on the exploratory study of flood risk perceptions in the Netherlands presented in the previous section and following the predictions of the combined PMT-TTM approach, we may make some preliminary suggestions with regard to what an application of PMT-TTM approach in our case might yield. Although flood risk experience and perceptions slightly vary geographically (MVW & MBZ 2007, p.20), we expect that the majority of the Dutch public would be found in the precontemplative decision stage with moderate to low risk knowledge level. If this expectation is supported by data (a large-scale survey will be carried out; the first results are expected by summer 2008), the communication strategy on raising flood risk awareness and individual responsibility on acting upon self protection would in the first place require focusing on vulnerability-promoting information. Yet, we may also find that contemplatives are present (in particular in combination with high knowledge level) who, most likely, would be effectively motivated by targeted communication of risk severity. A surprising

outcome would be to find a considerable ‘action’ group in the light of the faded flood risk awareness in the Netherlands and strong trust in government managing flood protection; however, it could comprise of people that have had personally experienced the last major flood of 1953, or evacuation during the near-flood events of 1993 and 1995, and still live in the flood prone areas.

## 6 REFERENCES

- Ajzen, I. & Fishbein, M. (eds). 1980. *Understanding attitudes and predicting social behaviour*. New Jersey: Prentice-Hall.
- Ajzen, I. 1988. *Attitudes, personality, and behavior*. Milton-Keynes, England: Open University Press & Chicago, IL: Dorsey Press.
- Ajzen, I. 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes* 50: 179-211.
- Bandura, A. 1977. Self-efficacy: Toward a unifying theory of behavioral change, *Psychological Review*, 84: 191-215.
- Becker, M.H. 1974. The Health Belief Model and Personal Health Behavior, *Health Education Monographs* 2(4).
- Block, L.G. & Keller, P.A. 1998. Beyond protection motivation: An integrative theory of health appeals. *Journal of Applied Social Psychology* 28(17): 1584–1608.
- Bočkarjova, M. 2007. *Major Disasters in Modern Economies: an Input-Output Approach at Modelling Imbalances and Disproportions*, PhD thesis, University of Twente, Enschede, the Netherlands.
- Bočkarjova, M., Steenge, A.E. & Hoekstra, A.Y. 2008. *Management of Catastrophes: A Paradigm Shift in Thinking about Flood Risk* In: H.Folmer and S.Reinhard (eds) “Water Problems and Policies in the Netherlands”, World Bank, forthcoming.
- Boer, J. de, Goosen, H. & Huitema, D. 2003. *Bewust werken aan waterbewustzijn: Studie naar de rol en relevantie van het begrip waterbewustzijn voor het waterbeleid*, IVM, VU Amsterdam.
- DGW/WV. 2006. Voortgang verkenning Waterveiligheid 21e eeuw, Brief van de Staatssecretaris MWV M.H.Schultz van Haagen aan de Tweede Kamer, DGW/WV 2006/1424. Den Haag, the Netherlands.
- Dickie, M. & Gerking, S. 2001. Parents’ Valuation of Latent Health Risks to Their Children. Proc. of Economic Valuation of Mortality Risk Reduction: Assessing the State of the Art for Policy Applications. 7 Nov 2001, Silver Spring, US.
- Douglas, M. & Wildavsky, A. 1982. *Risk and Culture: an essay on the selection of technical and environmental dangers*. Berkeley: University of California Press.
- Gaskell, G. & Allum, N. 2001. *Two Cultures of Risk*. Centre for Analysis of Risk and Regulation, London: LSE.
- Jonkman, S.N. 2007. *Loss of Life Estimation in Flood Risk Assessment*, PhD thesis, Technical University of Delft, Delft, the Netherlands.
- Klijjn, F., Klis, H. van der, Stijnen, J., Bruijn, K. de, & Kok, M. (2004) *Overstromingsrisico dijkringen in Nederland: beooglij en deskundigenoordeel*, Report, Delft Hydraulics and HKV lijn in water, Delft, The Netherlands.
- Krupnick, A., Alberini, A. & Cropper, M. 2001. Implications of Risk and Population Characteristics for the VSL: Results From Canadian and US Samples, Proc. of Economic Valuation of Mortality Risk Reduction: Assessing the State of the Art for Policy Applications. 7 Nov 2001, Silver Spring, US.
- Lindell, M.K. & Perry, R.W. 1992. *Behavioral Foundations of Community Emergency Planning*. Washington DC: Hemisphere Press.

- Lindell, M.K. & Perry, R.W. 2000. Household adjustment to earthquake hazard: A review of research, *Environment & Behavior* 32: 590-630.
- Maddux, J.E. & Rogers, R.W. 1983. Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology* 19: 469-479.
- Maier, H. 2007. Applying Leontief's input-output concept to a postulated global economic order of the natural World, paper pres. at 16<sup>th</sup> IIOA Conference, 2-6 July 2007, Istanbul, Turkey.
- Martin, I.M., Bender, H. & Raish, C. 2007. What Motivates Individuals to Protect Themselves from Risks: The Case of Wildland Fires, *Risk Analysis* 27(4): 887-900.
- MNP & RIVM. 2004. *Risico's in Bedijkte Termen: een thematische evaluatie van het Nederlandse veiligheidsbeleid tegen overstromingen*. Milieu en Natuur Planbureau, en Rijksinstituut voor Volksgezondheid en Milieu. Bilthoven, the Netherlands. (English version: "Dutch Dikes and Risk Hikes").
- Mullis, J.P. & Lippa, R. 1990. Behavioral change in earthquake preparedness due to negative threat appeals: A test of protection motivation theory. *Journal of Applied Social Psychology* 20(8): 619-638.
- Mullis, J-P. & Duval, T.S. 1995. Activating Effects of Resources Relative to Threat and Responsibility in Person-Relative-to-Event Theory of Coping With Threat: An Educational Application, *Journal of Applied Social Psychology*, 33(7): 1437-1456(20)
- Mullis, J-P., Duval, T. S. & Lippa, R. 1990. The effects of a large destructive local earthquake on earthquake preparedness as assessed by an earthquake preparedness scale. *Natural Hazards* 3: 357-371.
- MVW & MBZ. 2007. *Waterbewustzijn en Waterbewustgedrag in relatie tot waterveiligheid. Kennen, voelen, willen en doen*. Ministerie van Verkeer en Waterstaat en Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. Rijswijk, The Netherlands.
- Prochaska, J.O. & DiClemente, C.C. 1982. Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy: Theory, Research and Practice* 19(3): 276-288.
- Raaijmakers, R., Krywkow, J. & Veen, A. van der. 2008. Flood Risk Perceptions and Spatial Multi-Criteria Analysis: an Exploratory Research for Hazard Mitigation, *Natural Hazards* (forthc.).
- Rogers, R.W. 1975. A protection motivation theory of fear appeals and attitude change, *Journal of Psychology* 91: 93-114.
- Rosenstock, I. 1974. Historical Origins of the Health Belief Model, *Health Education Monographs* 2(4).
- Royal Society for Prevention of Accidents 1983. Risk Assessment: a Study Group Report. London: Royal Society.
- Savage, L.J. 1954. *The Foundations of Statistics*, New York: Wiley.
- Slovic, P. 1987. Perception of Risk, *Science* 236: 280-285.
- Terpstra, T. & Gutteling, J.M. 2007. Publieke Percepties van het Risico op Overstromen vanuit de Waddenzee. University of Twente, Enschede, the Netherlands.
- Terpstra, T. & Gutteling, J.M. 2008. Household Perceived Responsibilities in Flood Risk Management in the Netherlands. *Journal of Water Resources Development*, forthcoming.
- Weinstein, N.D. 1989. Effects of personal experience on self-protective behavior. *Psychological Bulletin* 105(3): 31-50.
- Weinstein, N.D., Rothman, A.J. & Sutton, S.T. 1998. Stage theories of health behavior: Conceptual and methodological issues, *Health Psychology* 17: 290-299.
- Wesselink, A.J. 2007. Flood safety in the Netherlands: The Dutch response to Hurricane Katrina, *Technology in Society* 29: 239-247.
- Woerdman, E. 2004. Legal Inertia and Path Dependence: An Economic Exploration of Analogies and Definitions. In: A. Prinz, A.E. Steenge & J. Schmidt (eds), *Institutions in Legal and Economic Analysis*, Münster: Lit Verlag, pp23-45.