



Detailed insights into the influence of flood-coping appraisals on mitigation behaviour



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ABSTRACT

Insights into flood mitigation behaviour are important because of the ongoing shift to risk-based flood management approaches in Europe and worldwide, which envisage a contribution from flood-prone households to risk reduction. The recent literature on factors that influence flood mitigation behaviour indicates that flood-coping appraisal is an important variable to understand and explain flood mitigation behaviour. Coping appraisal originates from Protection Motivation Theory (PMT), and refers to the cognitive process that people undergo when evaluating their own ability to avoid a certain risk. However, the empirical literature on the importance of coping appraisal is still scarce, and, in particular, little is known about the independent influence of the three single components of coping appraisal on precautionary behaviour: namely, response efficacy, self-efficacy, and response cost. This study presents the results of a recent survey among 752 flood-prone households along the river Rhine in order to provide detailed insights into the influence of the components of flood-coping appraisal on four different types of flood mitigation behaviour: structural building measures, adapted building use, the deployment of flood barriers, and the purchase of flood insurance. The results confirm that flood-coping appraisal is an important variable in terms of precautionary behaviour. In particular, both response efficacy and self-efficacy contribute to the models which explain the four different types of flood-mitigation behaviour. Based on these findings, it is concluded that risk communication should focus more strongly on the potential of flood-mitigation measures to effectively reduce or avoid flood damage, as well as on information about how to implement such measures in practice.

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1. Introduction

The acknowledgement that floods remain possible even in areas with comprehensive flood-protection works in place, has led to a shift to more integrated flood risk management concepts in Europe and worldwide (Büchle et al., 2006; European Union, 2007; Few, 2003; De Moel et al., 2009; Holub et al., 2012). Such integrated flood-risk management concepts focus not only on investments in flood-prevention infrastructure, such as dikes, but in addition embrace damage-mitigation measures implemented by households as a viable strategy to limit flood risks. This complementation of traditional flood-protection strategies is considered important, because it provides a hedge against the projected increase in flood risk resulting from the combined effect of ongoing socio-economic development in floodplains and the effects of climate change (Aerts

et al., 2008; De Moel et al., 2011; Linde et al., 2011). Several studies have shown that measures such as flood-adapted building use or the deployment of mobile flood barriers can effectively reduce flood damage (e.g. Kreibich et al., 2005; Bubeck et al., 2012b), and are cost-effective in many situations since they have a benefit–cost ratio larger than one (Holub and Fuchs, 2008; Kreibich et al., 2011a).

At the same time, it is often found that residents living in flood-prone areas do not adequately prepare themselves for potential flood events (Kunreuther and Erwann, 2009). Therefore, a growing number of empirical studies have examined the factors that influence the precautionary behaviour of flood-prone residents (e.g. Takao et al., 2004; Siegrist and Gutscher, 2006; Thieken et al., 2006; Botzen et al., 2009; Terpstra, 2011; Botzen and van den Bergh, 2012; Koerth et al., 2013). Insights into the factors that can explain flood mitigation behaviour are needed, because as part of integrated flood-risk management approaches, private households are also increasingly being required and encouraged through risk communications to contribute to flood-risk reduction by implementing mitigation measures (Wasserhaushaltsgesetz, 2009; Dawson et al., 2011; Meyer et al., 2012; Kellens et al., 2013).

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The majority of studies that have examined the factors which influence flood-mitigation behaviour initially focused on flood-risk perceptions, such as the perceived probability or the perceived consequences of flooding. However, the findings of most of these studies do not support the assumption that risk perceptions per se are a good predictor of flood mitigation behaviour (Bubeck et al., 2012a). A factor that has been shown to be consistently related to flood mitigation behaviour is what is referred to as flood-coping appraisal (Grothmann and Reusswig, 2006; Zaalberg et al., 2009). The concept of coping appraisal originates from Protection Motivation Theory (PMT), which is a widely adopted psychological model that explains decision making in response to threats (Rogers, 1975, 1983). Within PMT, coping appraisal refers to the cognitive process that people undergo when they evaluate possible actions in response to the perceived threat and their own ability to avert or avoid a certain risk. It consists of three individual components referred to as 'response efficacy', 'self-efficacy', and 'response cost'. Studies that have examined flood-coping appraisal consistently found statistically significant relationships with flood mitigation behaviour (Grothmann and Reusswig, 2006; Zaalberg et al., 2009). This suggests that flood-coping appraisal is an important variable to understand flood-mitigation behaviour and, therefore, is important for flood-risk communications.

Even though it has been shown that flood-coping appraisal is an important explanatory variable, the literature on this subject is still scarce, in general, and little is known about the independent influence of response efficacy, self-efficacy, and response cost on household decisions to implement different flood-mitigation measures, in particular. A limitation of the recent literature is that it applied a single variable 'coping appraisal' in statistical models that explain flood mitigation behaviour, instead of examining each component separately (e.g. Grothmann and Reusswig, 2006). Only few studies examined the effect of the different components of flood-coping appraisal on mitigation behaviour separately (e.g. Zaalberg et al., 2009). In other application domains of PMT, such as the literature on health-related behaviour, the distinction between the different components of coping-appraisal is more common (see e.g. Milne et al., 2000). With regard to flood-risk communications, it is important to gain further insights into the influence of the individual components of coping appraisal on protective behaviour. Such insights could provide important information for flood-risk management policies, because it indicates whether risk communications should emphasize the effectiveness of flood mitigation measures (response efficacy), should focus on providing practical guidelines on how to deploy such measures (self-efficacy), or, whether the costs of protective measures should be addressed when stimulating flood mitigation behaviour (response cost).

To gain insights into the influence of the three individual components of flood-coping appraisal on precautionary behaviour, this study presents data from a survey conducted among 752 flood-prone households along the German part of the river Rhine. It examines, how perceived response efficacy, perceived self-efficacy, and perceived response cost relate to the implementation of four different types of flood-mitigation measures: namely, structural building measures, adapted building use, flood barriers, and the purchase of flood insurance.

The remainder of this article is organized as follows. Section 2 discusses the theoretical background of (flood-) coping appraisal as well as the empirical findings with respect to flood mitigation behaviour. Section 3 presents the sample characteristics of the survey and the methods applied in this study. The results are provided and discussed in Section 4. Section 5 concludes, and discusses the implications of the findings for risk communication,

and for other policies that aim to stimulate flood mitigation behaviour.

2. Protection Motivation Theory

The concept of coping appraisal derives from Protection Motivation Theory (PMT) (Rogers, 1975, 1983), which is considered to be one of the main theoretical frameworks to predict and influence health-related behaviour (Milne et al., 2000; Floyd et al., 2000). Although PMT was initially developed to explain protective health behaviour, it has been applied in several other contexts, including technical and environmental risks, as well as natural hazards (Mulilis and Lippa, 1990; Wiegman et al., 1992; Grothmann and Reusswig, 2006).

In order to explain protection motivation, the model attempts to capture the two main cognitive processes that people undergo when facing a specific threat: namely, 'threat appraisal' and 'coping appraisal'. *Threat appraisal* consists of the two variables 'perceived vulnerability' (probability), and 'perceived severity' (consequence), and, thus, describes how threatened someone feels by the respective risk. *Coping appraisal*, instead, refers to the cognitive process that people undergo when they evaluate possible responses to the threat they face, as well as to their own ability to avert or avoid a certain risk. It consists of three separate components referred to as 'response efficacy', 'self-efficacy', and 'response cost' (Rogers and Prentice-Dunn, 1997; Floyd et al., 2000). *Response efficacy* describes whether a person considers a protective measure as effective to reduce a certain risk. *Self-efficacy* indicates whether a person feels able to actually implement a certain measure. Finally, *response cost* refers to the financial, time and emotional costs that a person associates with implementing the respective measures (Floyd et al., 2000; Milne et al., 2000). These two appraisal processes influence an individual's protection motivation, which is regarded as an intervening variable that arouses, sustains, and directs the activity of individuals to protect themselves (Maddux and Rogers, 1983), and leads to a coping response that can be either protective or non-protective. *Protective measures* are those actions that are suitable to actually reduce the threat and are adopted if high risk perceptions are accompanied by (positive) coping appraisals. In contrast, *non-protective responses* are adopted if high risk perceptions are accompanied by low coping appraisals. While non-protective responses, such as wishful thinking, avoidance or denial, do not actually reduce the risk itself, they can help to suppress negative emotions caused by the cognitive dissonance of high risk perceptions and low coping appraisals (Festinger, 1957). In the original version of PMT, Rogers (1975) proposed that threat appraisals and coping appraisals would combine in a multiplicative fashion, suggesting interaction effects between the variables. However, empirical support for this multiplicative function has been lacking (Norman et al., 2005). In his revised version of PMT, Rogers (1983) then proposed a simpler additive model, and most applications of PMT consequently only consider the main effects of threat appraisals and coping appraisals (Norman et al., 2005).

Only a few studies have examined the influence of flood-coping appraisals on mitigation behaviour, and find consistent relations with mitigation behaviour (Grothmann and Reusswig, 2006; Zaalberg et al., 2009). Grothmann and Reusswig (2006) find that coping appraisal could explain an additional 2–21 percent in the variance of mitigation behaviour. Zaalberg et al. (2009) find that the perceived effectiveness positively influences intentions for precautionary behaviour, while self-efficacy does not. Furthermore, other studies that do not apply PMT, as such, but examine variables that are part of the PMT framework, also find mostly statistically significant relations with precautionary behaviour (for an overview, see Bubeck et al., 2012a).

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