



adelphi



Implications of Behavioural Economics for Designing Adaptation Policies

Addressing Behavioural Barriers of Private Adaptation to Climate
Change

Christian Kind and Jonas Savelsberg

Prepared as part of a research project for the German Federal Environment Agency (FKZ
3710 41 137)

Date: 09/2013

POLICY PAPER

Contents

1. Introduction	2
2. A brief introduction to behavioural economics	3
3. Behavioural anomalies and barriers to private adaptation	4
3.1. Bounded rationality	4
3.2. Bounded self-control	6
3.3. Bounded self-interest	6
4. Empirical Observations	7
4.1. Hurricane adaptation in the Southeastern United States	7
4.2. Private flood protection in Europe	7
5. Policy recommendations	9
5.1. Making adaptation the default option	9
5.2. Using social norms and peer pressure	10
5.3. Adequate framing of choices	11
5.4. Establishing adaptation commitments and providing feedback	11
5.5. Behaviourally informed incentives	12
6. Framework for designing interventions	13
7. Propositions for further research	16
8. Literature	17

The authors wish to thank Clemens Haße, Dirk Osiek (both German Federal Environment Agency) and Daniel Osberghaus (Centre for European Economic Research) for valuable comments on drafts of this paper.

1. Introduction

There is evidence (Trenberth et al. 2007) and scientific consensus (Parry et al. 2007) that weather-related extreme events have changed in magnitude and frequency in the past decades. The types of events for which evidence is particularly strong are heavy precipitation and heat waves (Huber and Gullege 2011). While natural variability continues to play an important role in triggering extreme weather events, climate change has increased the probability and severity of such events on a global scale (Trenberth et al. 2011). Due to climate change, the number of extreme weather events like heat waves, heavy precipitation and winter storms in Germany is likely to increase by up to 50 per cent in the second half of this century (Deutschländer and Dalelane 2012). The described changes have been associated with considerable costs for individuals and private property as well as for states and public infrastructure: global estimates show that economic damages from extreme weather events have increased eight-fold between 1960 and 1999 (Mechler and Kundzewicz 2010), a magnitude which cannot fully be explained by an increase in population or economic output (Parry et al. 2007). In the future, more considerable damage costs are to be expected. Industrialised nations will be adversely affected by significant infrastructure damage and faster capital depreciation, as old infrastructure is being replaced by capital-intensive infrastructure. Furthermore, long-run production losses from extreme weather are expected to increase significantly (Stern 2007). However, anticipated damages and respective costs can be reduced significantly by adapting behaviour, assets and infrastructure to the changing climatic conditions (EEA 2012).

Under the neoclassical assumption of an efficiently operating, competitive market with perfectly rational agents, private actors will implement acts of private adaptation autonomously to deal with the present and expected changes in the most efficient way. Private adaptation is defined as '[a]daptation that is initiated and implemented by individuals, households or private companies. Private adaptation is usually in the actor's rational self-interest' (Mc Carthy et al. 2001: 982). In neoclassical theory, acts of private adaptation yield more private benefits than private costs and will therefore be performed autonomously, i.e. without any additional external incentives, as self-interest is assumed to be a sufficient incentive to adapt (Clar et al. 2011). Furthermore, analogous to markets, private adaptation measures will, according to neoclassical theory, not have to be directed by public authorities as long as market failures do not arise (Fankhauser and Agrawala 2008; Mendelsohn 2000). A chosen action to adapt to changes may include the acceptance of a certain level of residual damage if adaptation costs exceed adaptation benefits. However, in contrast to this paradigm that is based on perfectly rational actors, recent pieces of anecdotal evidence – like the many store-owners unprepared for floods that hit the east coast of the United States in spring 2013 – indicate that private actors often do not choose to adapt to impacts of a changing climate even if the cost-benefit-ratio of such measures seems positive. Observations like this can be explained by market failures, limitations due to policies and institutional arrangements, limited adaptive capacity or behavioural barriers of individuals (defra 2010).

As behavioural barriers are a central determinant of private adaptation, but so far have often been neglected in debates on adaptation to climate change (Jones 2010), this paper will examine the effects of and potential countermeasures to this likely barrier to private adaptation. To this end, the paper will at first briefly present a selection of basic concepts of behavioural economics, before transferring these concepts to the context of adaptation, grouping barriers to private adaptation that have been identified in various studies within different areas of behavioural economics. The paper will then provide an overview of recent empirical observations that can illustrate these barriers. Based on this literature-based review and the empirical findings, the paper will present concepts that can be used to address the determined barriers and suggest a framework for integrating findings from this field into the design of policies. The last section of this paper presents a number of recommendations for future empirical research.

2. A brief introduction to behavioural economics

One of the most fundamental assumptions in neoclassical economics is that human beings will make decisions based on a rational consideration of expected costs and benefits of their respective action in order to maximize their overall utility. These costs and benefits and the corresponding utility do not necessarily have to be defined in monetary terms but can also be defined by using more extensive concepts such as well-being or happiness (see e.g. Welsch and Kühling 2011). By assuming rationality, economic analysis is able to explain a broad variety of problems, but its explanations are at the same time subject to limitations, as other disciplines (mainly psychology and sociology) have observed human behaviour to be less rational than assumed in economic theory. Or as Mullainathan and Thaler (2000: 1) express it:

'[...] virtually all the behaviour studied by cognitive and social psychologists is either ignored or ruled out in a standard economic framework.'

In combination with a number of inexplicable anomalies in different areas of economics (see e.g. Mullainathan and Thaler 2000), this has led to the emergence of behavioural economics as a new field in economic research. Behavioural economics can roughly be structured into the discussion of three areas in which human behaviour differs from homo oeconomicus – the rational agent assumed in neoclassical economics: Individuals are bound in their rationality, their self-control and their self-interest (Diamond and Vartiainen 2007, Mullainathan and Thaler 2000).

The deviation in these areas can partly be explained by the postulation of different systems of decision-making. Kahneman (2003) distinguishes two types of systems; the Automatic System and the Reflective System (see Table 1):

Table 1: Two cognitive systems (Thaler and Sunstein 2008:20)

Automatic System	Reflective System
Uncontrolled	Controlled
Effortless	Effortful
Associative	Deductive
Fast	Slow
Unconscious	Self-aware
Skilled	Rule-following

He shows that, because the overall capacity for mental effort is limited, 'effortful processes tend to disrupt each other, whereas effortless processes neither cause nor suffer much interference when combined with other tasks' (Kahnemann 2003: 698). The interplay of Automatic System and Reflective System leads to the use of rules of thumb or heuristics and biases (Thaler and Sunstein 2008).

Despite the growing importance of behavioural economics, which has led to the occupation of leading behavioural economists in government agencies in the US and the UK (in so called 'nudge units'), behavioural economics has so far only played a minor role in German policy advice. The one exception touching on behavioural economics in policy advice (BMF 2010; also discussed in Weimann 2010) takes a fairly critical position, stating that the underlying empirical results are not sufficiently valid for broad scale applications. In fact, this strand of economics is not without criticism. As most findings from behavioural economics are based on experiments and case studies (Weimann 2010), a frequently cited caveat towards behavioural economics is the doubt in the validity of transferring findings from experiments among small and homogenous groups to a real world context (see e.g. Myagkov and Plott 1997, Darnton 2008, BMF 2010).

3. Behavioural anomalies and barriers to private adaptation

The concept of private adaptation is based on the assumption of rational actors choosing the optimal combination of private adaptation costs, adaptation benefits and residual private damage and furthermore on the assumption that these actors are fully aware of the probability and magnitude of risks they are facing. This means that people will act, if private benefits outweigh the costs of implementing adaptation measures (Clar et al. 2011). However, there is evidence that at least in some areas, neoclassical economic theory does not predict human behaviour adequately and therefore it seems worthwhile to examine possible behavioural barriers to private adaptation.

According to Parry et al. (2007) it is clear that barriers and limits to adaptation are present in various areas. Moser and Ekstrom (2010: 22027) define barriers to adaptation as ‘obstacles that can be overcome with concerted effort, creative management, change of thinking, prioritization, and related shifts in resources, land uses, institutions, etc.’ A number of scientific papers have addressed the issue of barriers to adaptation, which encompass not only behavioural but also institutional, financial and informational barriers (see e.g. Adger et al. 2007, Hulme et al. 2007, Adger et al. 2008, Biesbroek et al. 2009, Moser and Ekstrom 2010 or Clar et al. 2011). However, none of these studies have – to the authors’ knowledge – provided a systematic analysis of barriers to private adaptation in a behavioural economic framework. Instead, most studies use the concept of a policy cycle in order to identify various barriers to planned adaptation (Moser and Ekstrom 2010, Clar et al. 2011), or focus on selected barriers to adaptation, such as social barriers (Jones 2010, Jones and Boyd 2011).

3.1. Bounded rationality

The concept of bounded rationality describes the inability of individuals to process more than a limited amount of information and that, in order to analyse this information, they frequently rely on **heuristics** or rules of thumb, which are employed when making decisions under uncertainty in order to achieve efficient judgements. Even though these heuristics are helpful in many situations, they can also lead to systematic and predictable errors (Diamond and Hannu 2007). Some of the most commonly used heuristics in decision-making are the representativeness heuristic, the availability heuristic and the anchoring heuristic. The **representativeness heuristic** refers to the fact that people often assume consecutive random events to be part of a pattern (similarity), while they actually are stochastically independent. The **availability heuristic** uses the ease with which the occurrence of an event can be brought to mind (salience), whereas the **anchoring heuristic** is based on the use of an initial value or a reference point in order to determine the likelihood of the respective event (Tversky and Kahneman 1974). Among these heuristics, Lehto (2010: 17) describes the availability heuristic as particularly relevant for adapting to extreme weather events: ‘People assume some event to be more probable than some other when the event has taken place quite recently or is just more easily brought to mind’. As the risks associated with climate change are and in the near future will be cognitively available to only few citizens, the availability heuristic can provide an explanation to the differing levels of preventive action against climate-related disaster that people are taking up. In line with these findings, Thaler and Sunstein (2008) explain that people who have already experienced a natural catastrophe estimate the probability of occurrence of such an event much higher than those who have just read about it in a magazine. The association of salient events, such as hurricane activity in the US or flooding in Germany, to climate change can therefore increase the likelihood of a response (Sunstein 2005, Berrang-Ford et al. 2010). Consistently, discussing the effects of heuristics on adaptation to climate change, Shafir (2012) concludes that the use of heuristics could result in sub-optimal adaptation decisions that are chosen out of habit rather than by rational decision. Extending the concept of the availability heuristic, Slovic et al. (2004) have coined the term **affect heuristic**. The affect heuristic is closely linked to the automatic system and describes the fact that people make judgements and decisions based on their emotions. Even though Slovic and Weber

(2002) go as far as stating – based on Damasio (1994) – that arguments and analytic reasoning cannot be effective unless they are guided by emotions, the affect heuristic does often lead to a miscalculation of the likeliness of a certain outcome. Negative emotions lead to an increase of the perceived risk, while positive emotions have the opposite effect (Terpstra 2011). This misjudgement of probability has also been referred to as **probability neglect**, which means that people often feel more affected by catastrophic events than by statistically larger and more probable risks they face in their everyday life or by gradual changes due to climate change (Sunstein 2003).

Causes of misinterpretation of probabilities are not only limited to heuristics. Prospect theory is based on the assumption that people often use **reference points** for their judgements. This can mean that, in contrast to neoclassical economics, utility is drawn from changes in wealth rather than absolute levels of wealth and that people are more sensitive to losses than to gains – they are **loss averse** (Mullainathan and Thaler 2000). Furthermore, individuals give a higher value to goods once they own them (**endowment effect**) (Thaler 1980) and they are often more inclined to stick with a given default option (**status-quo bias**). Based on a survey, Lipson (2008) for example discovered that, if people already own a house, they will tolerate higher hypothetical risks to it than they would when deciding on the location for a new home, demonstrating the relevance of this bias in a disaster risk context. As the empirical examples in chapter 4 will show, the endowment effect can be seen as a supporting factor of adaptation. Instead of not adapting at all, individuals will be willing to put substantial effort into protecting their own homes or homes in which they have lived for a longer period of time. However, in situations where it would be more efficient to depopulate a flood-prone area rather than fortifying existing homes, the endowment effect can lead to maladaptation if people stay in their houses and put too much effort into making their house flood-safe instead of taking the easy way of moving from the site. When deciding whether to act or not in a certain situation, individuals often prefer harm caused by the omission of an action over equal or lesser harm caused by the action itself if it were carried out (**omission bias**) (Baron and Ritov 2004). In a number of workshops Patt and Schröter (2008) observed behaviour among Mozambican farmers confronted with climate change and its impacts that was consistent with the omission bias.

Another aspect covered in behavioural economics which can be related to the discussion of bounded-rationality is **overconfidence** – even in the absence of true or useful information, actors will rely on their abilities and in result will make irrational decisions with unforeseeable outcomes (Mullainathan and Thaler 2000). In a risk context this is, for example, addressed by Lai et al. (2003) who show that people are unrealistic optimists, as they consider the risk of local environmental perils (their personal risk) smaller than the risk of global environmental perils (the public risk). In contrast to this observation, Burger and Palmer (1992) show that people who have been affected personally by natural disasters (availability heuristic) show reduced unrealistic optimism. This example shows that different barriers or rather behaviour influencing factors can seldom be analysed separately but need to be examined for linkages and interactions among each other. When facing a multitude of options to choose from, individuals are often subject to **choice overload**, which is again contradictory to the neoclassical paradigm, where more choices would always be better than fewer choices (Pollitt and Shaorshadze 2011). In a broader context, human beings face a multitude of different topics they should be concerned with. Farmers in the Argentinian Pampas have for example been observed to decrease their concern with other risks, when worry about one risk increases. This phenomenon is often referred to as a **finite pool of worry**. In a broader context, this finite pool of worry leads to a limited perception of climate change risks, as many other problems are more urgent to most individuals (Linville and Fischer 1991).

Even though not often referred to in behavioural economic literature, social **norms and values** are an important factor influencing the willingness or motivation to adapt to environmental change, as they influence a person's interpretation of information, guide actions and determine the allocation of scarce resources, especially when facing uncertainty (Hulme et al. 2007, Osberghaus et al. 2010). According to Adger et al. (2007), they can be considered as a significant barrier to adaptation action, but can also enable rather than constrain action, thereby encouraging adaptation (Adger et al. 2009).

3.2. Bounded self-control

Bounded self-control or bounded willpower refers to the inability of individuals to carry out a previously made rational decision. This effect can be observed in various areas from addictive behaviour concerning food, alcohol or drugs to the inability of carrying through once made decisions of controlling these addictions. In addition, many individuals tend to display **inertia** and **procrastination** (Diamond and Hannu 2007; Wilkinson 2007; Mullainathan and Thaler 2000). Procrastination can either manifest itself as a tendency to delay decision-making in situations of conflicting evidence (Shafir 2008) or as procrastination of decision-making until it can no longer be delayed (Schimank 2005). Procrastination can be closely linked with choice overload, as people tend to procrastinate when facing more than one option, even if this means that they could suffer significant well-being losses in the future (defra 2010). Addictive behaviour and procrastination and other forms of **myopic behaviour** can be explained with **hyperbolic discounting**. This means that, in contrast to the neoclassical approach of exponential discounting, discount rates are high for the near future and rather low for events in the distant future (Loewenstein and Prelec 1992, Hepburn et al 2010). Inertia can additionally be related to loss aversion as it keeps people from making changes even if these changes are very much in their own interest (Thaler and Sunstein 2008). Bounded self-control can play an important role when considering barriers to private adaptation. Adger et al. (2008) connect the tendency for myopic behaviour with climate change adaptation, showing that there is a tendency to apply very short-term investment horizons with hyperbolic discounting of the potential future benefits of current adaptation actions. Inertia is especially relevant if people are willing to adapt to environmental change but rely on their traditional coping strategies rather than adjusting them to new knowledge. Analysing barriers to adaptation in two Western Nepalese communities, Jones and Boyd (2011: 1270) identified ‘persistence with traditional forms of coping strategies in times of shock and stress’. Hyperbolic discounting has a strong effect on most adaptation decisions, where actors have to invest financial resources today if they want to protect their assets from future climate impacts (defra 2010). The Australian Productivity Commission (2012: 81) concludes that ‘some individuals may respond to the long timeframes and uncertain impacts of climate change by procrastinating and deferring adaptation decisions that would be in their own best interest’.

3.3. Bounded self-interest

Various studies and experiments have shown that individuals often care about the well-being of others (**altruism**) (Mullainathan and Thaler 2000) and highly value fairness by expecting fairness not only towards themselves but also towards others (Diamond and Hannu 2007). Pollitt and Shaorshadze (2011) identify two different motivational factors for pro-social behaviour and fairness; first, individuals also value the consumption of others and not only their own and second, helping others makes individuals feel good leading to intrinsic motivation and vice versa (Frey 2008). Observations have shown that monetary rewards can occasionally **crowd-out** intrinsic motivation. This crowding-out effect counteracts the price effect (supply increases with a rising price) and leads to a change of the supply curve’s shape. Especially in the case of small monetary rewards, a negative net-effect can be observed – the crowding-out effect exceeds the price effect. Even though crowding-out can partially be explained in frameworks using an extended concept of welfare, even the mere introduction of the concept of money can result in a more self-centred behaviour (Vohs et al. 2008). The authors could not identify any literature commenting on bounded self-interest in an adaptation or disaster risk context. Nevertheless, bounded self-interest does not seem like a barrier but rather like a catalyst of adaptation, especially if public- or club goods are affected.

4. Empirical Observations

This chapter presents a number of cases in which individuals have refrained from taking precautionary measures against weather-related disasters despite strong evidence for their necessity or desirability. The examples discussed below belong to those types of events that are projected to become more frequent and severe under a changing climate. For each case, we briefly identify possible behavioural barriers that might explain the inactivity of individuals to adapt and reduce the risk of suffering from the looming disaster. However, in order to clearly determine whether or not behavioural barriers were the primary impediment to adaptive action, more in-depth research is needed. Limited adaptation effort could for example be in the private actor's rational interest, if factors not considered in the respective (case) study reduce the private benefit of acquiring insurance as an adaptation measure. Another example could be that a respondent has already adapted in a way which is not captured by the study's research design, thereby faultily classifying him or her as a non-adaptor.

4.1. Hurricane adaptation in the Southeastern United States

A survey carried out by Mason-Dixon polling & research for the National Hurricane Survival Initiative (NHSI) of the United States (US) indicates that, even after three devastating hurricanes in 2005 in the Southeastern US (Katrina, Rita and Wilma), people living in endangered coastal areas still had not started properly preparing themselves for future extreme events. The results of the survey show that 68% of respondents did not own hurricane survival kits and 83% had not taken measures to fortify their homes (Business Wire 2009). While the high salience (availability heuristic) and the enormous real and potential damages (probability neglect) of hurricane events should contribute to an increase of preparedness, other behavioural barriers might have had a stronger counteractive effect. First and foremost, in line with the representativeness heuristic, many people may have assumed that yet another category 5 hurricane in the same region must be highly unlikely. Furthermore, other behavioural barriers, such as overconfidence, procrastination and inertia may also have played an additional role for the observed lack in preparedness.

A similar survey on Hurricane preparedness in Florida identified, inter alia, the following determinants of preparedness: age, homeownership, income, race, years in home and gender (Baker 2010). While some of these determinants (especially income) can be explained from a neoclassical perspective, others seem to be of a more behavioural nature. Homeownership or years in home could be an indicator for the endowment effect, as people are willing to invest more in order to conserve their own property or property that almost feels like their own.

4.2. Private flood protection in Europe

In the UK, more than 5 million residential houses – and thereby almost every sixth house – are located in flood-prone areas (defra 2013a). By 2012, annual damage costs from flooding have reached €1.2 billion. Due to projected changes in the magnitude and frequency of precipitation events and due to a predicted sea level rise, both linked to climate change, flood risk is very likely to increase in already affected areas in the future. The British Government is trying to raise awareness of flood risk and to empower people living in flood-prone areas to take action. The British Environment Agency informs online as well as by telephone and email without charge about flood risk (Richard and Kazmierczak 2012). Furthermore, the British Government has recently reached an agreement with the Association of British Insurers (ABI), guaranteeing affordable flood insurance to all households in flood-prone areas (defra 2013b). Despite high damage costs and comprehensive governmental support, a recent survey among homeowners in England, Scotland and Wales has shown that many UK residents are still unprepared for flooding. The survey shows that only 29% feel prepared or very prepared for dealing with a flood (OnePoll 2012). Explaining these figures based on neoclassical theory can be difficult since, according to the British Environment Agency (2009:5),

every Euro invested in private flood protection would reduce damage costs from flooding and coastal erosion by eight Euros. This lack of preparation and insurance can be associated with hyperbolic discounting. Other behavioural barriers, such as omission bias or overconfidence could play an additional role. Furthermore, the status-quo bias may lead to unwillingness to procure flood insurance by people who have not had a policy so far. Due to recent flood events, in this case, the availability heuristic seems to act as a driver rather than a barrier of adaptation, or, as Bichard and Kazmierczak (2009) explain, UK citizens who had experience with recent flood events '[...] were more concerned about climate change and more likely to have undertaken precautionary measures such as subscribing to Floodline Warning Direct¹ or buying flood insurance'. In line with these results, a survey consisting of 1,510 face-to-face interviews (983 flooded and 527 at risk respondents) in 30 locations across England and Wales in autumn 2002 carried out by the British Department for Environment, Food & Rural Affairs (defra 2004) has shown that worry about future flooding was much higher for the group that had already been personally affected by flooding.

An in-depth study from the Netherlands indicates that both automatic and reflective mechanisms influence the behaviour of residents in flood-prone areas. Its author states that citizens' trust in governmental flood preparation reduces their own adaptation effort (Reflective System), while this trust, at the same time, reduces their fear of flood, impeding their flood preparedness intentions (Automatic System). Furthermore, he identified the affect heuristic to be of particular importance, observing that negative emotions towards previous flood hazard experiences most often reflected fear and powerlessness, as people fearing future flood events assume to be in higher risks than those associating positive feeling (e.g. feelings of solidarity) (Terpstra 2011). A recent study from Australia, based on a household survey with 501 participants in Eastern Australian cities has shown that the question whether or not a household has flood insurance is associated with perceived social norms but not with perceived flood risk. However, the author found that social norms play a mediating role between insuring decision and risk perception, underlining the important role of norms and value for adaptation (Lo 2013).

¹ Floodline Warning Direct is a service by the British Environment Agency that provides flood warnings by phone text or email free of charge (<https://fwd.environment-agency.gov.uk/app/olr/home>).

5. Policy recommendations

The previous sections have presented a diverse array of behavioural barriers to climate change adaptation and some examples exemplifying the possible effects of these barriers. Knowledge on behavioural barriers to adaptation to climate change is, however, only a first step on the way to behaviourally informed policy-making. The following section therefore presents different approaches for overcoming or using these behavioural anomalies when designing a choice environment that nurtures effective private adaptation action. Most of the approaches (or levers) outlined below address or make use of more than one of the behavioural barriers touched upon above. The approaches described are suitable to be taken up by different types of actors, mostly policy-makers on national or federal level, insurance companies and municipalities. The following paragraphs only present a selection of starting points for dealing with behavioural barriers, taken from a larger pool of tools and levers that deal with behaviour change in general (mostly towards more sustainable consumption), among them European Commission (2012), Osbadilston and Schott (2012) and Unilever (2011). Some of the recommendations outlined have been discussed in other contexts by Thaler and Sunstein (most prominently in their publication of 2008) who created the terms of libertarian paternalism, which refers to influencing decision making with nudges – low-cost, choice-preserving, behaviourally informed approaches to regulatory problems and choice architecture, which means that policy-makers have to design information in a way that incorporates knowledge on the interactions of Automatic and Reflective System.

5.1. Making adaptation the default option

Defaults are a particularly powerful tool for behaviour change. They address a broad array of the previously presented barriers and in some cases, rather than overcoming behavioural barriers or anomalies, they utilise them in order to guide individuals towards a desired decision. Defaults refer to presenting a desirable option but maintaining freedom of choice by giving people the possibility to opt-out of this option. In order to change the default rule, people have to make an active decision. Thereby, defaults make use of inertia and procrastination as well as the status quo bias. Simultaneously, intentionally setting a default helps to deal with choice overload, as well as the finite pool of worry by ensuring that a decision desired by policy makers will be made even if people are unwilling or unable to make a decision and stick with the default. Furthermore, defaults make use of people's loss aversion by setting a reference point from which losses and gains will be defined. Without defaults, people may evaluate their options from a different point of view and will therefore make different, potentially undesired decisions. The effectiveness of defaults can be strengthened by stressing that they represent the best option and providing explanations, preferably by trusted individuals or organisations, for why this is the case. However, the effect of defaults is marginal or even non-existent if people have clear preferences against the default option, as they will then overcome inertia and define their own reference point, making loss aversion far less relevant.

A possible application of defaults in an adaptation context could be the coupling of home-insurance with a default option for flood coverage. Currently, many policies for home-insurances in the German insurance market do not cover natural hazards – which many people are unaware of (Oberhuber 2013, Osberghaus et al. 2013). By including flood coverage as a default option of which purchasers have to opt-out when buying the insurance package, the outlined heuristics could work towards an increase in the overall insurance coverage against flooding. This should of course be flanked by a disclaimer that keeping flood coverage in the policy is voluntary and explanations why coverage will be a good choice in many cases. Approaches like this in the realms of flooding are already being discussed in the United States (see Friedman 2013) where positive experiences have been made with default options for increasing saving rates for retirement funds. According to Sunstein (2012), default rules should be applied when the context is confusing or unfamiliar, i.e. when people are facing uncertainties about their options and possible outcomes of their actions. As

uncertainties are a central element of climate change and adaptation by private actors, defaults seem to be particularly suitable in the adaptation sphere.

Given the necessary legislative support, the outlined applications of defaults for insurances could be taken one or two steps further: home-insurance owners who do not have flood coverage yet could be offered an upgrade to flood coverage by their insurance company – unless they opt against it. Or, individuals purchasing a new home could be offered flood insurance, again, unless they explicitly decide against that option.

However, the presented concept is subject to a number of limitations. Both homeowners and insurance companies might object to it as they may see themselves negatively affected by governmental default setting. On one hand, to some homeowners, default setting may appear like too much ‘paternalistic’ government intervention. On the other hand, insurance companies may feel restricted in their autonomy of policy design, but could also abuse the system by setting inefficient (i.e. too expensive) flood coverage as a default. Preventing this sort of behaviour, government would have to introduce additional regulation which would then lead further and further away from the idea of using simple, cost-effective nudges.

5.2. Using social norms and peer pressure

Social norms play a vital role for an individual’s attitude towards change, as they influence behaviour by supplying information or even creating peer pressure. If a sufficiently large number of individuals takes the same action, this creates an image about what might be best for others to do. This image leads, due to its high availability, to an increased sense of probability that a risk event might occur, leading to a greater willingness for change (Thaler and Sunstein 2008, OECD 2012). While norms and values do only play a minor role in behavioural economic literature, they have been comprehensively covered in the adaptation debate (see Adger 2003, Renn 2011, Lo 2013 or Wolf et al. 2013). They shape the perception of risks due to climate change while at the same determining which risks are identified as important and what actions should be taken (Kasperson et al. 2003). An effective way of using social norms for behaviour change is to inform individuals about desirable behaviour of others, possibly by emphasizing the real statistical probability of different risks in order to counteract the effects of heuristics.

Social norms could be made use of for example in campaigns with leaflets asking homeowner about what they are doing to improve the city’s climate (especially on hot days) and mentioning measures that other individuals have (or maybe might have) already undertaken in the district, e.g. installing green roofs, swapping the air conditioning for proper insulation, watering the trees in front of the house or making sure there aren’t any small puddles of water for mosquitos to breed in. Similar approaches could be taken to sensitize other entities for adaptation measures, e.g. at the start of summer, municipal health offices could contact retirement homes and inform them about preventive measures that others have taken to ensure excellent care during heat waves (e.g. ‘We recommend having additional personnel present at days with temperatures above 30°C. 70% of retirement and nursing homes in your area have already made good experiences with this precaution.’). However, it is important to keep in mind that when people learn that their actions are better than the social norm, this can also lead to an effort reduction (known as the boomerang effect; Institute for Government 2010). Furthermore, the way in which information is presented can influence the effect of social norms (see framing choices effectively).

To make further use of peer pressure and the importance of social networks and role models, insurance companies could offer incentives, such as gifts or reduced prices for those purchasers of natural hazard insurance who recommend the purchase to at least five of their friends. This mechanism can of course also be employed when promoting other adaptation options, e.g. the download of an app that warns against natural hazards.

5.3. Adequate framing of choices

Choosing the right way of communicating not only the necessity but also possible measures for private adaptation to climate change is crucial for changing behaviour that is locked in by behavioural barriers. One of the most important levers in this area is framing – the way in which information is presented. Framing can be very effective, as it can be used for a shift of the reference point in order to make use of loss aversion to motivate adaptation action. An explanation of the effectiveness of framing is given by Thaler and Sunstein (2008: 37): as people’s ‘Reflective System does not do the work that would be required to check and see whether reframing the questions would produce a different answer’. This means that framing can be a powerful nudge and has therefore, to be used with caution. Framing, in the context of climate change adaptation, can be considered a barrier in some cases but if properly used, can more often be applied as a very efficient tool to influence behaviour (Gowdy 2008). However, policy-makers have to consider that whether or not intended, they will always frame the information they give out and therefore always have to be aware of possible intended or unintended effects of framing. A comprehensive literature overview on the effects of framing in the health sector has shown that it is difficult to make general recommendations in this realm (Akl et al. 2011) and, as framing of information is a very delicate matter, more research into it is needed.

Furthermore, structured choice, e.g. assigning adaptation measures to different categories, can be used to avoid choice-overload. It can further promote decision-making by highlighting high quality choices, presenting choices in an order favouring the desired choice or even removing (choice-editing) undesired options (defra 2008, Deloitte 2012). More simplicity is useful as the attention of individuals is much more likely to be drawn to things they can understand (Institute for Government 2012). Structured choice plays an important role for adaptation by emphasizing the importance of structuring and limiting the selection of adaptation measures presented to private actors in information campaigns or online tools and thereby reducing procrastination of adaptation action.

Whereas findings on framing can be somewhat ambivalent, they are clear in the case of structured choice. Especially developers of decision support tools should therefore seek to present adaptation information in a well-structured way, offering filtering options for different adaptation needs. Furthermore, they should only present a well-chosen selection of best or good practice examples for users to choose from, completely cropping inferior measures.

5.4. Establishing adaptation commitments and providing feedback

An additional lever for behaviour change in an adaptation context, combining different approaches identified by Osbaldiston and Schott (2012), is the establishment of commitments that help overcome inertia. Asking people about their intentions prior to decision making can influence preferences by making dimensions salient that would otherwise have been considered less important (priming) and thereby increasing their willingness to act (Shafir 2008). This effect can be strengthened by questioning people on the exact point in time and manner in which they want to carry out their action (Thaler and Sunstein 2008). Furthermore, goal setting has been identified as an effective mean to induce motivation and the more stringent a goal is set, the more effective it becomes. The provision of feedback itself can be sufficient to induce behaviour change, but becomes even more effective, when combined with other tools (Osbaldiston and Schott 2012). Feedback can for example compare current actions to past actions or inform on money saved or rather losses averted due to a certain action (OECD 2012).

In an adaptation context, feedback could be used by regularly informing people about their current adaptation progress. Furthermore, provision of feedback on whether or not intentions and actual behaviour are in line with each other can be one of the most important levers for bringing about behavioural change. This makes use of an effect called cognitive dissonance – an aversion towards observed discrepancies between intentions and actual behaviour. Making people aware of these

inconsistencies does, in most cases², lead to a correction of behaviour (Osbaldiston and Schott 2012).

A possible way to make use of these mechanisms can be the establishment of ‘adaptation pacts’, for examples in a group of districts within a city or among a group of cities, in which entities voice their intentions, establish goals and receive regular feedback from a third party or each other on how they are meeting their goals and living up to their intentions.

5.5. Behaviourally informed incentives

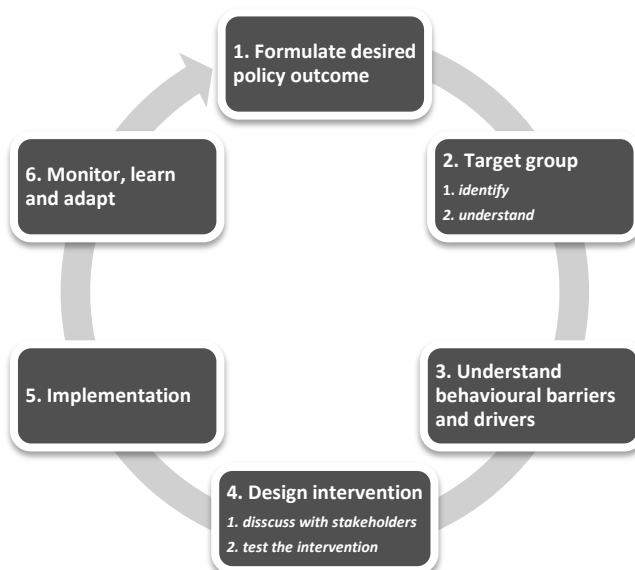
Incentives (e.g. remuneration, promotion or acknowledgement) are one of the most commonly used instruments for behaviour change. Even though the application of incentives is primarily based on neoclassical assumptions, including homo oeconomicus, there are some aspects from behavioural economics that have to be considered when designing and implementing incentives. According to a report by Deloitte (2012), incentives have to be put in place in the right magnitude and the right time in order to achieve their goal, as people are generally focused on the present and, due to hyperbolic discounting, prefer smaller immediate payoffs to larger payoffs in the future. Furthermore, incentives should ‘reward heart and soul before the wallet’ (Deloitte 2012: 6) in order to account for the affect heuristic and the potential crowding-out of intrinsic motivation. Incentives can thereby be a powerful tool to overcome inertia by giving people the needed motivation for change from the status-quo. Behaviourally informed adaptation support can make use of people’s bounded self-interest and altruism without having to set monetary incentives, as long as adaptation action brings benefit to a larger group. For example, homeowners could be motivated to set up cesspits through information campaigns, which emphasize that such measures will not only reduce flood-risks for themselves but also for others in their neighbourhood.

Discussing behavioural determinants of the effectiveness of classical, purely monetary incentives, Thaler and Sunstein (2008) emphasize that, due to the availability heuristic, salience of incentives is important. If people do not notice monetary incentives they face, they will not have any effect on their decisions. This means that such incentives have to be communicated directly (e.g. immediate display of power costs). Flood insurance policies can include monetary incentives on adaptive action by private actors, such as the purchase of flood barriers for their homes. In order to make these incentives as effective as possible, insurance companies do not only have to inform homeowners about the general existence of the respective cost reduction scheme and furthermore, communicate approaches for the implementation of appropriate adaptation actions, but also have to give prompt feedback after the implementation of the adaptation action, e.g. by highlighting cost reductions on the next insurance invoice. However, if private adaptation does also benefit others, it is important to keep in mind that monetary incentives might crowd-out intrinsic motivation for adaptive action, thereby becoming subject to the crowding-out effect.

² In some cases it can also lead to a change of beliefs.

6. Framework for designing interventions

When taking up one of the actions sketched-out in section 5 or when designing new interventions that are aiming to overcome behavioural barriers in adaptation to climate change, a thorough investigation of the target group addressed is required as a basis for an effective intervention. Based on different publications on behavioural change (Werner et al. (2009), Institute for Government (2010) and Deloitte (2012)), the authors suggest a general framework for the design and implementation of interventions for behaviour change in adaptation to climate change:



1. The first step in designing behaviourally informed interventions is the formulation of the desired policy outcome (e.g. increase amount of green space on private ground in the area by 15%).
2. The impact of a behavioural intervention is highly dependent on its target group. The second step in a framework for designing such interventions should therefore be the identification and understanding of the target group.
 - 2.1 Important questions for the identification of the target group concern whose behaviour should be changed and how attitudes and motivations differ between groups. Identifying the target group (e.g. residents in district with high heat stress) is a prerequisite to understanding the group.
 - 2.2 Any instrument aiming at behavioural change has to be based on an understanding of the behaviour it wants to change. The context people find themselves in (e.g. budget constraints and perception of climate change) shapes their options and affects their ability of selecting them. Behaviour is not only influenced by behavioural anomalies, but needs, desires and priorities play an equally important role. A careful analysis of different citizen types (see Figure 1) can be helpful in investigating behaviour.

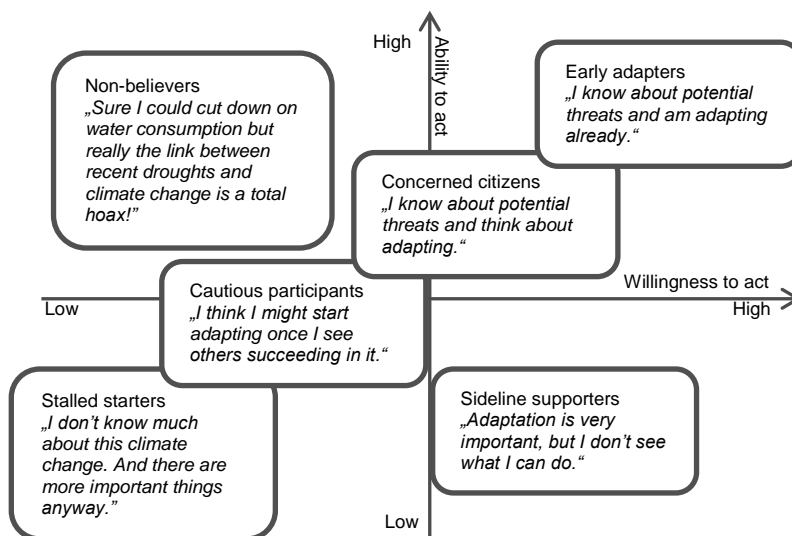


Figure 1: Potential target groups (inspired by Institute for Government 2010: 50)

3. The previous sections have provided a comprehensive overview of behavioural barriers and drivers that can affect citizens’ willingness and ability to adapt to a changing climate. Based on a deep knowledge of the target group, such barriers and drivers have to be identified and understood (e.g. levels of low risk perception and inertia to implement preventive action).
4. Based on an understanding of needs, desires, priorities as well as behavioural barriers and drivers of the target group, an appropriate intervention can now be developed (e.g. designing a leaflet campaign that presents actions that neighbours or people from another city have taken on their premises to improve the city climate).
 - 4.1 Behaviour change can be a controversial topic. Feelings of being manipulated or questions on the legitimacy of governmental intervention might arise among the target groups or observers. These issues should be addressed proactively (e.g. by involving different members or representatives of the target group in the design of the intervention).
 - 4.2 Furthermore, in order to minimize the potential for undesired effects of the intervention, it should be tested with selected members of the target group (e.g. by presenting the leaflets to selected residents) and subsequently optimised. The effects of behaviourally informed interventions can vary largely depending on the target group and other external factors. Therefore, each intervention should be tested using randomised controlled trials before being applied to the entire target group.
5. The next step is the implementation of the carefully designed and tested intervention (e.g. distributing the leaflets to the residents).
6. Interventions can have effects that differ from those previously intended and can be subject to interactions with other policy measures. Due to the fact that even well designed interventions can miss their target or lose effectiveness over time, feedback loops and a constant process of reviewing are necessary (e.g. interviewing selected residents about how they perceived the leaflets and observe what actions are taken, also inquiring about the motivations for actions taken). Thus, an evaluation of the intervention should be based on new findings and should take place at appropriate intervals. Policy measures have to be based on a sound knowledge of behavioural determinants and

accordingly, good evaluation is a crucial element to enhance the evidence base. The presented framework can of course be applied to a variety of other (behaviourally informed) interventions not concerned with climate change adaptation as well.

7. Propositions for further research

Instead of making assumptions on how different actors might behave, behavioural economics observe what people do and models their behaviour based on these observations. Even though this paper has presented a number of recommendations that can be put into practice, in order to gain a better understanding of the implications of behavioural economics in the field of climate change adaptation, a broader scientifically sound as well as observation- or experiment-based understanding is needed. Many concepts in behavioral economics have been developed based on results of small scale experiments. But, in order to achieve robust results for policy-making, behavioral economic research has to be transferred to a larger scale.

Particularly relevant research questions to pursue are the following:

- Which behavioral barriers play the most important role for adaptation to climate change?
- How do different heuristics or biases interact in a decision-making process?
- What is the importance of behavioral barriers to adaptation compared to other barriers (e.g. lack of sufficient funds)?
- How can existing instruments be improved based on findings from behavioral economics?
- How can the identified behavioral anomalies be efficiently transferred to policy-instruments?
- How effective are different behaviorally informed policy measures?

In order to answer these questions, two elements are needed. On the one hand, different heuristics and different theories from the behavioral economics nexus have to be brought together in a systematic manner. Furthermore, and even more importantly, different behavioral anomalies have to be analyzed for interactions and interdependencies. On the other hand, empirical observations and experiments, especially in an adaptation context, are needed for a statistically valid evaluation of the effects of behaviorally informed interventions in reality. Due to the fact that the outcomes of behavioral interventions can often be determined by slight changes to the intervention (e.g. different approaches of framing a message), intervention-design has to be very specific and has to be rigorously tested in order to ensure its effectiveness. In the UK, randomized control trials have proven to be a very efficient tool to verify the robustness of statements on the effect of behaviorally informed interventions. By introducing a randomly assigned control group, randomized controlled trials allow for a comparison of the effectiveness of one or several new interventions against the status-quo (and each other). Thereby, most external factors that would otherwise affect an evaluation of the intervention's effectiveness can be ruled out and the most effective intervention can be determined. This approach is very much in line with the Institute for Government's call for an application of "[t]he same rigour that is used to evaluate the effectiveness and cost-effectiveness of health technologies and, increasingly, public health interventions [...] to behaviour change interventions" (2010: 56). Indeed, intensified collaborations between policy-makers and the scientific community could be a powerful tool to improve the effectiveness of behaviourally informed interventions, especially when monitoring and evaluating the outcomes.

8. Literature

- Adger, W. Neil, Suraje Dessai, Marisa Goulden, Mike Hulme, Irene Lorenzoni, Donald R. Nelson, Lars O. Naess, Johanna Wolf, Anita Wrefor 2008: Are there social limits to adaptation to climate change? In: *Climatic Change* 93, 335-354.
- Adger, W.N., 2003: Social capital, collective action, and adaptation to climate change. In: *Journal of Economic Geography* 79, 387-404.
- Agrawala, S. and S. Fankhauser 2008: *Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments*. OECD, Paris.
- Akl E. A., A.D. Oxman, J. Herrin, G.E. Vist, I. Terrenato, F. Sperati, C. Costiniuk, D. Blank and H. Schünemann 2011: Framing of health information messages (Review). In: *The Cochrane Library* 12.
- Baker, E. J. 2010: Hurricane Preparedness in Florida Households in 2010. Florida Division of Emergency Management
- Baron, J. and I. Ritov 2004: Omission bias, individual differences, and normality. In: *Organizational Behavior and Human Decision Processes* 94, 74–85.
- Berrang-Ford, L. J. D. Ford and J. Paterson 2010: Are we adapting to climate change? In: *Global Environmental Change* 21:1, 25-33.
- Bichard, E. and A. Kazmierczak 2009: Resilient Homes: Reward-based methods to motivate householders to address dangerous climate change. Available online from: http://www.salford.ac.uk/__data/assets/pdf_file/0019/9622/report_FINAL_160909.pdf
- Bichard, E. and A. Kazmierczak 2012: Are homeowners willing to adapt to and mitigate the effects of climate change? In: *Climatic Change* 112, 633–654.
- Biesbroek, R., K. Termeer, P. Kabatz and J. Klostermann 2009: Institutional governance barriers for the development and implementation of climate adaptation strategies. Available online from: <http://www.earthsystemgovernance.org/ac2009/papers/AC2009-0044.pdf>
- BMF 2010: Klimapolitik zwischen Emissionsvermeidung und Anpassung – Gutachten des Wissenschaftlichen Beirats beim Bundesministerium der Finanzen. Available online from: http://www.bundesfinanzministerium.de/Content/DE/Standardartikel/Ministerium/Geschaefsbereich/Wissenschaftlicher_Beirat/Gutachten_und_Stellungnahmen/Ausgewaehlte_Texte/0903111a3002.pdf?__blob=publicationFile&v=2
- British Environment Agency 2009: Flooding in England: A national assessment of flood risk. Available online from: <http://publications.environment-agency.gov.uk/PDF/GEHO0609BQDS-E-E.pdf>
- Burger, J. M., and M. L. Palmer 1992: Changes in and generalization of unrealistic optimism following experiences with stressful events: Reactions to the 1989 California earthquake. *Personality and Social Psychology Bulletin* 18, 39-43.
- Business Wire 2009: Mason-Dixon Poll Reveals Residents of Costal States Grossly Unprepared for 2009 Hurricane Season. Available online from: <http://www.businesswire.com/news/home/20090528005801/en/Mason-Dixon-Poll-Reveals-Residents-Coastal-States-Grossly>, last access 14.12.2013.
- Clar, C., A. Prutsch and R. Steurer 2011: Barriers and guidelines in adaptation policy making: Taking stock, analysing congruence and providing guidance. Available online from: <http://www.adaptgov.com/wp-content/uploads/2012/03/Clar-Barriers-guidelinesinadaptation-policy-A86-Tscience.pdf>

- Damasio, A. R. 1994: *Descartes' error: Emotion, reason, and the human brain*. New York: Avon.
- Darnton, A. 2008: Reference Report: An overview of behaviour change models and their uses. Available online from: http://www.civilservice.gov.uk/wp-content/uploads/2011/09/Behaviour_change_reference_report_tcm6-9697.pdf
- defra 2004: The Appraisal of Human-Related Intangible Impacts of Flooding – Technical Report. Available online from: http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2005_1855_TRP.pdf
- defra 2008: A Framework for Proenvironmental Behaviours. Available online from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69277/pb13574-behaviours-report-080110.pdf
- defra 2010: Understanding and influencing behaviours: a review of social research, economics and policy making in Defra. Draft paper for discussion. Available online from: <http://archive.defra.gov.uk/evidence/series/documents/understand-influence-behaviour-discuss.pdf>
- Defra 2013a: Reducing the threats of flooding and coastal change. Available online from: <https://www.gov.uk/government/policies/reducing-the-threats-of-flooding-and-coastal-change>, last access: 13.12.2013.
- defra 2013b: Flood insurance agreement reached. Available online from: <https://www.gov.uk/government/news/flood-insurance-agreement-reached>, last access 13.08.2013.
- Deloitte 2012: From the bottom up: Influencing citizen behaviours to achieve policy outcomes. Available online from: <http://www.deloitte.com/assets/Dcom-UnitedKingdom/Local%20Assets/Documents/Industries/GPS/uk-gps-influencing-citizen-behaviours-oct2012.pdf>
- Deutschländer and Dalelane 2012: Auswertung regionaler Klimaprojektionen für Deutschland hinsichtlich der Änderung des Extremverhaltens von Temperatur, Niederschlag und Windgeschwindigkeit. Available online from: http://www.dwd.de/bvbw/generator/DWDWWW/Content/Presse/Pressekonferenzen/2012/PK__30__10__12/Studie__20121030,templateId=raw,property=publicationFile.pdf/Studie_20121030.pdf
- Diamond, P. and V. Hannu 2007: *Behavioural Economics and its Applications*. Princeton University Press, Princeton and Oxford.
- EEA 2012: Climate change, impacts and vulnerability in Europe 2012. Available online from: <http://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012>
- European Commission 2012: Future Brief: Green Behaviour. Science for Environment Policy. Available online from: <http://ec.europa.eu/environment/integration/research/newsalert/pdf/FB4.pdf>
- Frey, Bruno S. 2008: Motivation crowding theory — a new approach to behaviour. In: Productivity Commission 2008: *Behavioural Economics and Public Policy*, Canberra
- Friedman, Sam J. 2013: Is It Time for Opt-Out Flood Insurance? Available online from: <http://www.propertycasualty360.com/2013/01/30/is-it-time-for-opt-out-flood-insurance>, last access: 23.08.2013.
- Gowdy, J. M. 2008: Behavioral economics and climate change policy. In: *Journal of Economic Behavior & Organization* 68, 632–644.
- Haynes, L., Service, O., Goldacre, B., & Torgerson, D. 2012: *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials*. London: Cabinet Office and Behavioural Insights Team.

- Hepburn, C., S. Duncan and A. Papachristodoulou 2010: Behavioural Economics, Hyperbolic Discounting and Environmental Policy. In: *Environmental and Resource Economics* 46:2, 189-206.
- Huber, D. G. and J. Gullede 2011: Extreme Weather and Climate Change: Understanding the Link, Managing the Risk. Available online from: <http://www.pewclimate.org/publications/extreme-weather-and-climate-change>
- Hulme, M., W.N. Adger, S. Dessai, M. Goulden, I. Lorenzoni, D. Nelson, L.-O. Naess, J. Wolf and A. Wreford 2007: Limits and barriers to adaptation: four propositions. In: *Tyndall Briefing Note* 20, 1-7.
- Institute for Government 2010: MINDSPACE: Influencing behaviour through public policy. Available online from: <http://www.instituteforgovernment.org.uk/publications/mindspace>
- Jones, L. 2010: Overcoming social barriers to adaptation. odi Background Note. Available online from: <http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/6048.pdf>
- Jones, L. and E. Boyd 2011: Exploring social barriers to adaptation: Insights from Western Nepal. In: *Global Environmental Change* 21, 1262–1274.
- Kahneman, D. 2003: A Perspective on Judgment and Choice: Mapping Bounded Rationality. In: *American Psychologist* 58:9, 697–720.
- Kahneman, D. 2011: *Thinking, Fast and Slow*. Penguin Books Ltd., London
- Kasperson, J. X., R. E. Kasperson, N. Pidgeon, P. Slovic 2003: The social amplification of risk: asses fifteen years of research theory. In: Pidgeon, N., Kasperson, R.E., Slovic, P. (Eds.): *The Social Amplification of Risk*. Cambridge University Press, Cambridge, 13–46.
- Lai, C. J., A. Brennanb, H. Chanb and J. Tao 2003: Disposition toward environmental hazards in Hong Kong Chinese: validation of a Chinese version of the environmental appraisal inventory (EAI-C). In: *Journal of Environmental Psychology* 23, 369–384.
- Lehto, J. 2010: Risk tolerance and myopic behaviour – evidence from Finnish retail investors. Helsinki School of Economics Department of Accounting and Finance Master’s Thesis. Available online from: http://epub.lib.aalto.fi/fi/ethesis/pdf/12245/hse_ethesis_12245.pdf
- Linville, P. W., G. W. Fischer 1991: Preferences for separating and combining events: a social application of prospect theory and the mental accounting model. In: *Journal of Personality and Social Psychology* 60, 5–23.
- Lipson, M. 2008: *Climate Change Adaptation: the psychonomics of flood risk*. Imperial College Centre for Environmental Policy.
- Lo, A. Y. 2013: The role of social norms in climate adaptation: Mediating risk perception and flood insurance purchase. In: *Global Environmental Change* 2013, Article In Press.
- Loewenstein, G. and D. Prelec 1992: Anomalies in Intertemporal Choice: Evidence and Interpretation. *The Quarterly Journal of Economics* 107:2, 573-597.
- McCarthy, J.; O. F. Canziani; N. A. Leary; D. J. Dokken and K. S. White 2001: *Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge
- Mechler, R. and Z.W. Kundzewicz 2010: Assessing adaptation to extreme weather events in Europe. In: *Mitigation and Adaptation Strategies for Global Change* 15:7, 611-620.
- Mendelsohn, R. 2000: Efficient Adaptation to Climate Change. In: *Climatic Change* 45:3/4, 583-600.
- Moser, S. and J. A. Ekstrom 2010: A framework to diagnose barriers to climate change adaptation. In:

- Proceedings of the National Academy of Sciences 107:51, 22026-22031.
- Mullainathan, S. and R. H. Thaler 2000: Behavioral Economics. NBER Working Papers 7948, National Bureau of Economic Research.
- Myagkov M. and C. Plott 1997: Exchange Economies and Loss Exposure: Experiments Exploring Prospect Theory and Competitive Equilibria in Market Environments. In: The American Economic Review 87:5, 801-828.
- Oberhuber, N. 2013: Zwangsversichert gegen die Flut. Available online from: <http://www.zeit.de/wirtschaft/2013-06/hochwasser-versicherungen>, last access: 23.08.2013
- OECD 2012: An Inventory of Examples in Behavioural Economics which are Relevant for Environmental Policy Design. Working Party on Integrating Environmental and Economic Policies, Paris
- OnePoll 2012: Flood Risk Area. Available online from: , http://www.ambiental.co.uk/riskcentral/wp-content/uploads/1000/12/RC_One_Poll_Flood_Risk_Area_Survey.xlsx, last access: 13.08.2013
- Osbaldiston R. and J. P. Schott 2012: Environmental Sustainability and Behavioral Science: Meta-Analysis of Proenvironmental Behavior Experiments. In: Environment and Behavior 44:2, 257-299.
- Osberghaus, D., C. Schwirplies and A. Ziegler 2013: Klimawandel in Deutschland: Risikowahrnehmung, Wissensstand und Anpassung in privaten Haushalten – Ergebnisse einer Befragung Deutscher Haushalte 2012. Available online from: http://www.rwi-essen.de/media/content/pages/publikationen/sonstige/Eval-Map-Werkstattbericht_Klimawandel-in-Deutschland.pdf
- Osberghaus, D.; E. Finkel and M. Pohl 2010: Individual Adaptation to Climate Change: The Role of Information and Perceived Risk. Centre for European Economic Research (ZEW) Discussion Paper No. 10-061.
- Parry, M. L., O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson (eds) 2007: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.
- Patt A.G. and D. Schröter. 2008: Climate risk perception and challenges for policy implementation: evidence from stakeholders in Mozambique. In: Global Environmental Change 18, 458-467
- Pollitt, M. G. and I. Shaorshadze 2011: The Role of Behavioural Economics in Energy and Climate Policy. ESRC Electricity Policy Research Group, University of Cambridge
- Productivity Commission 2012: Barriers to Effective Climate Change Adaptation, Report No. 59, Final Inquiry Report, Canberra.
- Renn, O., 2011: The social amplification/attenuation of risk framework: application to climate change. Wiley Interdisciplinary Reviews. In: Climate Change 2, 154–169.
- Schimank, U. 2005: Die Entscheidungsgesellschaft. Komplexität und Rationalität der Moderne. Verlag für Sozialwissenschaften, Heidelberg
- Shafir, E. 2008: A behavioural background for economic policy. In: Productivity Commission: Behavioural Economics and Public Policy. Roundtable Proceedings. Canberra: Productivity Commission, 9-26.
- Slovic, P. and E. U. Weber 2002: Perception of Risk Posed by Extreme Events. Center for Decision Sciences (CDS) Working Paper, Columbia University.
- Slovic, P., M. Finucane, E. Peters, and D. G. MacGregor 2004: Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality. In: Risk Analysis 24:2, 311-322.
- Stern, N. 2007: The economics of climate change: the Stern review. Cambridge University Press,

Cambridge.

- Sunstein, C. R. 2003: Terrorism and Probability Neglect. In: *The Journal of Risk and Uncertainty* 26:2/3, 121-136.
- Sunstein, C. R. 2005: The Availability Heuristic, Intuitive Cost-Benefit Analysis, and Climate Change. John M. Olin Law & Economics Working Paper No. 263. University of Chicago, Chicago.
- Sunstein, C. R. 2012: Impersonal Default Rules vs. Active Choices vs. Personalized Default Rules: A Triptych. Regulatory Policy Program Working Paper RPP-2012-17. Cambridge, MA: Mossavar-Rahmani Center for Business and Government, Harvard Kennedy School, Harvard University.
- Terpstra, Teun 2011: Emotions, Trust, and Perceived Risk: Affective and Cognitive Routes to Flood Preparedness Behavior. In: *Risk Analysis* 31:10, 1658-1675
- Thaler, R. H. 1980: Toward a positive theory of consumer choice. In: *Journal of Economic Behavior and Organization* 1:1, 39–60.
- Thaler, R. H. and C. R. Sunstein 2008: *Nudge – Improving Decisions About Health, Wealth and Happiness*. Penguin Books Ltd., London
- Trenberth, K. E., J. Meehl, J. Masters and R. Sommerville 2011: Current Extreme Weather and Climate Change. Available online from: <http://climatecommunication.org/wp-content/uploads/2011/09/Extreme-Weather-and-Climate-Change.pdf>
- Trenberth, K. E., P. D. Jones, P. Ambenje, R. Bojariu, D. Easterling, A. Klein Tank, D. Parker, F. Rahimzadeh, J.A. Renwick, M. Rusticucci, B. Soden and P. Zhai 2007: Observations: Surface and atmospheric climate change. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge and New York: Cambridge University Press, 235-336.
- Tversky, A. and D. Kahneman 1974: Judgment under Uncertainty: Heuristics and Biases. In: *Science, New Series* 185:4157, 1124-1131
- Unilever 2011: Inspiring Sustainable Living: Expert insights into consumer behaviour & Unilever's Five Levers for Change. Unilever Sustainable Living Program. Available online from: http://www.unilever.com/images/slp_5-Levers-for-Change_tcm13-276832.pdf
- Vohs, K. D., N. L. Mead, and M. R. Goode 2008: Merely Activating the Concept of Money Changes Personal and Interpersonal Behavior. In: *Current Direction in Psychological Science* 17:3, 208-212.
- Weimann, J. 2010: Politikberatung und die Verhaltensökonomie: Eine Fallstudie zu einem schwierigen Verhältnis. Otto von Guericke Universität Magdeburg Faculty of Economics and Management Working Paper No. 13/2010
- Welsch, H. and J. Kühling 2011: Are Pro-Environmental Consumption Choices Utility Maximizing? Evidence from Subjective Well-Being Data. In: *Ecological Economics* 72, 75-87
- Werner, J., D. Krömker, T. Grothmann and J. Werg 2009: Klimaschutz und Klimaanpassung als Verhaltensänderung. In: Grothmann, T., D. Krömker, A. Homburg and B. Siebenhühner (eds.) 2009: *Kyoto^{PLUS}-Navigator Praxisleitfaden zur Förderung von Klimaschutz und Anpassung an den Klimawandel – Erfolgsfaktoren, Instrumente, Strategie*. Downloadfassung April 2009. Available online from: <http://www.ERKLIM.de>
- Wilkinson, N. 2007: *An Introduction to Behavioral Economics: A Guide for Students*. New York: Palgrave MacMillan.
- Wolf, J., I. Aliche, and T. Bell: 2013: Values, climate change, and implications for adaptation: evidence from two communities in Labrador, Canada. In: *Global Environmental Change* 23, 548–562.

Abbildung: lizenziertes Bildmaterial von gettyimages

© 2013 **adelphi**

adelphi

Caspar-Thyß-Straße 14a
14193 Berlin

T +49 (0)30-89 000 68-0 www.adelphi.de
F +49 (0)30-89 000 68-10 office@adelphi.de