Chapter 2
Perceptions of Catastrophic Climate Risks

Wouter Botzen

Abstract Many climate change-related risks, such as more frequent and severe natural disasters, can be characterised as low-probability/high-consequence (LP/HC) events. Perceptions of LP/HC risks are often associated with biases which hamper taking action to limit these risks, such as underestimation of risk, myopia, and the adoption of simplified decision heuristics. This chapter discusses these biases and outlines key elements of policies to overcome them in order to enhance climate action.

2.1 Introduction

Climate change is projected to have severe societal impacts and economic consequences around the world (IPCC, 2014). The consequences of climate change are far reaching and will be experienced by a large diversity of economic sectors and population groups. For example, these consequences encompass increases in the frequency and/or severity of various extreme weather events and related losses from natural disasters in many regions around the world (IPCC, 2012; Botzen et al., 2019a). Moreover, climate change is expected to have impacts on human health as well as on the agriculture, tourism, industry, and financial sectors (Tol, 2018).

Since at least part of the climate change caused by increasing concentrations of greenhouse gases in the atmosphere can no longer be avoided, climate change adaptation policies and measures must be put in place to limit societal impacts from the aspects of global warming that will inevitably occur (Mauritsen & Pincus, 2017). If around the world stringent climate policies are implemented in the coming years to drastically reduce greenhouse gas emissions, then there is still a chance that global warming can be limited to meet the objectives outlined in the 2015 Paris Agreement to keep the global average temperature rise to well below 2 °C above pre-industrial

W. Botzen (✉)
Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam & Utrecht University School of Economics, Amsterdam, The Netherlands
e-mail: wouter.botzen@vu.nl

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levels (IPCC, 2018). However, this objective can only be met if current climate change mitigation policies become much more ambitious around the world as there are large gaps between countries' intentions to reduce greenhouse gas emissions and what is actually needed to meet the Paris targets (Rogelj et al., 2016). The required reductions in greenhouse gas emissions imply that a fundamental transformation of consumption and production processes is needed to move towards a low-carbon economy which produces net zero emissions between 2040 and 2050 (IPCC, 2018).

Section 2.1 explains why perceptions of catastrophic risks matter. Section 2.2 discusses several of the main biases which influence perceptions of risks associated with climate change and impact individual decision making about climate change mitigation and adaptation actions. This is followed in Sect. 2.3 by a discussion of climate policy strategies which work with, instead of against, these behavioural biases to stimulate climate action. Section 2.4 concludes.

2.2 Why Perceptions of Climate Risks Matter

The diversity of climate change impacts for which adaptation measures are needed and the systemic changes required to successfully move towards a low-carbon economy imply that a large variety of actors should be involved in climate change adaptation and mitigation strategies. Each of these actors, such as firms, households, and governments, have different roles to play with distinct responsibilities. For instance, in climate change mitigation policies which aim to reduce greenhouse gas emissions, governments have a central role in designing and enforcing regulations and putting a price on carbon, either through carbon taxes or emission trading systems. The reason is that the public good nature of the atmosphere implies there are strong incentives for companies and individuals to free ride on emission reductions by others, whilst problems with carbon leakage and rebound effects of energy savings also imply that voluntary action by individuals and firms is unlikely to be effective in solving climate change (van den Bergh et al., 2020).

However, in the end it are the individual households and firms who should take the required steps and measures to reduce emissions and improve energy efficiency, such as switching to renewable energy. Moreover, the implementation of stringent climate policy measures by the public sector is likely to depend on the support of voters and lobbying by firms.

Since climate change is a global issue, not only is action by national governments needed, but international collaboration is critical (Nordhaus, 2015). Regarding climate change adaptation policies, governments are crucial in the financing or provision of measures related to the public good, such as improved infrastructure for flood protection. Furthermore, governments are well positioned to enforce regulations such as building codes which enhance resilience to extreme weather, and they can, for example, guide adaptation practises, like agricultural policies, through subsidies. Adaptation measures that limit impacts from climate chance often bring

private benefits by lowering risks for households, farmers and companies that implement these measures. This implies that these private agents also have a responsibility and financial interest in limiting the climate change risks they face, for instance, by taking steps to reduce damage to their properties from natural disasters and obtaining financial protection by purchasing insurance against these risks.

Therefore, individual perceptions of the risks associated with climate change are likely to be an important driver of support for adaptation and mitigation policies and to influence the actions individuals take to prevent or mitigate the impacts of global warming. Many of these climate change-related risks, such as more frequent and severe natural disasters, can be characterised as low-probability/high-consequence (LP/HC) events. Decades of research in psychology and behavioural economics have shown that individuals have challenges understanding LP/HC risks and that they do not necessarily perceive them the same way an expert would (Slovic, 2000). Individual decision making about LP/HC climate change risks appears to be based on simplified decision heuristics, and individual behaviour is found to be associated with systematic biases which hamper being adequately prepared for these risks (Kahneman, 2011; Meyer & Kunreuther, 2017). The presence of such biases is supported by studies showing that individual perceptions of LP/HC risks associated with climate change systematically deviate from expert assessments of these risks (Botzen et al., 2015; Mol et al., 2020).

Many residents of disaster-prone areas fail to take cost-effective measures to limit the impacts of these disasters and do not purchase insurance against these risks, even when premiums are close to actuarially fair levels or subsidized (Kunreuther, 1996; Botzen, 2013). These observations conflict with principles of economic rationality, and highlight the need to understand behavioural biases that lead to suboptimal preparedness for climate change to guide the design of effective climate policy.

2.3 Biases and Heuristics in Decision-Making

Suboptimal climate action may be explained by insufficient support for climate policy that is related to climate change perceptions, a lack of individual support for the common good by insufficiently reducing one's own carbon footprint, and a failure to adequately prepare for risks associated with climate change, such as natural disasters. This section starts with the first topic that is often related to support for public sector climate policy, although individual perceptions of climate change also influence their own actions to reduce greenhouse gas emissions and adapt to climate change impacts.

Although awareness about climate change has generally increased around the world during the last several decades, perceptions amongst citizens are not always in line with expert consensus (Capstick et al., 2015). This is, for instance, due to the presence of a large group of so-called climate sceptics (Whitmarsh, 2013). Many studies have examined how perceptions of climate change differ amongst

sub-groups of the population, showing, for example, that political affiliation is an important determinant, with more conservative individuals having lower perceptions of climate change-related risks than liberals do (e.g. Botzen et al., 2016). This may be caused by differences in underlying individual values, ideologies, and worldviews which influence attitudes towards climate change.

A meta-analysis of the literature on this topic by Hornsey et al. (2016) discusses empirical evidence for these drivers of climate change perceptions. In particular, they show that individuals who place a high importance on the natural environment are more likely to believe that climate change is real. With regard to cultural aspects, people with relatively individualistic and hierarchical values prefer the status quo and are likely to doubt that industry threatens the environment, meaning they do not believe in climate change (Hornsey et al., 2016). Opposite beliefs that industry does pose a threat are held by people with egalitarian and communitarian values (Hornsey et al., 2016). Moreover, climate change scepticism has been associated with free market ideologies (Heath & Gifford, 2006). These individual beliefs in climate change are likely to influence public support for climate change mitigation policies; however, understanding their underlying causes can aid in the design of communication messages which enhance this support (Sect. 2.3).

Moreover, individual support for adaptation measures, and actors' willingness to take such steps to limit the impacts of climate change, is likely to depend on people's perceptions of specific risks associated with climate change, such as natural disasters. A substantial body of literature has shown that individuals have difficulties understanding and processing information about low-probability/high-consequence (LP/HC) risks (Kunreuther et al., 2001). This also applies to risks associated with climate change, such as the probability of and losses due to natural disasters. As an illustration, Botzen et al. (2015) and Mol et al. (2020) have compared individual perceptions of the probability of and the potential damage from flooding regarding households in flood-prone areas in the United States and the Netherlands, respectively. They have observed that even when an error margin of 50% is allowed, less than 25% have correct perceptions of the flood probability, and about 50% or fewer individuals have correct perceptions of potential flood damage. Underestimation of natural disaster risks is commonly viewed both as an explanation for a failure to take cost-effective risk-reduction measures by inhabitants of areas prone to natural disasters (Kunreuther, 1996) and as an obstacle to implementing climate change adaptation measures (van Valkengoed & Steg, 2019). This observed lack of disaster preparedness conflicts with principles of economic rationality of welfare maximizing agents. Individuals appear to regret not taking preparedness actions before disasters occur, since after personally experiencing a natural disaster people change their behaviour and start taking measures to limit impacts from future disasters (Bubeck et al., 2012). Individual perceptions of LP/HC risks and decision-making processes about these risks are associated with biases and heuristics, which can explain a lack of action to reduce impacts from LP/HC events before they occur. Here, I discuss some of the main biases which contribute to insufficient preparedness for risks associated with climate change and may hamper climate change mitigation actions. These can be categorised as simplification,

availability, finite pool of worry, myopia, and herding (Kunreuther, 2018; Botzen et al., 2021).

Simplification Instead of making rational assessments of the full distribution of risks which individuals face, many people tend to simplify their assessments of risks due to bounded rationality and limited cognitive abilities to process them. For instance, many people tend to treat low probabilities as being zero, which implies that they do not consider taking action to reduce the risks. Others tend to overweigh low probabilities in decision making because they are concerned or worried about the risks. This behaviour is consistent with the application of threshold models, in which individuals judge whether a probability is below or above a threshold level of concern (Slovic et al., 1977). Because many risks associated with climate change, such as natural disasters, are LP/HC risks, individuals simplify this low probability to being zero or falling below their threshold level of concern, meaning no risk-reduction action is undertaken (Robinson & Botzen, 2018, 2019).

Availability Many individuals tend to underestimate LP/HC events unless they have personally experienced one, such as a natural disaster. This behaviour is caused by the availability heuristic, which postulates that individuals find it difficult to imagine a disaster occurring if they have not experienced it before (Tversky & Kahneman, 1973). In contrast, after people personally experienced a disaster, they can more easily imagine that it can happen to them again in the future. There is broad empirical support for this availability bias in the context of natural disaster risks by showing that individual perceptions of them (Kellens et al., 2013), as well as preparedness for future natural disasters (Bubeck et al., 2012; Osberghaus, 2017), increase after such a disaster occurs. However, since the probability that an individual personally experiences a disaster is low, the availability bias may contribute to underestimation of natural disaster risks amongst the majority of the population.

Finite Pool of Worry The finite pool of worry means that individuals cannot worry about too many risks at the same time (Capstick et al., 2015). This implies that if concern about one kind of risk increases, concern about other kinds of risks reduces. For instance, substantial declines in concern about climate change were observed in Europe after the 2008 financial crisis and its aftermath, when worries about employment increased (Duijndam & van Beukering, 2020). Given the large health and economic consequences of the current COVID-19 pandemic, the finite pool of worry is likely to result in decreased concern about risks associated with climate change once individuals become more concerned about health and unemployment (Botzen et al., 2021). As a consequence, support for climate policy and individual willingness to take climate change mitigation and adaptation measures is likely to go down.

Myopia Climate change adaptation and mitigation measures often have high upfront costs, as well as benefits which accrue over time in terms of lower risks or savings on energy bills. Individuals are less likely to invest in these measures if they

have short time horizons over which they value future benefits and/or they heavily discount these benefits, meaning they weigh less in current decisions (Gillingham & Palmer, 2014; Botzen et al., 2019b; Gelino & Reed, 2020). This myopic behaviour is especially problematic with climate change, which is often not considered to be salient and rather viewed as a long-term problem. Myopia has the effect that people focus on near-term risks and neglect long-term risks, for which action is delayed. However, a dangerous feature of climate change is that once undesirable catastrophic impacts occur in the future, it may be too late to reverse global warming due to inertia in the climate system.

Herding Under conditions of uncertainty, such as benefits from climate change mitigation or adaptation, individual choices are guided by the behaviour of others. This has been called the herding bias and may be caused by the presence of social norms (Meyer & Kunreuther, 2017). Herding has been observed in individual decisions to prepare for natural disaster risks since individuals are more likely to take measures which limit disaster damage if they know others, like family, friends, or neighbours, have also taken such steps (Bubeck et al., 2013). Moreover, a large body of literature has shown that energy-savings measures are guided by social norms (Frederiks et al., 2015). The herding bias may also indicate fewer climate actions if individuals do not know others in their close social peer group who have taken adaptation and mitigation measures, which is likely given the lack of climate change action implied by the other aforementioned behavioural biases.

2.4 Policies that Work With—Not Against—Behavioral Biases

Effective climate policy strategies should be carefully designed to work with, instead of against, individual risk perceptions and behavioural biases. This can be achieved by a broad package of climate policy measures which combine communication strategies with regulations, financial incentives, and choice architecture (also called behavioural nudges). This section outlines the key elements to be included in such a strategy.

Communication strategies can contribute to building support for climate change adaptation and mitigation policies implemented by the public sector and create awareness about the risks and consequences of climate change to stimulate individual action. Support by citizens for climate change policies may be enhanced by working with individual ideologies and worldviews. Examples are framing pro-environmental climate change policies as a form of patriotism (Feygina et al., 2010) and communicating that transitions to renewable energy are investments in green technology (Bain et al., 2012) and also enhance national energy security (Gromet et al., 2013). These kinds of communication messages can also appeal to individuals

with conservative ideologies and individualistic values who otherwise tend to oppose climate policy.

Furthermore, communication strategies should focus on overcoming the behavioural biases which prevent individuals from adequately preparing for risks associated with climate change, such as natural disasters. To overcome the simplification bias for people who treat low probabilities of experiencing a disaster as zero, communication strategies could frame low probabilities over long time horizons so individuals are less likely to perceive these risks as being below their threshold level of concern. For example, communicating the probability of flooding over a longer time horizon (e.g. a one in four chance of a flood in 30 years) instead of an annual time horizon (a one in 100 chance of a flood per year) can increase demand for protective measures against flooding (Botzen et al., 2016; Chaudhry et al., 2020). Empirical evidence has also shown that communicating the consequences of not preparing for climate change risks, such as the damage one would experience from a flood, can make people pay attention to the risk and demand protection against it (Bradt, 2019). Focussing on such worst-case scenarios may trigger individual concern for a risk and overcome the simplification bias.

A more general recommendation which goes beyond raising awareness of natural disaster risks is to stress health consequences from climate change in communication strategies. The reason is that health risks are salient to people and, for example, were a main cause of the broad public support for the Montreal Protocol to prevent ozone depletion (Pillay & van den Bergh, 2016). Moreover, stressing the link between pandemics and climate change may overcome declining concerns about climate change when worries about health risks increase (due to the current COVID-19 pandemic). This can address the finite pool of worry (Botzen et al., 2021). Climate change and pandemic risks are interlinked since several of the causes of the current pandemic (e.g. unsustainable transport, tourism, and food systems) also contribute to global warming, whilst climate change itself may increase the risks of infectious diseases and pandemics (IPCC, 2014). Creating awareness of this link amongst the general population may cause people to pay more attention to climate change in addition to pandemic risks (which are currently weighing heavily on the public's mind due to the availability bias). Once the memory of experiencing pandemics or natural disasters fades over time, communication policies can work with the availability bias by keeping the memory of such past disasters alive (Garde-Hansen et al., 2017).

To work with the herding bias, communication policies can focus on triggering social norms about energy efficiency and implementing adaptation measures such as preparing for natural disasters. Such social norm nudges can, for instance, inform people about climate change actions undertaken by others or be triggered by giving a seal of approval after certified inspections confirmed that people have taken measures which contribute to climate change mitigation or adaptation (Meyer & Kunreuther, 2017). Regulations and financial incentives can help in ensuring that a sufficient critical mass of people take climate actions, which can be spread further amongst the population by herding. Examples of regulations are building code

policies which require new properties to be protected against the impacts of extreme weather.

Although requiring individuals to take climate change mitigation and adaptation measures may be viewed as being paternalistic and limiting individual free choice, these requirements may be welfare enhancing if they focus on minimum standards that are cost-effective, such insulation of buildings and elevating properties in flood-prone areas to a minimum height above expected flood water levels. Moreover, financial incentives such as carbon pricing can stimulate consumers and businesses to take measures which save energy and reduce greenhouse gas emissions since high carbon production and consumption would be penalised with a higher price (van den Bergh et al., 2020).

A carbon price would address the common good problem associated with reducing one's carbon footprint since taking individual actions to reduce greenhouse gas emissions results in monetary savings for individuals once carbon is priced. In the absence of carbon pricing these benefits would largely accrue to others in the form of lower climate impacts, resulting in suboptimal incentives for individual action.

In the European Union, higher carbon prices can be achieved by restricting carbon emission permits in the European Emission Trading System, which would increase carbon prices, and by expanding the scope of emissions which fall under this system. Implementing a sufficiently high and stable carbon price would send a strong signal to private investors and firms that low-carbon technologies and production processes will pay off in the long run. High carbon prices also limit the myopia bias in energy conservation because they result in short-term savings on energy bills when households invest in energy-efficiency improvements.

Similar financial incentives can be given to individuals who implement adaptation measures which limit natural disaster damage by rewarding such behaviour with discounts on insurance premiums (Botzen et al., 2009; Mol et al., 2018). The myopia bias can be further addressed by allowing individuals to spread the sometimes high upfront costs of climate change mitigation or adaptation measures through low-interest loans. Means-tested subsidies can further overcome affordability problems amongst low-income households taking these measures (Kousky & Kunreuther, 2014).

2.5 Conclusion

Drastic reductions in greenhouse gas emissions are needed around the world if governments aim to meet the climate policy objectives agreed upon in the Paris Agreement. Moreover, some degree of global warming will inevitably occur and cause impacts on a broad variety of economic sectors and on households, such as increasing losses from natural disasters. The systemic changes required to move to a low-carbon economy, as well as the heterogeneity of adaptation measures needed to limit impacts of climate change, imply that climate action is needed from a wide variety of actors, including governments, firms, and individuals.

Individual perceptions of climate change-related risks are an important driver of both support for climate policy by the public sector and individual decision making about implementing mitigation or adaptation measures. However, individual perceptions of low-probability/high-consequence (LP/HC) risks, such as those associated with climate change, are likely to deviate from expert assessments. Moreover, individual behaviour with regard to LP/HC risks has been associated with a variety of biases and heuristics.

This chapter has reviewed several key factors which shape individual perceptions of climate change risks and discussed the main behavioural biases which hamper individual action. Individual perceptions of climate change appear to be largely driven by political ideology, individual values, and cultural aspects. The main behavioural biases which hamper optimal individual responses to climate change include simplification of risk, availability bias due to underestimating risks in the absence of personal experience, finite pool of worry, myopia (focus on near-term risks), and herding behaviour. Understanding individual risk perceptions and behavioural biases can guide the design of policies which work with these perceptions and biases to improve individual climate action.

Finally, I outlined key elements of a package of climate policy measures which combine communication strategies for making people pay attention to climate change risks with regulations and financial incentives to stimulate energy savings, renewable energy use, and adaptation measures. Another element of this broader climate policy package is choice architecture, such as nudges which encourage climate action by working with social norms. These policy proposals can be seen as an extension of moral inclinations of families and firms, such as the stewardship for the natural environment and the climate, by rewarding such pro-environmental behaviour with financial incentives and encouraging others to take action.

Using perspectives from the field of behavioural economics, this chapter has offered suggestions for enabling an upscaling of climate change mitigation and adaptation actions beyond the sub-group of people currently engaged with the issue of global warming. A broader willingness to contribute to solving this problem, based on intrinsic motivations, is urgently needed if policymakers aim to rapidly transit to a low-carbon economy.

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Wouter Botzen is full Professor of Economics of Global Environmental Change at the Utrecht University School of Economics. Moreover, he is Professor of Economics of Climate Change and Natural Disasters, and Head of the Department of Environmental Economics, Institute for Environmental Studies, VU Amsterdam. He is a senior research fellow at the Risk Management and Decision Processes Center at the Wharton School of the University of Pennsylvania. His main research interests are climate change economics with a particular focus on risk, natural disaster insurance, behavioural economics of decision making under risk, and natural disaster risk assessment and management. He has published widely on these themes.