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**Doctoral Thesis**

## Homo irrationalis and climate change mitigation: Behavioral economic approaches to climate-relevant behavior change

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**Homo irrationalis and climate change mitigation – Behavioral economic  
approaches to climate-relevant behavior change**

Inaugural dissertation  
submitted to attain the academic degree  
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at  
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by  
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**Table of contents**

- List of tables.....II
- List of figures..... III
- List of abbreviations ..... IV
- 1. Introduction and background ..... 1
  - 1.1. Climate change as a behavioral problem ..... 1
  - 1.2. The pathway to climate change mitigation and the state of play ..... 3
  - 1.3. Behavioral changes needed to mitigate climate change..... 5
  - 1.4. Climate policy as a driver for behavioral change ..... 8
  - 1.5. Behavioral economics to support climate policy ..... 13
- 2. Research papers ..... 16
  - 2.1. Overview of research papers ..... 16
  - 2.2. Paper 1: Why change does (not) happen: Understanding and overcoming status quo biases in climate change mitigation ..... 17
    - 2.2.1. Summary..... 17
  - 2.3. Paper 2: Does recalling energy efficiency measures reduce subsequent climate-friendly behavior? An experimental study of moral licensing rebound effects..... 18
    - 2.3.1. Summary..... 18
  - 2.4. Paper 3: The benefits of less: The effect of gain framings on the adoption of sufficiency behavior ..... 19
    - 2.4.1. Summary..... 19
- 3. Discussion ..... 20
  - 3.1. Key findings and contributions to theory, method, and practice ..... 20
  - 3.2. Contribution of behavioral economics to climate change mitigation ..... 25
  - 3.3. Limitations and future research outlook ..... 27
  - 3.4. Concluding remarks ..... 30
- References..... 33

## **List of tables**

Table 1: Overview of research papers and publication status .....	16
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## **List of figures**

Figure 6: Overview of the contributions of the research papers to policy making ..... 25

## List of abbreviations

CNRS	Centre National de la Recherche Scientifique (French academic organization that provides a ranking of academic journals in the field of economics and business)
e.g.	Exempli gratia (for example)
et al.	Et alii (and others)
IAM	Integrated Assessment Model
i.e.	Id est (that is to say)
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental organization
OECD	Organization for Economic Co-operation and Development
p.	Page
para.	Paragraph
SDGs	Sustainable Development Goals
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USA	United States of America
VHB	Verband der Hochschullehrer der Betriebswirtschaft (German academic organization that provides a ranking of academic journals in the field of economics and business)

# **1. Introduction and background**

## **1.1. Climate change as a behavioral problem**

Climate change is ultimately a behavioral problem. It results from human impact on the environment, which emerges from the sum of all individual human behaviors (Swim et al., 2011; Wang et al., 2021). Yet, in the climate policy discourse, climate change is predominantly viewed as a technical or economic problem, neglecting the inherent processes of human decision making (Pongiglione & Cherlet, 2015). This dissertation explores the potential of understanding the non-rational aspects of human behavior to identify and overcome barriers to climate change mitigation.

Anthropogenic climate change is one facet of a broader planetary crisis that encompasses multiple environmental issues, including biodiversity loss and pollution (IPBES, 2019; IPCC, 2022a; Steffen et al., 2015). This work will focus on climate change, but the findings are broadly applicable to the other environmental issues, since all aspects of the planetary crisis are caused by human activity exceeding the Earth's capacity to sustain that activity as a result of past and present extractive, fossil-fuel driven industrialization (Rockström et al., 2009, 2023). Human impacts on the planet are by now so profound that a new geological epoch has been declared: the Anthropocene (Crutzen & Stoermer, 2000; Lewis & Maslin, 2015; Waters et al., 2016). So-called tipping points and hysteresis effects make any way back much more difficult, and some consequences, such as the mass extinction of species, are completely irreversible (Armstrong McKay et al., 2023; Cai et al., 2016; Jeltsch-Thömmes et al., 2020).

Not only are human activities transforming the planet, but climate change in particular poses a significant threat to the livelihoods of current and future generations, and thus to the survival of human civilization. A runaway climate change, caused by continued greenhouse gas emissions or accelerating feedback effects, could turn the planet into a



hothouse Earth with conditions completely hostile to life (Steffen et al., 2018). Even at lower temperature rises, and thus within the lifetimes of current generations, a growing body of literature sees a significant risk of societal collapse and human mass mortality from effects such as water scarcity, crop failure, and resulting mass migration and conflict (Bendell, 2018; Brozović, 2023; Kemp et al., 2022; King & Jones, 2021; Servigne & Stevens, 2020; Tollefson, 2021).

To understand why, despite the existential risk, climate change is so difficult to solve, it has been characterized from a policy perspective as a “super wicked problem” with four aggravating factors compared to other policy problems (Lazarus, 2009; Levin et al., 2012): time is running out; those who cause the problem must also provide the solution; a central authority to address it is weak or nonexistent; and due to long time horizons, policy responses irrationally discount the future. In addition, responsibility for climate change and suffering from climate change are not proportional to each other; in fact, those who have contributed the least suffer the most, both between and within societies (Newell et al., 2021; Porter et al., 2020). From an ontological perspective, climate change has been defined as a “hyperobject” (Morton, 2013), a phenomenon so immense in time and space in relation to human life that it is beyond human understanding. The initial mechanism of greenhouse gas emissions is infinitely diffuse, being caused by millions of factories, cars, and planes, while their interacting effects extend across the entire planet.

The defining question of the 21st century is whether humanity can yet change its collective behavior, especially what is summarized as the economy (consumption and production of goods and services), in a way that allows the biosphere and ecosystems, and thus society’s livelihoods, to survive (Miller McDonald, 2023; O’Neill et al., 2018). Although humanity’s global collective behavior emerges from the behavior of individuals, it is also shaped by interactions, societal institutions, and power structures (Bak-Coleman et al., 2021; Moore, 2016). Climate change cannot be solved at the

individual level alone and individualization may even impede progress towards effective solutions (Lamb et al., 2020; Maniates, 2001). Therefore, the focus of this work is not primarily what individuals can do to minimize their ecological impact, but how policy making can drive structural changes that catalyze collective behavioral changes to mitigate climate change.

## **1.2. The pathway to climate change mitigation and the state of play**

There is broad consensus that to mitigate climate change, humanity must reduce its emissions of greenhouse gases, primarily carbon dioxide, into the atmosphere to zero, and that this means decarbonizing all human activities such as agriculture, transportation, manufacturing, and heating (IPCC, 2022b). This requires, in the first place, the use of carbon-free and renewable energy sources, and, in the second place, changes in agricultural technology, reforestation rather than deforestation, and the removal of existing carbon dioxide from the atmosphere (Xu & Ramanathan, 2017). A sustainable human society must also reduce other pollution to levels that can be sequestered by natural processes, minimize human interference with natural ecosystems, and ensure a fair distribution of the burden of transformation (Steffen et al., 2015).

What is ultimately needed is a balance between ecological and economic systems that ensures basic needs and well-being for all (e.g., nutrition, sanitation, access to electricity, life satisfaction) while respecting planetary boundaries (O'Neill et al., 2018; Vogel et al., 2021). This idea is sketched out for example with the concept of a “Doughnut Economy” (Raworth, 2017), with the inner ring representing the minimum social standards required for a good quality of life, such as access to clean water, food, education, and healthcare and the outer ring representing the ecological limits of the planet, such as the amount of pollution that can be emitted, the level of eutrophication, or the amount of water that can be used sustainably. Many policies that could guide such a transformation are known to be effective and, in principle, ready for implementation.

Examples include carbon pricing and emissions trading, land use policies, industry efficiency standards and industrial process emissions regulations, renewable portfolio standards, building codes and appliance standards (Black et al., 2022; Krogstrup & Oman, 2019).

There are no mysteries, neither in the nature of the problem nor in the solution. It is evident that human activity must change rapidly and drastically for long-term survival, it is also known in which direction, and it has been known for several decades (Stoddard et al., 2021). It has even been clear for some time that the costs of mitigation are much cheaper than the damages of climate change (Stern, 2007; Ueckerdt et al., 2019; van der Wijst et al., 2023). And yet, action has been slow and insufficient. The United Nations (UN) no longer sees a credible pathway to limit temperature rise to 1.5 degrees above pre-industrial levels (UNEP, 2022), and the world is most likely headed for around 2.7 degrees or more by 2100 (Climate Action Tracker, 2022; Tollefson, 2021), while warming and its impacts, such as sea level rise, may well continue after 2100 even without additional emissions due to slow processes and feedback loops (Lyon et al., 2022). There is an immense gap between what in economic terms is called the “optimal mitigation effort” that can be calculated by climate economic models and the much slower actual progress (Ueckerdt et al., 2019).

One reason for this is the psychological nature of humans and the resulting barriers to behavioral and lifestyle change (Stankuniene et al., 2020). Mitigating climate change requires far-reaching behavioral changes and the rapid adoption of low-carbon lifestyles, and therefore depends inter alia on individual decisions and actions (Wang et al., 2021; Whitmarsh et al., 2021). However, climate-relevant behavior changes often occur much more slowly than expected by climate economic models and policy makers (Blasch & Daminato, 2020; Gifford, 2011; Mazutis & Eckardt, 2017). Despite strong evidence, this issue still receives limited attention in the climate change and especially climate policy discourse (Broberg & Kazukauskas, 2015; Williamson et al., 2018). It

was only in its recent Sixth Assessment Report that the Intergovernmental Panel on Climate Change (IPCC) acknowledged the role of behavioral dynamics at all (IPCC, 2022b), reflecting the way the transformation towards mitigation is discussed in public discourse.

### **1.3. Behavioral changes needed to mitigate climate change**

While there is a broad consensus on the need for decarbonization, the consensus breaks down when it comes to how to achieve this change. A key debate in the climate discourse is whether human activity can be reconciled with planetary boundaries through technological advancements, or whether the focus must instead be on behavioral changes such as a shift away from existing consumption patterns (Latour & Weibel, 2020; Mundaca et al., 2019; Pedinotti-Castelle et al., 2021). The technology approach relies on improving the eco-efficiency of human economic activities on the supply side, i.e., making it possible to produce and consume the same amount of goods and services while using fewer resources and generating fewer emissions (Nelson & Allwood, 2021; Sorrell, 2007). This would eventually allow economic activity to be decoupled from its negative externalities, so that economic development can increase without endangering human livelihoods (von Weizsäcker et al., 2014).

One element of this efficiency approach is consistency, which aims to increase the circularity of production and consumption processes (e.g., through recycling) to further improve eco-efficiency (Huber, 2000). Another element is the development of negative emission technologies that absorb greenhouse gases from the atmosphere to further decouple economic activity from its climate-changing effects (Hilaire et al., 2019). The efficiency approach advocates a sustainable or green way of economic development and growth through green innovation, green investment, and circular economy (Meckling & Allan, 2020). Respective policy instruments aim to provide incentives to market forces, e.g., through taxes and subsidies, to shift economic activity from less to more

environmentally friendly and to promote innovation (Crespi et al., 2016). The technology-oriented efficiency strategy is the prevailing approach in the current climate and sustainability discourse (van de Ven et al., 2018). It is also at the heart of the OECD's recommendations to governments (OECD, 2022), as well as the processes towards the UN Sustainable Development Goals (SDGs) and the Paris Agreement (Kurz, 2019).

However, technological improvements often fail to deliver the expected absolute reductions in resource use and emissions (Brockway et al., 2021; Vadén et al., 2020). Measures to increase efficiency can lead to rebound effects that increase the production and consumption of goods and services, which can offset some or all of the gains from the improvements (Binswanger, 2001; Otto et al., 2014; Sorrell & Dimitropoulos, 2008; Wüst et al., 2022). In addition, global economic growth continuously increases production and consumption, further undermining the efficiency gains achieved (Herrington, 2021). There is intense public debate about whether it is possible to decouple economic output and economic growth from environmental pressures (Hubacek et al., 2021; Ward et al., 2016), but the scientific consensus is that there is at least no evidence of decoupling of the type and scale required for ecological sustainability (see for reviews Haberl et al., 2020; Vadén et al., 2020).

In contrast to improving the ways in which economic output is generated, so-called demand-side approaches emphasize changing people's demand for goods and services to reduce environmental pressures (Creutzig et al., 2016; van de Ven et al., 2018). Demand-side measures can be divided into three categories: improving the use of goods and services, shifting to substitutes, and avoiding the demand (Creutzig et al., 2018; Roy et al., 2021). Improving and shifting demand patterns are important enablers for the implementation and realization of technological advances and contribute to increasing the eco-efficiency of the economy (Lee et al., 2020; Mundaca et al., 2019). However, with growing evidence that increasing efficiency alone will not be enough to meet

planetary boundaries, the third category, changing behaviors and lifestyles towards less consumption, is becoming inevitable (Alexander & Rutherford, 2019; Burke, 2020; Cordroch et al., 2022; Spangenberg, 2014; Wiedmann et al., 2020).

Reducing the demand for goods and services is the focus of the so-called sufficiency approach, which is concerned with a possible enoughness of consumption and production practices and living well with less (Princen, 2005; Spengler, 2016). To reconcile human well-being within ecological limits, eco-sufficiency approaches seek to reduce the demand for energy, materials, land, and water in absolute terms by limiting production and consumption, especially in the wealthy Global North (Figge et al., 2014). Whereas efficiency aims to decouple the output of economic activity from its ecological inputs, sufficiency strategies aim to limit or reduce economic activity.

The concept fundamentally challenges the prevailing notion that economic growth (i.e., increasing the production and consumption of goods) is the only path to greater human well-being (Hickel & Kallis, 2020; Parrique, 2021; Spash, 2021). Building on the idea that human well-being can be achieved without ever-increasing economic activity, sufficiency aims to stop taking demand for granted and to reinvent the way people meet their needs (Bocken & Short, 2016; Burke, 2020; Sandberg, 2021). Sufficiency is related to ideas of degrowth or a steady-state economic system and is discussed both as a means to reduce the ecological impact of human activities and as an end in itself, promising the satisfaction of basic needs, well-being for all, and a more satisfying life for the individual (Jungell-Michelsson & Heikkurinen, 2022; Sandberg et al., 2019).

It is unlikely that either of the two strategies, efficiency or sufficiency, alone can adequately reduce human impacts on the environment and resolve climate change and other ecological problems. To mitigate climate change, technological solutions remain critical, but they must be accompanied by behavioral changes. An effective approach will likely require limiting economic activity and increasing the eco-efficiency of that

limited activity (Kurz, 2019). Despite extensive academic discourse on the need and on ideas for demand-side solutions and in particular sufficiency strategies for climate change mitigation, the implementation of related policy measures is very limited (Fitzpatrick et al., 2022; Zell-Ziegler et al., 2021) and they are largely ignored in government and IPCC mitigation scenarios (Hickel et al., 2021; Keyßer & Lenzen, 2021). While there is growing public support for progress in the form of policies following efficiency strategies in many areas of the world (Fairbrother, 2022; UNDP, 2021), the limited evidence that exists suggests that public support for sufficiency approaches is much lower (Schmid & Guinaudeau, 2022; Tröger & Reese, 2021).

This is likely due to the fact that sufficiency strategies entail profound socio-ecological transformations, with changes in routines, lifestyles, and worldviews, as well as in the social paradigm of consumerism (Brand & Wissen, 2017; Sachs & Santarius, 2014; Wiedmann et al., 2020). In other words, while the first approach promises to work without changing too much about the way people live, the second approach requires fundamental changes in their lives. Moreover, while the directions for technological improvements are relatively obvious (e.g., reliable zero-carbon energy sources, clean production processes, carbon sequestration), the directions and levers for such behavioral changes to be more environmental and climate-friendly are much less clear (Alcott, 2008; Dubois et al., 2019).

#### **1.4. Climate policy as a driver for behavioral change**

Measures to achieve behavior change in the environmental and climate context can be divided into three main approaches (Karp & Gaulding, 1995). The first approach, referred to as regulatory or command-and-control approach, relies on the implementation of laws and regulations that mandate or prohibit specific actions or outcomes (Lamperti et al., 2020; Tuladhar et al., 2014), such as banning the use of certain technologies or granting people or companies a limited individual carbon

allowance (Bertoldi, 2022; Brock et al., 2022). One example is the effort in many countries around the world to ban the sale and use of vehicles with internal combustion engines (Plötz et al., 2019).

If there is an effective central authority, such as a functioning nation-state with a monopoly on the use of force, this method has the advantage of providing clear and binding guidelines for actors, thus ensuring a consistent and predictable response to environmental challenges. However, this approach can stifle innovation and flexibility, as it often imposes a one-size-fits-all solution that may not be appropriate for addressing individual differences and the complexities and contextual nuances of climate change issues (Guo et al., 2021).

The second approach is voluntarist environmental policy, which encourages and facilitates voluntary action by individuals, organizations, or industries. In contrast to coercive command-and-control mechanisms, voluntarist environmental policies often rely on people's good will and social responsibility, and include measures such as providing information and education (Arredondo Trapero et al., 2023; Choi et al., 2016). After the German government called for gas savings during the 2022 energy crisis, the savings in industry and households were greater than could be explained by price effects, which means that there must have been significant voluntary reductions in consumption (Roth & Schmidt, 2023; Ruhnau et al., 2023).

The voluntary approach can work particularly well when there is a potential win-win situation of personal and climate benefits, such as installing photovoltaic panels on roofs or replacing old heating systems with cheaper and cleaner ones (Meissner et al., 2020). Whilst voluntary policies offer a great deal of flexibility to actors, when it comes to costly changes, they may be less effective than more coercive approaches in achieving meaningful behavior change and cannot adequately address the free-rider problem of people relying on the contributions of others (Diederich & Goeschl, 2014).



The third approach is relying on price- or market-based policies, leveraging financial incentives such as taxes and subsidies to influence actors' behavior. Market-based policies aim to correct market failures at least cost by driving behavioral change through economic incentives (Lamperti et al., 2020). This approach is lauded for its ability to harness the power of market forces to achieve its goals, promoting efficiency and innovation in the process (X. Chen & Lin, 2021; Guo et al., 2021). In the climate change mitigation discourse, there has been a significant shift towards favoring market-based policies, such as carbon pricing, emissions trading, and subsidies, as primary instruments to address the issue (Rosenbloom et al., 2020; Stiglitz et al., 2017). For example, feed-in tariff policies, which provide a long-term price floor for renewable energy, have been used by many governments to accelerate investment in and use of these technologies (Bhandary et al., 2021).

Compared to well-enforced command-and-control regulations, market-based mechanisms are characterized by lower predictability of target achievements because actors have greater freedom to choose their behavior (Guo et al., 2021). Their impact depends heavily on the proper calibration of incentives, which is often difficult to achieve in policy practice and leaves room for interest groups to dilute the effectiveness of the mechanism (Meng & Rode, 2019). Moreover, market-based policies have been criticized for commodifying the atmosphere and the environment by allowing emitters to buy their way out of emissions reductions, thereby normalizing and perpetuating climate-damaging behavior (Monios, 2022; Pearse & Böhm, 2014).

Thinking about market-based solutions draws heavily on economic theory, particularly the rational choice model of human behavior and the concept of homo oeconomicus, which assumes that individuals act in their own self-interest and make decisions based on optimizing their utility (Frey, 1999; Gsottbauer & van den Bergh, 2011). Consequently, manipulating economic incentives should reliably and predictably change people's behavior. The dominance of the economic approach stems from the

extension of economic principles, theories, and methods to fields such as politics, law, sociology, and other social sciences in the late 20th century in general and to climate policy in particular (Meckling & Allan, 2020). It has been fueled by the belief that economics offered a universal language and set of tools that can be applied to a wide range of social phenomena, including those traditionally studied by other social sciences (i.e., economics imperialism; Becker, 1976; Lazear, 2000). Despite criticism for oversimplification and the neglect of important social and cultural factors that shape human behavior, economists are still playing an influential role in areas such as political science, law, and sociology, and have a significant impact on the discourse of climate policy (Małecka, 2018; Wolff & Haubrich, 2008).

However, the economistic view of human behavior poses problems when applied to climate change mitigation (Missemer, 2023). One key issue with this approach is the use of discount rates, which leads to an underestimation of the long-term benefits of climate change mitigation efforts in favor of short-term gains (Hampicke, 2011). Additionally, the pursuit of aimless efficiency in market-based policies may result in unintended consequences or suboptimal outcomes, as they often fail to account for broader societal and environmental goals (Pearse & Böhm, 2014). Finally, the reliance on the rationality assumption in the context of climate change policy is problematic. Human behavior is not driven solely by rational economic considerations. People frequently use heuristics, are subject to cognitive biases, pursue goals that deviate from the rational actor model, are affected by emotions, and are influenced by other people and social norms (Gsottbauer & van den Bergh, 2011; Karp & Gaulding, 1995).

While the model of *homo oeconomicus* is now seriously debated in the academic economics community, it is still very much present as a mental model in climate policy and other disciplines such as development cooperation and international relations (Ramazzotti, 2019; Urbina & Ruiz-Villaverde, 2019). By assuming fully rational and perfectly informed individuals, many potentially problematic behaviors that contribute

to climate change might be assumed away and inaccessible to analysis (Beckenbach, 2016; Oels, 2005). The non-rationality of human behavior can undermine the popular market-based policies because people may not be as sensitive to economic incentives as assumed. They may not always make cost-benefit analyses to decide how to behave, and therefore may not change their behavior as quickly as an economic model would suggest. At the same time, non-rationality may also provide new levers for changing behavior.

Therefore, a more comprehensive view of human behavior in the context of climate change, one that goes beyond rational choice theory, could provide a better understanding and prediction of climate-relevant behavior. It would provide insights into how people respond to attempts to change their behavior, including behavioral factors that hinder change (Botzen et al., 2021; Gifford, 2011; Shu & Bazerman, 2012; Zhao & Luo, 2021). Moreover, such an approach could open up new avenues for changing behavior that target factors that shape human behavior apart from or in addition to coercion and economic incentives (Andor & Fels, 2018; Howlett & Rawat, 2019). By incorporating social and psychological factors into the analysis, climate policy making would gain a more accurate understanding of how people make decisions related to climate change and could develop interventions that are more likely to be successful.

The discipline that most notably integrates insights from economics and psychology, taking into account cognitive, emotional, cultural, and social factors to provide a more complete perspective on human behavior, is behavioral economics. It is increasingly informing and influencing public policy in many contexts, including health care, education, and criminal justice (Hallsworth, 2023), as well as climate change mitigation (Avineri, 2012; Botzen et al., 2021; Gowdy, 2008; Howlett & Rawat, 2019).

## **1.5. Behavioral economics to support climate policy**

In response to a growing body of evidence that humans reliably and predictably deviate from the assumption that individuals act as rational agents, constantly seeking to maximize their utility (Urbina & Ruiz-Villaverde, 2019), behavioral economics has emerged as an interdisciplinary field, dedicated to providing a more comprehensive understanding of human decision making processes (Angner & Loewenstein, 2012; Thaler, 2017). Originating from pioneering work on bounded rationality (Simon, 1957) challenging the traditional assumptions of rationality in economic decision making, it evolved into an interdisciplinary research area with a focus on practical application in economic and policy contexts (Ewert, 2019). Behavioral economics relies largely on experimental methods, including lab and field experiments, to test its theories and explore the effectiveness of its policy recommendations.

Behavioral economics' practical policy ideas have long focused primarily on the implementation of nudges, i.e. subtle interventions that gently guide individuals towards a desirable behavior without restricting their freedom (Thaler & Sunstein, 2008). These strategies have proven effective in promoting climate-friendly behavior in various contexts, from energy conservation to waste reduction (Bergquist et al., 2023; Carlsson et al., 2021; Schubert, 2017). Recent developments in behavioral policy have expanded on this, suggesting that beyond nudging, a more comprehensive understanding of humans as “homo irrationalis” (Stoll & Mehling, 2021, p. 3), subject to bounded rationality and bounded self-interest, and susceptible to cognitive biases that affect their decision making processes, can significantly improve climate policy in general (Beckenbach, 2016; Bhargava & Loewenstein, 2015; Safarzyńska, 2018; Stoll & Mehling, 2021).

Chetty (2015) identifies three ways in which behavioral economics can contribute to and improve policy making: by generating new welfare implications (contribution one),

by improving predictions about the effects of existing policies (contribution two), and by offering new policy tools (contribution three). The first contribution builds on the idea that biases in human behavior can lead to differences between the welfare that a policy maker using classical economic models expects agents to experience and maximize in their decisions and the goals that agents actually pursue when making decisions. Generating new welfare implications means that knowing and accounting for these differences can help to better explain human decisions and understand the positive or negative welfare implications for people subject to a regulation (e.g., regarding the neighborhood choice of people; Shah et al., 2012).

The second contribution suggests that taking into account the limitations of human reasoning, such as imperfect knowledge or susceptibility to bias and the use of heuristics, can lead to more accurate predictions of how people will respond to a policy measure (e.g., acceptance and speed of adoption of a digital health policy; Khan et al., 2022) and thus improve the prediction of policy effects. The third contribution implies that knowledge of specific patterns of behavior allows for the design of policy tools beyond coercion and economic incentives to shift human behavior in the direction desired by policy makers (e.g., increasing organ donation by declaring people donors by default with the option to opt out; Steffel et al., 2019).

In the context of climate change mitigation policy, new welfare implications (contribution one) may mean that a different view of human beings can improve cost-benefit analyses by including non-market, non-monetary factors to better reflect their needs and wants. The predictions of effects of existing climate policies (contribution two) can be improved by understanding what determines acceptance of a policy and what behavioral barriers might hinder compliance. New policy tools (contribution three) that are more effective or work in complement to other tools to promote climate-friendly behavior can be developed by drawing on non-coercive and non-monetary incentives.

This thesis comprises three explorations of the use of behavioral economic approaches to understand and shape climate-relevant behavior. While each manuscript in isolation presents a concrete way in which behavioral economics can inform climate policy, together they aim to substantiate the theoretical rationale for the usefulness of behavioral economics for climate change mitigation. Chetty's (2015) framework is used to categorize the different contributions, as each manuscript serves one or two of the three types. The subsequent chapter introduces the papers, followed by a discussion of their findings and implications.

## 2. Research papers

### 2.1. Overview of research papers

This dissertation is composed of three research papers. Table 1 provides an overview of the three manuscripts according to publication status, journal, and journal ranking, and indicates the points they contribute pursuant to the PhD regulations for cumulative dissertations at ESCP Business School Berlin. Each research paper is self-contained and includes an individual introduction, methods section, results, and discussion. A brief summary of the content precedes each manuscript.

**Table 1:** Overview of research papers and publication status

	<b>Manuscript 1</b>	<b>Manuscript 2</b>	<b>Manuscript 3</b>
<b>Title</b>	Why change does (not) happen: Understanding and overcoming status quo biases in climate change mitigation	Does recalling energy efficiency measures reduce subsequent climate-friendly behavior? An experimental study of moral licensing rebound effects	The benefits of less: The effect of gain framings on the adoption of sufficiency behavior
<b>Authors</b>	Simon Rabaa Sylvie Geisendorf Robert Wilken	Simon Rabaa Sylvie Geisendorf Robert Wilken	Manuel Suter Simon Rabaa Andrea Essl
<b>Journal</b>	Zeitschrift für Umweltpolitik und Umweltrecht	Ecological Economics	Ecological Economics
<b>Publication status</b>	Published	Major revisions	Under review (passed desk reject)
<b>Journal rankings</b>	VHB: B CNRS: -	VHB: B CNRS: A	VHB: B CNRS: A
<b>Points achieved</b>	2.5 / 3 = 0.83	2.5 / 3 = 0.83	2.5 / 3 = 0.83
<b>Total points</b>	2.5		

## **2.2. Paper 1: Why change does (not) happen: Understanding and overcoming status quo biases in climate change mitigation**

### **2.2.1. Summary**

The first paper is a conceptual literature-based study that addresses the gap between optimal mitigation efforts calculated by climate economic models and the slower actual progress towards climate change mitigation. The paper argues that irrational decision making in the form of cognitive biases, especially those that make people stick to a given status quo, plays an important role in impeding behavioral change towards more climate-friendly behavior. However, irrational decision making is largely overlooked in the optimization-driven logic of climate economics, and despite evidence from behavioral economics and psychology on such effects, it is also largely ignored in the broader climate change debate.

To address this gap, the paper first identifies and categorizes 20 status quo biases that affect people's decisions in climate-relevant behavior. This categorization helps structure the discussion and allows to propose policy options for dealing with these biases. In addition, the paper shows that some cognitive biases, if properly understood, can be turned positive to encourage climate-friendly behavior. This paper provides a new perspective on the role of cognitive biases in climate change mitigation and highlights opportunities to advance climate protection beyond material incentives.

The manuscript is published as: Rabaa, S., Geisendorf, S., & Wilken, R. (2022). Why change does (not) happen: Understanding and overcoming status quo biases in climate change mitigation. *Zeitschrift für Umweltpolitik und Umweltrecht*, 45(1), 100–134. <https://doi.org/10.5281/zenodo.7677305>.



## **2.3. Paper 2: Does recalling energy efficiency measures reduce subsequent climate-friendly behavior? An experimental study of moral licensing rebound effects**

### **2.3.1. Summary**

This paper explores the relationship between energy efficiency, rebound effects, and moral licensing bias. While increasing energy efficiency is a popular strategy for mitigating climate change, rebound effects are known to undermine its effectiveness. Moral licensing bias, which suggests that people who perceive their behavior as morally good are more likely to behave less morally in another area, has been proposed as a driver of rebound effects. However, empirical support for this mechanism is weak. Therefore, this study aims to provide experimental evidence on whether moral licensing can drive an indirect energy efficiency rebound effect. Three pre-registered and high-powered experimental studies were conducted.

The results show that an initial energy efficiency behavior increases people's feeling of having done something good for the climate. However, this had no negative impact on subsequent climate-friendly behavior. Contrary to predictions derived from previous literature, the findings show no evidence for a moral licensing rebound effect. Instead, demographic variables and environmental attitudes, especially climate literacy, were strong predictors of climate-friendly behavior. The study challenges previous claims about the impact of moral licensing on energy efficiency measures. It is a pioneering study in the experimental research on psychological rebound effects and provides avenues for further research.

The revised manuscript is under re-review at Ecological Economics.

## **2.4. Paper 3: The benefits of less: The effect of gain framings on the adoption of sufficiency behavior**

### **2.4.1. Summary**

This paper examines the effectiveness of communication in promoting sufficiency behavior. While current efforts to mitigate climate change are largely focused on efficiency strategies, sufficiency strategies are increasingly seen as necessary to bring human activities within ecological limits. Such strategies aim to reduce production and consumption through behavioral and lifestyle changes. So far, the promotion of sufficiency behavior has shown little success, and despite much research on the power of message framing for promoting other pro-environmental behaviors, its potential for voluntary sufficiency behavior remains largely unexplored.

This paper uses an experimental framing study to examine the effect of different types of information messages on participants' willingness to reduce consumption. Unique to this study is that sufficiency is not presented as a sacrifice, but as something positive. The messages emphasized different benefits of sufficiency behavior with respect to nature, society, or the individual. Overall, the results suggest that informing people about the benefits for individual well-being, such as more free time and better mental health, is most effective in promoting sufficiency behavior, and that this may be a promising approach for governments, non-governmental organizations (NGOs), and other stakeholders to promote sufficiency.

The manuscript is under review at *Ecological Economics*. It is available as a preprint article: Suter, M., Rabaa, S., & Essl, A. (2023). The benefits of less: The effect of sufficiency gain framing on consumption reduction. *SSRN Working Paper*. <https://doi.org/10.2139/ssrn.4500681>.

### **3. Discussion**

#### **3.1. Key findings and contributions to theory, method, and practice**

All three papers explore ways in which behavioral economics thinking and methods can improve the understanding of climate-relevant behaviors and inform climate change mitigation policy, although they do so in very different ways. While papers two and three are experimental studies to improve understanding on specific behavioral phenomena, the first paper is methodically different in that it is literature-based and conceptual. Its contribution is that it transfers and extends existing knowledge from behavioral economics to the context of climate-relevant behavior.

The first paper argues that status quo biases are a well-established phenomenon (Kahneman et al., 1991; Samuelson & Zeckhauser, 1988) that helps explain why individuals persist in a certain behavior despite better alternatives being available and known. Although it seems plausible that these biases may also hinder the shift towards more climate-friendly behavior, there is little literature that explores the phenomenon in this context. The paper identifies 20 different status quo biases, categorizes them according to their impacts on climate-relevant behavior, and illustrates how the biases can specifically impede more climate-friendly behavior. Based on the identified mechanisms of impact, measures are then developed that can help overcome the status quo biases. In addition, some of the biases are shown to be useful as levers for inducing behavioral change if properly exploited by climate policy.

The development of a comprehensive framework for status quo biases in climate-relevant behavior contributes to theory by organizing and consolidating existing knowledge that is currently scattered across various disciplines. The framework has the potential to inspire and guide empirical research in this area. While there is limited empirical research on the effects of some of the status quo biases in the context of climate change, there is no empirical research at all on the effects of many others.

The paper contributes to policy-making by turning the spotlight on irrational elements of human behavior to explain why more climate action is not being taken. It demonstrates that reasons other than rational ones can cause people to persist in climate-damaging behaviors and, by systematically transferring the concept of status quo biases to the climate discourse, it opens up a new way of thinking about both psychological barriers to and psychological levers for climate policy. In doing so, paper one contributes in ways one and two of Chetty's (2015) categorization of the contributions of behavioral economics to policy making (see Figure 6).

First, it generates new welfare implications (contribution one) by documenting what is important to people apart from maximizing their economic welfare. Examining the biases that make people stick to the status quo shows what sentiments in life are more important to them than economic benefits. This improved understanding of welfare helps to better understand the ends that people pursue and the pain they suffer when a policy (e.g., a coercive regulation) forces them to deviate.

Second, the paper contributes to the provision of new policy tools (contribution three). Of the 20 biases, 10 are identified as potentially supportive of climate policy if properly exploited. While they generally hinder the transition to more climate-friendly behavior, these biases can also work in favor of climate policy. Specific knowledge of the mechanisms of status quo biases can offer ways to improve the effectiveness of existing policies and provides ideas for designing new policy instruments for mobilizing behavior that work without coercion or economic incentives, and thus may enjoy higher acceptance and compliance.

The second paper follows the call articulated in the first paper and other literature (Nielsen et al., 2021; Rabaa et al., 2022; Wang et al., 2021) to develop empirical, particularly experimental, research on the effects of aspects of nonrational behavior within climate-relevant behavior. Moral licensing is a well-established bias in moral

psychology research, meaning that behavior perceived as morally good in a specific situation leads people to be less moral in a subsequent situation (Blanken et al., 2015). The possibility that this bias affects climate-relevant behavior, and in particular causes rebound effects, has so far been a theoretical proposition without solid empirical evidence (Reimers et al., 2021).

To provide this evidence, the paper seeks to establish a causal relationship between an initial energy efficiency increasing behavior and a subsequent different climate-relevant behavior. If increasing energy efficiency reduces the climate friendliness of another behavior, this would be evidence of a moral licensing rebound effect, because the savings in environmental impact from the efficiency measure are lessened by the increased climate unfriendliness in another area. Such a moral licensing rebound effect, if confirmed, would have crucial implications for the understanding of rebound effects, which today are largely thought to be caused by economic mechanisms (Binswanger, 2001; Ruzzenenti et al., 2019).

It would also have important implications for policy making, since rebound effects from moral licensing would need to be tackled differently than economic rebound effects, which can be mitigated, inter alia, through targeted taxation (Q. Chen et al., 2022; Freire-González & Ho, 2022). Moreover, any policy designed to increase efficiency measures (e.g., subsidies for more efficient heating in homes) would have to be expected to be less effective in its overall impact compared to standard economic estimates because of undesired behavioral changes due to moral licensing bias. Thus, paper two aims to improve the prediction of climate policy effects, which represents the second way of Chetty's (2015) categorization of behavioral economics contributions to policy making (see Figure 6).

To provide reliable evidence, the study differs from previous studies by using an experimental randomized controlled trial approach that allows for the isolation of the

moral licensing mechanism from other mechanisms, and by using pre-registered and highly powered experiments (total  $n = 2,315$ ). The study also aimed for high external validity and avoided hypothetical bias by using a new measure of potentially affected climate-friendly behavior with real consequences for individuals (money) and the climate (CO<sub>2</sub> emission reduction) (Berger & Wyss, 2021), and a manipulation that relates to participants' actual past behavior.

However, the three experiments conducted (one main study and two control studies to rule out possible confounding explanations for the results) found no evidence of a moral licensing rebound effect with this design. This does not prove the absence of such a bias and its detrimental effects, but since the study uses a similar approach to previous studies, but with a more reliable experimental setup, it calls into question their positive findings. If supported by future research, this would suggest that moral licensing bias is not a major driver of rebound effects following and counteracting household energy efficiency measures, suggesting that policy makers should focus on economic mechanisms if rebound effects are observed.

While moral licensing effects may not be present in this context, they are likely to be present in other contexts, such as recycling behavior, adoption of electric cars, or air travel (Burger et al., 2022; Robitaille, 2014; Seebauer, 2018; Truelove et al., 2016). This illustrates a key challenge for behavioral economic approaches to climate policy, namely that findings and policy recommendations are highly context sensitive. What may be important for one type of climate-relevant behavior may be irrelevant for another. For example, a bias may exist for buying a more efficient car but not for buying a more efficient heating system. This, however, is also a key strength of behavioral approaches and an argument why they should be used, because they are able to identify these differences, whereas standard economic approaches tend to generalize behavior when it is not economically different.

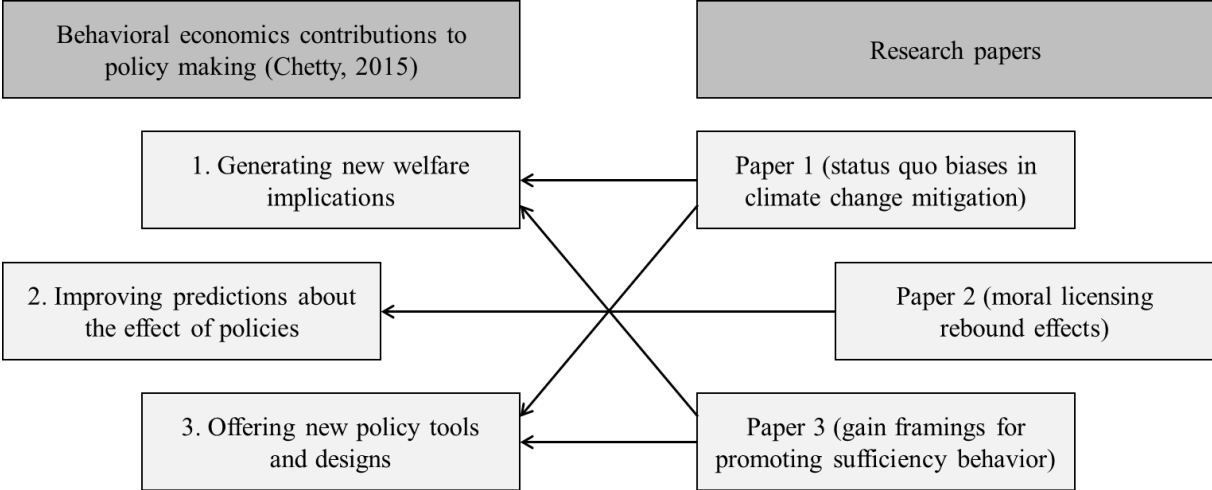
Such differences in context and their impact on behavior are the subject of the third paper (Suter et al., 2023). Similar to the second paper, it is a randomized controlled experimental study, but in this case, it is a framing study that examines how different communication that relate to different spheres of human life affect behavior. The paper examines, first, whether sufficiency behavior, i.e., reducing consumption, can be encouraged by directly communicating the benefits of such behavior and, second, what type and context of benefit communication works best.

With a between-subjects design with three treatment groups and one control group, an incentivized task, and a large sample size ( $n = 1,317$ ), the study strives for high validity. None of the communication treatments decreased the willingness to reduce consumption, implying that open communication about sufficiency does not have a deterrent effect. Furthermore, the group that was exposed to scientifically based information about the individual benefits of sufficiency behavior (such as more free time and better mental health) showed a significantly higher willingness to reduce consumption compared to the control group. Communicating scientifically based information about benefits for nature or society had no effect.

Despite the importance of sufficiency and related behavioral changes, the topic is difficult to analyze with standard economic models, and difficult to promote with instruments derived from them, because reducing consumption is usually seen as a loss that people will always try to avoid. The paper contributes to theory about human behavior in that it shows how people voluntarily refrain from consumption and that, contrary to some of the current literature (Gifford & Comeau, 2011; Nolan & Tobia, 2019), consumption reduction can be communicated as something positive.

In terms of Chetty's (2015) categorization of behavioral economics contributions to policy making, the paper contributes to climate policy in two ways (see Figure 6). The study generates new welfare implications (contribution way one) by showing that

forgoing consumption can be part of people’s welfare, and by assessing what kind of non-monetary benefits motivate people to turn towards more sufficiency. By demonstrating that participants’ sufficiency behavior can be increased through specific framing alone, the study illustrates a new policy tool (contribution way three). Framing can be particularly useful when economic incentives are unsuitable, or to support them in order to combine the effects (Homar & Cvelbar, 2021). In the context of this study, framing information as beneficial to individual well-being seems to be most effective. If this is confirmed by further research, it may encourage policy makers or NGOs to focus their communication more on the individual benefits of sufficiency, rather than focusing on the need for it for the environment, the climate, or society.



**Figure 1:** Overview of the contributions of the research papers to policy making

**3.2. Contribution of behavioral economics to climate change mitigation**

Each of the three papers offers ways in which behavioral economics thinking can contribute to climate change mitigation. The papers two and three address the need for more empirical and experimental research on climate-relevant behavioral biases that was identified in paper one. Yet, the papers do not build on or depend on each other, but



each proposes a discrete approach to support climate policy making. When taken together, however, they allow for an abstraction of their findings and a more general assessment of the usefulness of behavioral economics for climate change mitigation.

All three studies demonstrate the potential of interdisciplinary research, especially between economics and psychology. The first paper showed that many of the behavioral patterns relevant to climate policy have already been studied in psychology, often in different contexts and with different terminology. The transfer of knowledge and research methods to the climate change discourse can accelerate the development of a more behaviorally realistic basis for climate policy. Other phenomena, such as the moral licensing rebound effect studied in the second paper, are only conceivable when economic thinking about rebound effects is combined with psychological thinking about people's moral behavior. The three studies provide examples and evidence that behavioral economics is indeed more than just another policy tool (Ewert, 2019), but that it can fundamentally change both economic analysis and policy recommendations for the better.

A particular value of behavioral economics is its ability to change the principles and thus the recommendations of traditional economics while remaining within its established frameworks and terminology, such as in the case of the rebound effect. This can help increase the acceptability of recommendations, as economics enjoys a high degree of influence and credibility among policy makers (Meckling & Allan, 2020). While behavioral economics research on climate-relevant behavior is closely related to research in environmental and social psychology, it may be more effective than other disciplines in bringing about change because it frames problems in familiar economic terms.

Within economics, behavioral economics has evolved from a separate subfield that challenges the mainstream, like many heterodox economic schools of thought (Dobusch

& Kapeller, 2012; Hodgson, 2021; Rabaa, 2017), to a force that transforms all economic thinking (Angner, 2019). As a result, rather than positioning itself as an alternative advisor, behavioral economics is reshaping the way economics advises on policy issues. Recommendations based on behavioral economics are helpful in all kinds of policy areas, but they may be particularly useful in climate policy due to the strong role of non-rational behavioral drivers in the problem and the strong economic arguments in the solutions currently under discussion (Botzen et al., 2021; Howlett & Rawat, 2019).

Finally, climate change and measures to mitigate it have highly complex and interconnected impacts on many areas of society and individual lives. Any progress requires expertise from many different fields. This is where the inclusiveness of behavioral economics, as opposed to traditional economics, becomes an advantage. A behavioral economics framework can bring together people from across disciplines, i.e., policy makers with behavioral scientists, climate scientists, and activists, who may resist or be deterred by classical economic approaches.

### **3.3. Limitations and future research outlook**

Each of the three papers has specific limitations due to the chosen perspective and method, which are discussed within the manuscripts. However, some limitations of the studies are overarching and point to general challenges of behavioral economics research on climate change. They can be described as limited generalizability, limited representativeness, and limited comprehensiveness.

The two experimental studies share the limitations relevant to behavioral economic experimental research in general. Both offer spotlights on certain behavior patterns, which may, however, play out differently in a different situation or context. For example, a moral licensing rebound effect might occur after the purchase of a more efficient car, but not after the installation of a more efficient heating system, because the

latter is not perceived as moral enough to do so. Thus, a key limitation is that generalization of the results is much more difficult than it is common practice in standard economic approaches, and much more research is needed to establish knowledge. Future research must test the findings of paper two and three in other contexts, and to avoid diluting the findings, behavioral studies must be conducted properly. In the wake of a replication crisis in the behavioral sciences (Shrout & Rodgers, 2018; Stanley et al., 2018), careful attention must be paid to avoiding a flawed evidence base by using preregistration, high statistical power, and aiming for high validity and replicability (Lonati et al., 2018; Nosek et al., 2022; Strømmland, 2019).

The experimental studies in papers two and three are all online experiments. While such experiments have been shown to provide reliable insights into human behavior (Buso et al., 2021; Gagné & Franzen, 2023), they can only be a first step in understanding and influencing it through policy. One of the main criticisms of behavioral economics research is that it is too often limited to laboratory settings and does not pay enough attention to whether and how the results can be scaled to real-world situations (Mažar & Soman, 2022). Thus, future research needs to test the findings not only in more experimental contexts, but also with field studies to increase external validity (Bergquist et al., 2023; Lonati et al., 2018). In addition, research could also establish collaborations with policy makers or private or public organizations to test the findings in real-world settings. This could also help to overcome the lack of diffusion of behavioral economic approaches and help to mainstream its thinking and methods into organizations and political systems.

Second, the data for papers two and three come from participants in the UK and US, as do the data for most of the literature used in paper one. Like much behavioral economics research, the findings are based on data from people in the Global North because they are easily accessible. This is a different limitation than the limitation from specific contexts (limitation one), because overall patterns of behavior (e.g., regarding morality)

may be different for different populations, and the motivation for climate-relevant behaviors may vary entirely (Kleres & Wettergren, 2017; Noll et al., 2020). The often narrow and unrepresentative range of participants in behavioral science research is a major future challenge for the discipline (Henrich et al., 2010), as is the homogeneity in location and characteristics of the behavioral scientists themselves, which influences their perspectives and horizons of thought (Dupree & Kraus, 2022). Future research needs to expand the range of people whose behavior is studied and the range of people who study behavior. Indeed, behavioral economics is much better equipped than standard economics to account for the fact that human behavior varies across contexts and populations, but it needs to pay more attention to this. By studying and accounting for these variations, predictions and policy recommendations can be better tailored to the specifics of different people and can be more effective in their specific contexts.

Third, there are many factors other than individual biases that impede or accelerate climate-friendly behavior, a limitation relevant to all three papers. The behavioral perspective is thus not sufficient for a comprehensive understanding of climate issues. These other factors include the concurrence or contradiction between individually rational self-interest and collectively rational behavior, as many climate-damaging behaviors may be individually rational (Raihani & Aitken, 2011), as well as social factors, since people do not act in isolation from others (e.g., conspicuous and status consumption; Bourdieu, 1984; Veblen, 1899). The focus of the three papers on the individual level overlooks the influence of interdependencies of psychological tendencies, social relationships and societal structures. It does not take into account limiting environmental factors such as technological and institutional lock-ins (Marquardt & Nasiritousi, 2022), and it ignores the dynamics of political processes that are also driven by interests and power structures (Basseches et al., 2022; Dorsch & Flachsland, 2017).

Power and societal phenomena have always been disciplinary blind spots in economics, neglecting the role of institutions, processes, and politics in determining economic phenomena (Burtraw, 2013; Gale, 1998; Gigerenzer, 2018). Similarly, behavioral economics has been criticized for paying too little attention to the reality that people are embedded in established societies and practices, and to the contextual constraints that limit the ability of individuals to adopt behavioral changes, independent of their willingness to do so (Ewert, 2019). All behavioral economics research should keep these factors more in mind, and in order to analyze further the interactions between human irrationality and political processes, it seems necessary to establish a behavioral political economy research field (Schnellenbach & Schubert, 2015; Špecián, 2022). For climate policy making, this means that recommendations from economics, including behavioral economics, should always be complemented with expertise from social and political science. Future research on climate policy should therefore be even more interdisciplinary, involving (behavioral) economists, climate scientists, as well as social and political scientists.

### **3.4. Concluding remarks**

This dissertation examines how behavioral economics, its recognition of human irrationality, and its methods can improve and reinvent the recommendations of economics for climate policy. Mitigating climate change requires much more significant changes in behavior and lifestyles than are taking place today, and there is a great need for policies that initiate and accelerate these changes. It is essential that policies create a framework that enables and encourages climate-friendly behavior and shapes people's attitudes and values accordingly.

However, the standard economic recommendations that largely guide climate policy making often fall short because climate-relevant behaviors are also driven by non-monetary factors such as habits or fears. Policies that rely on economic incentives, such

as taxes or subsidies, may therefore be less effective than if people were fully rational. Moreover, such policies may not be implemented at all by policy makers because they are also subject to the same effects. The three papers show that predictions about human behavior and recommendations for policy instruments differ when a behavioral economics perspective is taken. This opens up new possibilities for climate policy making to evaluate existing policy ideas and to replace or complement them with other tools.

There may well be other reasons why people do not behave in ways that are good for the climate that are not related to individual irrationality and therefore cannot be captured directly by the approaches discussed here. However, behavioral economics offers a more open alternative to standard economic orthodoxy that allows for the recognition of not only psychological but also social and political mechanisms, making more behavioral economics also a stepping stone towards analyzing and incorporating knowledge about these other factors into the climate debate. In the same vein, behavioral economics can be a springboard for interdisciplinary efforts that bring together behavioral scientists, economists, political scientists, social scientists, climate scientists, legal scholars, and policy makers to collaborate on a more behaviorally accurate climate change debate and more effective policy tools. In this way, behavioral economics can be understood not as a tool, but as a “lens” (Hallsworth, 2023, p. 311) that can be applied to enhance the understanding of and enable multidisciplinary collaboration on climate policy issues.

Humanity faces enormous technical challenges, such as the dependence of renewable energy production on fossil fuels, the dependence of agriculture on synthetic fertilizers, and uncertainties about the effects of feedback loops in the climate system. However, the greatest uncertainty in the fight against climate change is how humans will behave. A better understanding of human behavior is therefore a key piece in the puzzle of what may be the greatest challenge humanity has ever faced.

The dissertation substantiates the behavioral economics credo of putting more focus on the human factor, because ultimately it is people who need to change their behavior, be it in the role of politicians who have to work for the implementation of stronger climate policies, of journalists and managers who have to put the issue on the agenda, of consumers who have to choose more climate-friendly consumption patterns, or of citizens who can vote and take to the streets for stronger climate policies.

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