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Sustainability policy as if people mattered: developing a framework for environmentally significant behavioral change

Chad M. Baum[1] · **Christian Gross**[2]

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Abstract International climate accords like the Paris agreement set the broad agenda for climate action. To realize their potential however, it is vital to 'get the context right' so that environmentally significant behaviors can be repeated over time. This paper reviews the extant interdisciplinary literature to outline how a richer understanding of the interrelationships between individual and contextual factors is required to cultivate behavioral change. In this manner, 18 distinct behavioral determinants are identified. We argue that the likelihood of behavioral change and overall environmental impact are thereby reliant on the complex interaction between individual behavior and the multiple distinct layers of context that frame its expression. Our behavior-informed approach thus helps to explain processes of behavioral change more fully, establish the types of obstacles that exist, and delineate a fuller and more substantial role for individual-driven behavioral change that is able to build on the initial impetus of global-level frameworks.

Keywords Sustainability policy · Individual behavior · Rebound effects · Behavioral spillovers · Contextual determinants

JEL Classification A12 · O33 · P28 · P36 · Q01 · Q58

✉ Chad M. Baum
ch.baum@ilr.uni-bonn.de

[1] Institute for Food and Resource Economics, University of Bonn, Meckenheimer Allee 174, 53115 Bonn, Germany

[2] Secretariat of the Advisory Council for Consumer Affairs, Federal Ministry of Justice and Consumer Protection, Mohrenstrasse 37, 10117 Berlin, Germany

Over the last 25 years, continuous negotiations through the United Nations Framework Convention on Climate Change (UNFCCC) have sought to tackle climate change and ensure a safe operating space for humanity. Nevertheless, the strain that societies place on the resilience and carrying capacity of our planet is still intensifying (Steffen et al. 2015). In fact, the energy intensity and environmental impact of the global economy is severe enough to have now surpassed a host of significant planetary boundaries, with undesirable consequences for humanity expected as a result (Rockström et al. 2009). Saliently for instance, each of the last 3 years has assumed the undesirable title of warmest year on record, representing the first time this has happened (Fountain 2016; Nuccitelli 2016). A recent study has calculated the odds of such warming taking place only through natural variation in the planet's climate at 0.01% (Mann et al. 2016). More troubling, according to a NASA report, average temperatures for the first six months of 2016 are close to 1.5 °C higher than pre-industrial levels, typically seen as the lower threshold to avoid the severe effects of climate change (Fountain 2016).

Given the scope and gravity of the problems that exist, it is immediately apparent why the signing of the first-ever universal and legally binding global climate treaty last December was greeted as 'the world's greatest diplomatic success' (Harvey 2015) and a 'turning point' (Obama 2015; UN 2016). In fact, in the wake of failed negotiations in Copenhagen in 2009, the 21st Conference of the Parties in Paris (COP21) seemed to represent a last best chance for countries to outline a unified plan to address climate change. Crucially in this regard, the Paris Agreement is successful as a multilateral accord that identifies explicit objectives (e.g. global temperature levels and targets for emissions reductions) towards which policy initiatives at the national level can be directed (UNFCCC 2015). The necessity, feasibility, and simplicity of such targets, which provide a framework for mitigation in the short and long term, is thus optimistically viewed as an essential initial step for climate action (Schellnhuber et al. 2016).

Once the agreement had been signed, however, a wave of opposition began to emerge. Taking aim at its mostly aspirational nature, James Hansen, for instance, analyzes the deal as "no action, just promises" (Milman 2015). As a result, affording individual nations the policy space to specify their own intended nationally determined contributions (INDCs) is explained to invite hypocrisy from policymakers. After all, the 2 °C guardrail, though first adopted at the Cancún conference in 2010, has proven insufficient to foster subsequent global climate action. Further, even if all INDCs were to be implemented as planned, their combined impact is expected to limit temperature increases to between 2.2 and 3.4 °C (Climate Action Tracker 2015), well short of even this upper threshold. The level of "constructive ambiguity" needed to agree on a target therefore represents a critical shortcoming of not only the Paris agreement but the entire apparatus of international climate negotiations (Geden 2016).

But if we rightly acknowledge the reasons for being pessimistic, what are we to make of the Paris Agreement and the initial optimism that greeted it? Can such an agreement, in spite of its apparent deficiencies, trigger concerted action and actionable plans that deliver on the promises made in Paris and reduce overall environmental impact? Or is the chronic failure of global negotiations to ensure a safer operating space for humanity, as some commentators have recently argued (Victor and Kennel 2014; Geden 2015), an inescapable outcome of the 'targetism' of this approach and the ultimate lack of political will to which it gives rise?

From our perspective, the doubts at the heart of such questions reflect the frequently underappreciated fact that the Paris agreement is necessary but not sufficient for a transition towards more sustainable and resource-efficient societies. As such, the lack of meaningful and comprehensive climate action is not a result of the global nature of the agreement but rather the fact that its aspirational targets are not accompanied by parallel changes across a number of levels. On this point, it is important to recall the recurrent debate between local, bottom-up strategies and global, top-down approaches (e.g. Sovacool and Brown 2009a; Ostrom 2012). According to the former, the types of integrated frameworks that international negotiations strive for, while needed to curtail free-riding problems at a global level, are not without issues of their own. Among others, such global approaches have a tendency to stifle both innovation and policy experimentation while also failing to account for differences in local conditions (Sovacool and Brown 2009a, b). Hence, polycentric systems of governance are proposed as a potential strategy to link together the need for broad action at the global level with the types of positive actions already underway at a range of smaller scales (Ostrom 2012, 2014). On this basis, it is then possible to bring about the degree of collective action that is required to promote sustainability and address problems related to climate change—even if such action is undertaken not collectively but rather by private individuals and households.

From our perspective, polycentric approaches therefore provide a suitable framework for sustainability policy. Notably, the emphasis on the need for action across a range of levels offers greater scope to highlight both the importance of individual-driven action and the types of contextual factors that prevent such action from taking place. Accordingly, the potential of polycentric systems for climate action is explored in this paper by devoting greater attention to the importance of 'getting the context right' so that behavioral change can actually occur. Toward this end, this paper draws on the literature of environmentally relevant behavior, from fields like economics, psychology and sociology, to provide a richer conception of individual behavior and its (contextual) determinants. We then utilize these insights to outline a variation on polycentric governance informed by and highlighting the significance of individual-driven behavioral change for sustainability policy. Given the novelty of this perspective, we first turn our attention to a number of questions that can be expected. For instance, how exactly is the behavior of individuals relevant for sustainability policy, and how certain can we be that a given behavioral change ultimately results in the desired reductions in environmental impact? The sections that follow are thus framed as responses to some questions that are likely to arise in the process of developing a more behavior-informed approach for sustainability policy:

1. What is it that lends environmental significance to one behavior and not another (Sect. 2)?
2. What is the link between individual behavior and environmental significance (Sect. 3)?
3. What is the nature of the relationship between individual and contextual factors, and how is such an approach relevant for sustainability policy (Sect. 4)?
4. Which determinants populate the different contextual levels, and how do the factors influence the likelihood of environmentally significant behavior (Sect. 5)?

5. How do the interactions among the contextual levels influence the potential for behavioral change, and why are spillovers between behaviors important (Sect. 6)?
6. What insights for polycentric governance (and sustainability policy in general) can be derived from a more behavior-informed approach (Sect. 7)?

2 What makes a behavior environmentally significant?

Before considering the practical significance of individual-driven action, it is crucial to clarify what makes a specific behavior more or less environmentally significant. In this paper, we characterize environmental significance as the capacity to engender long-term reductions in environmental impact. After all, to keep increases in average temperatures to well below 2 °C, it is estimated that emissions reductions of more than 80% (compared to 2010 levels) are required by 2050 (Jackson 2009; Antal and van den Bergh 2014). We thus envision that, for change in a behavior to be environmentally significant, it must bring about a reduction in an individual's environmental impact, both overall and over the long run. Highlighting the overall impact seeks to make clear that a given change is not significant if counteracted by changes in other behaviors. Crucially, this accounts for the prospect of behavioral spillovers, given that the greater prevalence of a behavior can have a consequent (positive or negative) effect on the likelihood that another behavior occurs (see Truelove et al. 2014). Hence, although change in a single behavior could (temporarily) diminish one's impact, this act is not sufficient to guarantee an improvement in environmental quality once all other behaviors have been considered (Sect. 5). For the sake of conceptual clarity, those behaviors that are only relevant for the environment, i.e. due to their input to emissions levels, are held distinct from those able to foster long-term reductions in overall impact. Specifically, the latter we denote as environmentally significant behaviors in distinction from the first and more general category of environmentally relevant behaviors.

In order to tease out the particular meaning of environmental significance in relation to behavior (and behavioral change), it is moreover necessary to be clear on what we mean by 'impact'. In this regard, we must address the twin issues of the types of factors included in our conception and, similarly, how environmental significance can be measured. In short, in order to understand what makes a given behavior environmentally significant, and not just relevant, this broader sense of its relationship with the environment should be established.

On both points, the familiar measure of carbon footprints offers a rough picture of how individuals affect their environments. In specific, the size of carbon footprints demonstrates how impact can markedly vary depending on where one lives. Focusing on the consumption-driven use of resources, for instance, per-capita carbon footprints illustrate the disparate impact between each individual living in an African nation (equal to approximately 1 tCO_2) and that of a person in the United States ($\geq$30 tCO_2); see Hertwich and Peters 2009). We can moreover observe, corresponding to growing levels of environmental impact worldwide, that global per-capita emissions have increased from about three to five tons CO_2 over the past 50 years (own calculations; based on World Bank 2015). On this basis, it is possible to put the scope of the problem, and the respective contributions of countries, in quantitative terms.

In addition, such figures provide us with broad strategies for reducing environmental impact. The IPAT identity (i.e. Impact = Population × Affluence × Technology) is particularly useful in this regard to outline a number of vital factors for sustainability policy. Initially developed to demonstrate the significance of population growth (Holdren and Ehrlich 1974), this identity is increasingly utilized to illustrate the relevance of levels of per-capita income and degree of technological development (Swim et al. 2011; O'Rourke and Lollo 2015). To be precise, the more that individuals have to spend, the more environmentally harmful products and activities they can purchase. Both population growth and rising income levels are therefore expected to intensify the burden on environmental systems. In contrast, further technological development is seen to provide a broad solution for addressing such degradation. Notably, by increasing the resource and energy efficiency of existing production systems, there is the potential to offset the consequences of economic growth. Indeed, one likely implication is that, if technological development were fast enough, it might be possible to diminish environmental impact without any change in other factors being required. This eventuality provides one reason for the broad impetus to decouple economic growth from environmental impact as well as the featured role of innovation within "green growth" approaches (OECD 2011; Barbier 2012).

Nonetheless, this neat picture of environmental significance has come under criticism for various reasons. First, many authors are overtly critical of "green growth" approaches for their limited attention to other dimensions of sustainability (Martínez-Alier et al. 2010; Schmalensee 2012; Lorek and Spangenberg 2014; Antal and van den Bergh 2016). For instance, as reflected in the Sustainable Development Goals, there is typically a broad correspondence between attaining ecological objectives and the pursuit of social objectives such as poverty eradication. Given that the day-to-day tasks of resource management often fall to those individuals in the least developed countries, a more all-encompassing understanding of sustainability is justified. Second, the expected results of technology-driven transitions are likely to be insufficient, that is, unless accompanied by changes in individual behavior. Notably, attaining emissions reductions of more than 80% compared to 2010 levels translates to a carbon intensity of production that is nearly 130 times lower than now (Jackson 2009). Accordingly, the exclusive reliance on technology-driven solutions makes it necessary to bet on the large-scale deployment of unproven "negative-emissions technologies" that foster the net removal of greenhouse gases (GHGs) from the atmosphere. Far from a risk-free strategy, however, the benefit of the widespread application of such technologies in terms of emissions reductions is likely to come with significant economic and environmental costs (Smith et al. 2015). Consequently, Antal and van den Bergh (2016) contend that the emergence of more sustainable infrastructure, regulation, and technology—all of which are necessary for an energy transition to be successful—is not likely to occur quickly enough to be sufficient on its own.

3 Environmental significance and individual behavior

Given the scope and speed of changes needed to address contemporary environmental problems, it is doubtful that an approach that neglects the human dimensions of

Table 1 Categories of environmentally significant behaviors

Consumption and conservation behavior	Production	Environmental citizenship and other environmental behaviors
Direct use of resources	Home production of renewable energy (e.g. solar panels)	Environmental activism (e.g. private sphere, within firms and organizations)
Indirect use of resources (e.g. from consumption of food and manufactured goods)	(Re-) Forestation	General behavior (e.g. ventilation)
Recycling and re-use		

sustainability transitions will translate into a lower environmental impact (e.g. Antal et al. 2012; Stern 2014; Steg et al. 2015). Of course, the global nature of such problems is often cited as a reason that collective action is necessary and why it might be improbable to expect individuals to have a sizable impact (cf. Sovacool and Brown 2009a; Ostrom 2012). According to some estimates, however, the level of emissions for which households are responsible accounts for more than two-thirds of the overall total in high-income countries (Baiocchi et al. 2010). Even if only emissions under their direct control are considered, the share of American households is still a third of all emissions in the United States and 8% of total emissions worldwide (Vandenbergh and Steinemann 2007; Gardner and Stern 2008). This is higher than that of any single country besides China (Gardner and Stern 2008). Further, since such emissions exceed those of the entire United States industrial sector, targeted behavioral interventions can achieve reductions in environmental impact that are both affordable and have little impact on individual well-being (Vandenbergh and Steinemann 2007; Gardner and Stern 2008; Dietz et al. 2009).

Highlighting the role of individual behavior therefore provides us with novel strategies to tackle climate change. Nevertheless, there are many obstacles that must be addressed first, among them the contextual factors that can diminish and obstruct the potential for individual-driven behavioral change (see Sects. 4–6). Even more generally, if we are to in fact explain how to 'get the context right' so that behavioral change can occur, it is necessary to appreciate the incredible diversity of individual behaviors that have an impact on the environment. For instance, rather than attempting to not do greater damage only through one's consumption decisions, one can also purposefully engage in behaviors such as planting trees, promoting the creation of wildlife reserves, and supporting pro-environmental policies and political parties. Accordingly, a more comprehensive view of the relationship between individual behavior and the environment is needed to understand the extent of one's environmental impact (see Table 1 for a broad overview).

Unfortunately, a more multifaceted approach to environmental behavior brings with it a range of issues, notably regarding measurement. Taking the case of environmental activism, the consequences for the environment are neither immediately subsequent to these activities nor indeed able to be measured quantitatively. Given the need to take into account the indirect environmental impact of a behavior as well, the change

in level of emissions alone is unlikely to be a sufficient indicator. That is, as we begin to appreciate the manifold ways by which people attempt to improve environmental quality, the sheer diversity of problems that result from such attempts also comes to the fore. Rather than single targets such as average global temperature, it is argued that a bundle of indicators is needed to track environmental health, including ocean heat content and high-latitude temperature (Hansen et al. 2013; Victor and Kennel 2014). Accordingly, Tukker and Jansen (2006) enumerate a range of consequences like land use, energy use, resource use, acidification, and smog formation that are also relevant. Using this more comprehensive list, it is determined that more than 70% of the environmental impact of final consumption in the US (Jones and Kammen 2011) and EU (Tukker and Jansen 2006) is attributable to three main areas: transport, household energy, and food. As such, this analysis goes some length towards dispelling concerns that measurement becomes impossible with a more complicated view of environmental behavior. Moreover, it underscores the insufficiency of pursuing efficiency-focused innovations without regard for the environmental significance of the domain in question. Such "efficiency myopia" is more likely to simply shift the burden of environmental issues somewhere else (Antal and van den Bergh 2014; O'Rourke and Lollo 2015).

For this reason, Stern (1997, 2000) has portrayed environmental significance in terms of how a behavior affects the availability of energy and materials in the environment or alters the structure and dynamics of ecosystems. This specific conceptualization offers an inherently structural reason for why some behaviors are more environmentally significant, i.e. because of their greater capacity to affect the operation of environmental systems (cf. Meadows 1999). However, this approach does not directly account for the added importance of socio-economic factors and the possibility that a behavior is actually the result of the context itself rather than individual attitudes. If unsustainable activity were 'locked in' by the prevailing context, e.g. because of the limited availability of organic food or lack of public transportation, individuals could find it exceedingly costly or difficult to reduce their environmental impact (O'Rourke and Lollo 2015). Bamberg and Möser (2007) similarly observe that, in spite of the increase in pro-environmental attitudes and the number of individuals wanting to do more to protect the environment, the overall level of emissions continues to increase over time. In this regard, the growing literature on the disagreement between the stated intentions of individuals and how they actually behave (i.e. 'attitude-behavior gap') demonstrates why the interaction between context and behavior requires greater attention (Kollmuss and Agyeman 2002; Gifford 2011).

Accordingly, the concept of environmental significance could benefit from exploring a number of other dimensions, beginning with the ease of undertaking behavioral change. There is anecdotal evidence, in fact, that the degree of environmental impact is positively related to how deeply a behavior is entrenched in various levels of context. For instance, whereas behaviors like the maintenance of existing technical systems and taking better care of home appliances can be adopted relatively easily, behavioral change in more significant domains like car use, recreational travel, and home heating and cooling systems proves more challenging (Gardner and Stern 2008). Irrespective of projected benefits from changing such high-impact behaviors, the actual benefits for the environment are therefore contingent on additional considerations related to the

cost, feasibility, and overall effort required. Expected environmental impact is therefore insufficient to distinguish environmental significance, and this aspect must instead be weighed alongside the (perceived) difficulty of undertaking behavioral change. If not, any improvements in environmental quality likely overlook the issue of feasibility and, as a result, may not actually take place.

In addition, since the establishment of more resource-efficient societies and economies represents the ultimate aim of sustainability transitions, widespread change to existing societal and technological contexts can be expected. In order for a given instance of behavioral change to persist over the long run, it must prove resistant to changes in the decision-making context. In this respect, the factors that provide the impetus for change are another crucial consideration for environmental significance. A given decline in household energy consumption could, for instance, be judged to have more limited environmental significance insofar as the change results from a short-term shock to energy prices. As the foundations of this behavioral change are temporary in nature, its significance is likely to be similarly short-lived. However, many of the policy instruments utilized to incentivize behavioral change are not necessarily resilient to changes in the wider context. Consider the growing debate over the effectiveness of 'classic' instruments like financial incentives and information provision (BIO Intelligence Service 2012; Grolleau et al. 2015). Generally speaking, such policies are criticized for their limited understanding of behavior and narrow consideration of contextual factors. To remedy the former, there is greater interest in how insights from behavioral research can be applied to improve policy effectiveness. Looking at eco-labels, Grolleau et al. (2015) underscore how greater knowledge of the causes of 'predictable errors' can avoid unintended consequences and enhance the ability of such labels to promote sustainable consumption. There is as a result a growing interest in how the prevailing heuristics and eventual biases of decision-making can guide behavioral change in more beneficial directions (Thaler and Sunstein 2008).[1]

Consistent with the role of individual action, we thus re-conceptualize environmental significance to reflect the capacity of individuals, via changes in their behaviors, to shape the context in which later choices are made (cf. Rosa and Dietz 1998). Consequently, the pursuit of behavioral change that is environmentally significant—that is, environmentally impactful, persistent to other changes, and feasible for individuals—requires accompanying changes in a range of factors in the surrounding context. In fact, as illustrated by the number of gaps that exist (e.g. attitude-behavior gap, value-action gap, energy-efficiency gap), behavioral change is as much a matter of 'getting the context right' so significant behaviors can be repeated as it is fostering the individual will to do so. In spite of their apparent differences, we thus contend that one crucial characteristic that environmentally significant behaviors share is the potential to cultivate suitable circumstances for other pro-environmental behaviors, both now and in the future. Of course, this presents a somewhat optimistic version of things, since the potential for behavioral change is frequently constrained by contextual factors (e.g. Guagnano et al. 1995; Thøgersen 2005; Steg and Vlek 2009). Nonetheless, we contend that individuals have the power to make changes to their behaviors and,

[1] Note that the question of whether heuristics lead to behavioral biases and hence bad decisions is the subject of much debate (see e.g. Gigerenzer 2015).

to the extent that these changes can create leverage for transformation in the broader context, thereby give rise to reductions in overall environmental impact greater than otherwise possible. In addition, this approach also provides a better reflection of the manner in which individuals often shape their environments, especially in the case of those behaviors that have an 'indirect' impact on the environment like environmental activism.[2] In contrast, solely direct approaches tend to neglect both the indirect means people have at their disposal and the diverse contextual factors that, irrespective of the level of individual will, can prevent objectives from being attained. Hence, we must turn our attention to the relationship between individuals and the various contextual factors more directly.

4 Outlining an individual-centered framework for sustainability policy

To understand how to get the context right through sustainability policy, it is useful to highlight the exact mechanism by which policies attempt to change behavior: i.e. by changing the context of decision-making. In other words, by modifying the degree to which a context is either supportive or antagonistic of a behavior, it becomes possible to increase the frequency or intensity of its occurrence. However, there is an inherent difficulty of such an approach in the environmental sphere. Owing to the systemic nature of environmental problems, the set of relevant contextual factors is not only substantially larger but these factors exist and operate across a range of distinct levels. Any policies targeting change at a single level are unlikely to be effective as a result, thus making it necessary to develop "solutions that embed multiple behavioral interventions within broader structural reforms" (O'Rourke and Lollo 2015, p. 245; see also Swim et al. 2011). Although a step in the right direction, focusing on the 'biases' that define the narrow frame of decision-making, as is done by behavioral research, is only able to integrate a restricted assortment of contextual factors. It cannot therefore explain, for instance, why the responsiveness of individuals to price incentives varies by a factor of 10 due to non-financial features of energy-efficiency programs (Stern et al. 1986). However, because of the existence of this energy-efficiency gap, financial incentives alone are insufficient to convince one to behave more efficiently (Jaffe and Stavins 1994; Dietz et al. 2009; Dietz 2010). In a similar vein, the use of monetary incentives to promote energy conservation is found to be generally less compelling than appeals of a moral or biospheric nature (Bolderdijk et al. 2013). Given that self-interest is unlikely to be sufficient, it is necessary to consider the wider range of strategies and policy alternatives available—across a range of overlapping levels—to environmental campaigners to promote individual-driven behavioral change (e.g. Asensio and Delmas 2015; Schwartz et al. 2015; Van der Linden 2015).

A richer explication of the interaction between contextual and individual determinants is therefore needed to understand processes of behavioral change more fully. To facilitate this discussion, we put forward a conceptual framework comprised of four

[2] See, e.g., Vandenbergh and Steinemann's (2007) discussion of the potential use of legal reforms to activate and promote norms that encourage carbon-neutral lifestyles.

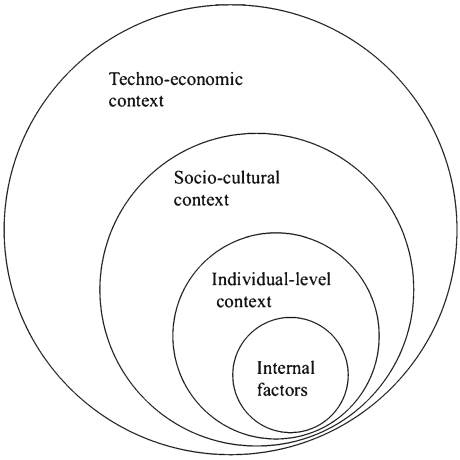

Fig. 1 Internal and contextual factors of behavior

distinct levels, three of which correspond to the various contextual factors that are relevant for individual behavior (see Fig. 1). Given our desire to situate the ultimate impetus for behavioral change with the individual, the internal factors (e.g. attitudes and preferences) are assigned their place at the core of the framework. As a reflection of the broad desire to reduce the level of environmental impact, we thus envision such factors to constitute a clear point of departure for exploring the potential for lasting and durable behavioral change. Meanwhile, the various contextual factors are grouped into three different layers according to the relative degree of difficulty of making changes—from the perspective of individuals. Higher-order determinants including available technology and infrastructure are therefore assigned to the superordinate level of the techno-economic context, since these factors are beyond the immediate control of any single person. Next, those factors of a more social in nature, e.g. norms and status considerations, populate the socio-cultural context and characterize how others influence one's behavior. The influence of such factors, even though a consequence of broader social and cultural forces, is ultimately expressed in the actions of individuals. In contrast, the techno-economic factors (e.g. policies and technology), while certainly influencing action at the individual level, are less likely to be directly influenced by the actions of a typical person. Lastly, those determinants that shape the immediate frame of decision-making and the set of alternatives seen to be feasible (e.g. habits and knowledge) are assigned to the individual-level context. It can be noted that it is exactly this more proximate understanding of context with which 'nudging' and behavioral research is typically engaged—that is, by seeking to promote change in individual behavior through the modification of the immediate context relevant for decision-making. As a side-note, this also serves to illustrate the limited scope of behavioral interventions so long as the influence of the higher-order contextual factors is not taken into account during policy-making.

Besides its straightforward presentation, this conceptual approach is suitable for a host of reasons. To begin with, the behaviors themselves and their environmental significance are placed front and center. As such, it is not the effectiveness of certain policy interventions (e.g. Truelove et al. 2014; Stern et al. 2016) or types of barriers

that demand further consideration according to our approach (e.g. Moser and Ekstrom 2010; O'Rourke and Lollo 2015). Instead, we stress a potential role for individual-driven action to establish how the capacity to improve one's degree of sustainability is ultimately dependent on the impetus generated by individuals themselves. On the one hand, the relative novelty of pro-environmental behavior across many domains makes changing one's behavior a practical necessity. Consequently, the fact that the status quo of behavior tends to be environmentally destructive implies that contextual change alone is not sufficient, at least not for behaviors that are deeply entrenched in the existing context (e.g. Gardner and Stern 2008). Even though the importance of internal factors is often overshadowed by that of contextual factors, it is therefore reasonable to consider the willingness and inclination to behave sustainably as delivering the crucial impulse for behavioral change. Moreover, there are various philosophical and moral reasons for why individual-driven action ought to be prioritized, including the relevance of principles like autonomy, legitimacy, and self-determination (Taylor 1991; Habermas 1996). On a more practical note, the degree to which individuals feel involved and active in their decisions also corresponds to expressions of environmental behavior such as behavioral frequency (Green-Demers et al. 1997) and the level of intrinsic motivation to support the environment (Pelletier et al. 1999). According to Thøgersen (2005), the value of instilling consumers with a greater sense of empowerment to change their lifestyles thus shifts greater focus to strengthening their capacities to create better opportunities for themselves—rather than have sustainable behaviors made easier for them.

Furthermore, the overlapping layers of context are included for a few crucial reasons. First, such layers are important in regulating whether and how the influence of internal factors is reflected in actual behavior. Second, the increased emphasis on the factors operating at each of the respective levels allows us to consider the possibility that a given behavior is not the result of underlying attitudes and preferences but rather constraints in the existing context. By removing the thwarting influence of contextual factors, it would then become possible to have behavior that is more reflective of internal factors. In contrast to other approaches (e.g. Stern 2000; Thøgersen 2014), we thereby adopt a less path-oriented portrayal of behavior in order to emphasize how the distinct levels of context interact with, and modify the expression of, the internal factors that furnish behavior with its underlying orientation. Similar to Swim et al. (2011), it is the interrelationships between contextual and internal factors, and the resulting influence of these interactions on behavioral change, which is therefore seen to require greater attention. Finally, by envisioning context as three separate levels, we are able to illuminate the potential for interactions between contextual determinants as well. As a rule, such interactions are essential to explain the potential for behavioral change that is environmentally significant. Otherwise, it can be difficult to predict how likely a given behavioral change is to persist over time and prove resilient to changes in the overarching context (see Sect. 6).

Table 2 Determinants of environmentally significant behavior

Internal factors	Individual-level context	Socio-cultural context	Techno-economic context
Preferences	Resources (such as income and time)	Socio-demographics (e.g. household size, geographic location)	Policies and regulations
Attitudes	Knowledge	Social and personal norms	Institutional framework
	Habitual behavior	Status considerations	
Intentions	Identity and Self-image		Technology
	Values		Infrastructure
			(Relative) prices

5 Determinants of environmentally significant behavior

5.1 Summarizing the relationship between internal and contextual factors

The literature on environmentally relevant behavior spans a number of disciplines and, as a result, is understandably extensive and diverse. The benefits for sustainability science of such a trans-disciplinary perspective are repeatedly described, and especially in relation to the possibility of cultivating a more substantive role for individual actors (Brandt et al. 2013; Stern 2014). Nevertheless, given the distinct emphases of the relevant disciplines, it is necessary to integrate the various 'polycentric' levels that are relevant in order to provide guidance for those wishing to reduce their overall environmental impact. In the first place, the terminology used to describe the willingness to engage in sustainable behavior can vary substantively across disciplines. Relevant differences among the internal factors of *attitudes*, *preferences,* and *intentions* are thus the first point of discussion for the conceptual framework.

Furthermore, in order to flesh out a more pragmatic approach to behavioral change, it is necessary to integrate the distinct psychological, social, cultural, and economic factors (see Table 2 for an overview). Since the transitions literature tends to focus more on technological and economic factors, the relevance of these other factors is often less prominent. To harness these determinants to promote transitions, it is moreover necessary to survey the significance of both internal and lower-order contextual factors as well. Splitting the contextual factors into three distinct levels is helpful in this respect to illuminate how the factors potentially influence one another. For this reason, each of the sub-sections on context begins with a brief expository case of the decision whether to use a bike or a car to get to work. In this manner, we introduce both the types of factors that are relevant in a given contextual level and provide some initial clarity with regard to the interlacing considerations that underlie a given decision in the environmental domain, even one as seemingly simple as this one. Even though the role of individual action is stressed, this section illustrates that it is often the factors operating within the many layers of context—and not only the designs of individual actors—which establish the momentum for behavioral change, and thus determine the overall environmental impact.

5.2 Characterizing internal factors

The significance of individual-driven behavioral change in our conceptual approach makes it necessary to explore how each internal factor is relevant. In spite of differences in how the concepts are applied in economics and psychology, respectively, both preferences and attitudes reflect the value attached by individuals to an event or object (Kahneman et al. 1999). In the case of *preferences*, the underlying value judgment is typically represented as a choice between two (or more) potential alternatives. In the specific case where the alternatives are products that differ in terms of environmental impact, pro-environmental preferences can be 'revealed' via the act of provisioning. More generally, however, it is not always so easy to infer preferences directly from consumption behavior. For this reason, Kahneman and Sudgen (2005) have proposed an alternative version of preferences as the choice between alternative states of the world. In this respect, pro-environmental preferences represent a (hypothetical) comparison between worlds of higher and lower environmental quality, and not simply a choice among a set of products. Likewise, a preference for environmental quality can alternatively be characterized by the decision to vote for a 'green' party that advocates for stricter environmental regulation (Kahn 2002) (see Table 3 for some illustrative examples of the relevance of the different factors for everyday decision making).

Unlike preferences, *attitudes* express value in terms of the degree of favor or disfavor associated with particular objects, issues, persons, events, or institutions (Sherif and Hovland 1961; Eagly and Chaiken 1993). For this reason, attitudes often assume an emotional valence in their immediate response to objects (Kahneman et al. 1999; Ajzen 2001). However, when attitudes do not reflect evaluations vis-à-vis the direct comparison of (at least) two different stimuli, as is generally the case with social objectives such as environmental protection, they entail a notable increase in complexity in relation to preferences. Namely, an attitude towards a given objective cannot be described by a single action (e.g. purchasing behavior), but rather all the manifold actions by which that objective can be attained (Stern and Dietz 1994; Stern et al. 1995). When it comes to environmentally relevant decisions, the types of judgments that individuals typically make are thus more reflective of attitudes and attitude expression (Dietz et al. 1998; Kahneman et al. 1999). In specific, one reason that the use of attitudes is broadly appropriate for environmental decision-making is its greater flexibility. Whereas preferences might model choice in the binary sense of whether to purchase, the "latitudes of acceptance" that underlie attitudes provide individuals with 'wriggle room' to navigate situations where there is a potential conflict between two goals (Sherif and Hovland 1961).[3] To wit, individuals may desire to protect the environment by purchasing organic food while still recognizing that, in light of their limited budgets, this money may be more impactful if used to purchase an electric car and/or install solar panels. Taken in isolation, the decision not to purchase organic food may be construed as not having interest in environmental protection even though it better reflects a conscious decision of how to make use of one's limited resources in a manner most concordant with one's priorities. Expression of positive attitudes

[3] Our thanks to an anonymous reviewer for bringing this point to our attention.

Table 3 Should I cycle or drive to the office today?

Contextual layer	Behavioral determinant	I will probably take the bike since…
Internal factors	Preferences	…I prefer cycling over driving for a number of reasons (e.g. it is healthier, cheaper, and more friendly to the environment).
	Attitudes	…I just like cycling.
	Intentions	…all the circumstances are right and that is what I had planned to do anyways.
Individual-level context	Income	…I cannot afford a car.
	Time	…I'm not in a hurry today. And often, during rush hour, cycling is even faster!
	Knowledge	…I am aware of the health benefits of cycling. I also know that car driving is among the most environmentally impactful behaviors, so I attempt to drive less whenever possible.
	Habits	…I cycle to work every day and therefore don't even consider driving anymore.
	Identity	…I consider myself an environmentally responsible person.
	Values	…I'm a person who generally cares a lot about society and nature. To me, the desire to have one's own car is somewhat egotistical.
Socio-cultural context	Socio-demographic factors	…I do not live far from where I work.
	Social norms	…all my neighbors cycle, which puts some pressure on me.
	Personal norms	…, after observing other members of my family cycling and being encouraged to take the bike as well, I now feel somewhat obliged to do so—even if they occasionally are themselves too lazy to take the bike!
	Status	…Green is the new Black. In fact, I sometimes make a detour on my way to work to make sure others will see how environmentally responsible I am.
Techno-economic context	Policies and regulations	…it is becoming more difficult to drive to work given the greater incidence of car-free days and limitations on use of cars in the downtown area where I work.
	Institutional framework	…I sense a general trend towards sustainability. One day I might be glad that I started questioning my detrimental impact on the environment so early.
	Technology	…the invention of E-Bikes has made cycling much easier for an elderly person like me.
	Infrastructure	…there are nice and safe cycling paths that pass directly by where I work.
	(Relative) prices	…gas prices have increased so much that I only drive when there is really no other option.

towards the environment and the pursuit of attitude change are, for this reason, central determinants of pro-environmental behavior (e.g. Guagnano et al. 1995; Stern et al. 1995; Bamberg and Möser 2007). Moreover, pro-environmental attitudes are strongly correlated with the degree of environmental concern that one expresses (Stern and Dietz 1994; Dietz et al. 1998). Owing to their greater generality and flexibility, attitudes are often employed to explain less economically situated behaviors such as the desire to make a voluntary contribution to protect the environment (Kahneman et al. 1993; Kahneman and Ritov 1994) and support the objectives and outcomes of the broader environmentalist movement (Stern et al. 1999; Stern 2000).[4]

The downside to attending more closely to the motivations of individuals to engage in environmentally relevant behavior, however, is the increasing conceptual distance from actual behavior. In this respect, *intentions* act as the link between attitudes and stated preferences on the one hand, and actual behavior on the other hand. Within the psychological literature, intentions thus represent the immediate antecedents of behavior (Sheeran and Abraham 2003), while the economic literature similarly portrays intention formation as the mechanism through which consumers are encouraged to establish stable consumption behaviors (Sherman 1980). Nevertheless, if consumers are unable to retrieve intentions at the precise moment or within the precise context of decision-making, the effort devoted to forming intentions could prove fruitless (Shapiro and Krishnan 1999). Perhaps for this reason, pro-environmental intentions have proven to be insufficient predictors of actual behavior (e.g. Gatersleben et al. 2002). In contrast, a recent meta-analysis has established a stronger correspondence between intentions to behave environmentally and actual behavior in both developed countries and individualistic cultures (Morren and Grinstein 2016). The type of culture in which individuals live and reside is thus a crucial factor of whether pro-environmental intentions (and positive attitudes towards the environment) ultimately result in behavior that is more environmentally friendly.

5.3 Behavioral determinants and the individual-level context

While necessary to characterize how much individuals value the environment, internal factors alone are not sufficient to explain environmentally relevant behavior. With regard to attitudes, for instance, the oft-described gap between environmental attitudes and behavior demonstrates that other factors must be considered (e.g. Conner and Armitage 1998). In order to understand the potential to reduce overall environmental impact, it is important to consider the types of contextual factors that may determine whether the internal factors of attitudes, preferences, and intentions are ultimately expressed in environmentally relevant behavior.

[4] The discussion of meta-preferences (or second-order preferences) does however signal the potential for greater correspondence that exists between attitudes and preferences (Frankfurt 1971; Hirschman 1985). Decisions over what to consume are argued to consider not only preferences but also preferences about the types of preferences one wishes to have. For instance, while an individual might 'prefer' to take the car when in a rush, this does not rule out the possibility of having a meta-preference for driving less in general to reduce environmental impact.

In this regard, contextual factors operating at the individual level offer some reasons why actual behavior need not necessarily reflect the influence of internal factors such as preferences and attitudes. Such reasons can be illustrated using some brief examples related to the decision of whether or not to commute to work by car or bike. First, concerning *income*, the availability of this resource generally determines the respective quality of car or bike that an individual can afford, establishing both the broad frame of the decision and potential level of satisfaction that can be expected. However, while a higher income level might increase the likelihood of having a better bike, the greater *time* pressure that comes with longer working hours could cultivate the desire to get to work as soon as possible, making it necessary to take the car. To overcome the initial sway of such resources (or their lack), taking the decision to cycle to work might therefore require a sufficient level of *knowledge* about the likely health-related or environmental benefits. Such knowledge could specifically counteract the perceived costs that exist. Nonetheless, in spite of one's intentions, should a contradictory *habit* already exist (i.e. taking the car to work), any change to routine would require a substantial initial investment in terms of time and effort, again shifting the decision calculus towards the costs involved. Finally, the decision to cycle to work is influenced by matters of *identity* as well, including whether an individual views herself as someone that cares for the environment and thus perceives the need to act accordingly.

With regard to *income*, environmental quality is often considered to represent a normal (or sometimes luxury) good. As such, those individuals with larger budgets are expected to be more able and thus more likely to care for the environment, since they have more disposable income (Dasgupta et al. 2002; Kahn 2002). In fact, a recent cross-national survey has revealed a positive relationship between levels of national income and the likelihood of contributing to environmental protection (Lo 2014, 2016). However, there is also growing evidence from empirical investigations of energy use at the household level that the scope of emissions is actually increasing with income (e.g. Baiocchi et al. 2010; Druckman and Jackson 2010). In spite of having greater opportunity to do so, there is no guarantee that wealthier households are any more likely to engage in environmentally significant behavior. In fact, there is evidence that income actually promotes more environmentally harmful behavior, i.e. given the negative relationship between national income and perceptions of environmental risk (Lo 2016). Irrespective of substantial differences in their attitudes and behaviors, Csutora (2012), for instance, finds that the ecological footprints of 'green' and 'brown' consumers are almost identical. Nevertheless, the (negative) effect of income remains highly significant.

Although higher incomes are expected to make sustainable lifestyles relatively easier, it is important to recall that behaving sustainably also places demands on other resources. In this regard, the limited incidence of pro-environmental behaviors like recycling is explainable by the increasing amount of *time* required, even if simply to learn how to perform the behavior. In contrast to income, there is however no straightforward explanation with respect to the possible impact of time. In fact, the complexity of the relationship between time and consumer behavior is made readily apparent if one considers the unexpected consequences of increasing the length of the workday. On the one hand, the desire to maximize the use of one's more limited free time is predicted to promote the purchase of more time-saving goods, which, due

to being more energy-intensive, results in a less sustainable lifestyle (Devetter and Rousseau 2011). On the other, the separate problem arises that, even when time is relatively abundant, individuals can find themselves lacking things to do. The greater consumption of material goods can thus represent a potential means to fill up the day and create meaningful passages of time (Csikszentmihalyi 2000). Conversely, it is also true that not all forms of time are at the discretion of individuals, i.e. given their existing time commitments. Highlighting the need for such 'discretionary time', Chai et al. (2015) determine how its greater availability is linked to the capacity of individuals to develop preferences in line with their underlying levels of environmental concern—and thereby overcome the gap between values and action.

The crucial importance of *knowledge* for environmentally significant behavior follows from the greater appreciation of how individuals fail to fully grasp both the environmental consequences of their activities and the most suitable means to address the problems that exist (Bord et al. 2000; Gifford 2011, 2014). Speaking to this point, Attari et al. (2010) describe the sizable divergence between consumer and expert beliefs with respect to how best to increase energy efficiency. In addition, individuals are found to typically underestimate their level of energy use by a factor of 2.8—a pattern also observed for water use (Attari 2014). In view of such general deficiencies in knowledge, individuals tend to be more persuaded by and rely on information that coheres with their existing political, cultural, and social worldviews—even if such information is not necessarily the most accurate (cf. Kahan et al. 2012; Kahan 2013). For this reason, Bamberg and Möser (2007) conclude, using a meta-analysis of environmental behavior, that greater awareness of environmental problems alone is not sufficient to reduce overall environmental impact. Rather, it is not more but better information that is required to overcome existing 'biases', namely information better tailored to individual circumstances and which takes into account individual goals (e.g. Abrahamse et al. 2007; Zelezny 2010). As revealed by Shi et al. (2016), consequently, there is a linkage between level of knowledge and the degree of environmental concern, though only when knowledge is conceived in a domain-specific fashion. As such, only knowledge related to the causes of climate change—instead of about its underlying physical processes and expected consequences—is found to heighten the degree of environmental concern.

In light of the shortcomings of information provision, the existence of countervailing *habits* provides an explanation for why environmentally significant behavior is less prevalent than expected. Notably, the entrenchment of habitual behaviors is likely to make behavioral change more difficult in many situations, no matter an individual's level of environmental concern. Accordingly, Verplanken (2010, p. 639) argues that: "the defining quality of habit is the automaticity and efficiency of behavior occurring in stable contexts". This definition first underscores why there is often strong resistance to behavioral change, i.e. because habits tend to have a countervailing impact on intentions to behave pro-environmentally (Wood et al. 2005; De Bruijn et al. 2007). As a result, the significance of habits is especially pronounced for behaviors that are frequently repeated and relatively easy to perform, e.g. short-distance car usage (Gardner and Abraham 2008). However, as stressed by Verplanken, contextual aspects are also important for habitual persistence. That is, habits initially form and continue to endure because of the presence of a stable context. In this regard, habit formation is

also beneficial since habits reduce the uncertainty of decisions taken repeatedly over time (Carroll 2000). Accordingly, behaviors like recycling or taking public transport become easier for individuals, in spite of the objective costs involved, when a habit for doing so has already been established (Verplanken et al. 1998; Carrus et al. 2008).

Similar to habits, issues of *identity*, especially the degree to which an individual self-identifies as a 'green' individual, can broadly predict pro-environmental behavior (Sparks and Shepherd 1992; Whitmarsh and O'Neill 2010; Hornsey et al. 2016). In specific, the fact that diverse consumers can value the same objects and outcomes differently raises the need of explaining where this additional value comes from. Within economics, the concept of identity utility is introduced for this reason to explain how greater utility can be obtained from those activities and objects most reflective of an individual's identity or self-image (Akerlof and Kranton 2000). It is, paraphrasing Festinger (1957), the desire to minimize their levels of mental stress and discomfort that thus precisely motivates people to, e.g., seek out products and activities that best conform to how they view themselves. Consequently, the existence of a stronger pro-environmental sense of self can explain whether an individual is more likely to engage in non-consumption activities such as environmental activism (Fielding et al. 2008; Clayton et al. 2013). More generally, entering identity into the equation can also clarify why some individuals still refuse to recognize the broad scientific consensus on climate change. According to Dan Kahan, it is actually the under-considered weight of so-called "expressive incentives" that explains why high levels of scientific knowledge fail to produce a similar degree of environmental concern (Kahan et al. 2012; Kahan 2013). That is, risk perceptions are not derived from a rational calculation of all available knowledge and information, but rather individuals more often have levels of environmental concern in agreement with those of the groups with which they most closely identify (Kahan et al. 2012; Fielding and Hornsey 2016). Surprisingly, the individuals found to be most steadfast and confident in their beliefs are not those who have the least knowledge but rather those who are the most scientifically informed (Kahan et al. 2012). If true, however, this implies that no amount of informed discourse is likely to prove persuasive—unless promoted by a messenger from one's own group. Alternatively, establishing a linkage between one's own past behavior and attainment of pro-environmental outcomes could provide another potential strategy to foster environmentally relevant behavior in the future (Van der Werff et al. 2014; Fielding and Hornsey 2016).

As a further expression of identity, the *values* that individuals seek to uphold can offer a more general account of how they perceive their relationships to the people and places that matter to them (Stern et al. 1995; Hornsey et al. 2016). Notably, the degree to which people endorse egoistic, altruistic, and biospheric values describes the weight attached to outcomes affecting themselves, other individuals, and the broader environment, respectively. In other words, the more people care about other humans, other species, and the environment—and less about themselves alone—the more likely they are to engage in environmentally friendly behavior (Stern and Dietz 1994; Corner et al. 2014). Further, as broad guiding principles that orient one's life (Schwartz 1992), values are able to explain the likelihood that individuals engage in a range of environmentally relevant behaviors (Nordlund and Garvill 2002; De Groot and Steg 2007). Values can also illuminate why some individuals are more likely to perform behaviors

of a more public nature such as voting and environmental activism, which tend to evade explanation by norms alone (Stern et al. 1999). In relation to environmental campaigns, moreover, the consideration of the full spectrum of individual values is often necessary to ensure their ultimate success. Notably, it is found that monetary incentives are often less compelling reasons to conserve energy than 'non-price incentives' of a moral or biospheric nature (Bolderdijk et al. 2013). In fact, the exclusive reliance on self-interest to foster energy conservation—while ignoring the more intrinsic reasons for acting environmentally—can backfire and diminish the likelihood that behavioral change even takes place (Asensio and Delmas 2015; Schwartz et al. 2015; Van der Linden 2015).

5.4 Behavioral determinants and the socio-cultural context

The significance of the socio-cultural context is evident from the range of factors that broadly inform the relationship of individuals with their surrounding social environments. Again referring to the example of cycling, whether an individual actually bikes to work might be explained in relation to his or her current life situation. In this regard, *socio-demographic characteristics* relating to one's household size and geographic location provide a general description of the potential for cycling versus driving to work. Nevertheless, if the individual lives in a neighborhood where the *social norm* of cycling to work prevails, the commonplace nature of this behavior—as well as subtle pressure to conform—potentially offsets the greater difficulty. Furthermore, the degree to which individual behavior adheres to a *personal norm* that encourages a greater sense of responsibility to protect the environment, the more likely they are to cycle regularly. Perhaps even in situations when driving might be more convenient or practical, this normative sway is strong enough for individuals to deliver on their intention to cycle to work. Conversely, if the societal context is prejudiced against cycling because of *status considerations*—for instance, because their high-status role models tend to drive—then individuals might instead invest their existing resources in a manner more reflective of their level of status, or perhaps the status to which they aspire.

The significance of *socio-demographic characteristics*, including household size and geographic location, provide a general picture of the potential fit between a behavior and the general life situation. For instance, an individual living in a region with a colder climate is likely to have greater need for indoor heating in winter months. Consequently, geographic location and household size are two of the principal determinants of household energy use, the latter specifically due to the greater energy requirements for cooking and transportation (Jackson 2005; Hunecke et al. 2007). Nonetheless, although this effect is present for certain behaviors, it does not seem to hold true for environmentally significant behavior as a whole (Martinsson et al. 2011). One explanation is that the presence of scale economies, by lowering the per-capita costs of pro-environmental behavior for entire households, makes it more affordable to reduce overall environmental impact. Given how much the effect varies by behavior, it is difficult to provide sweeping conclusions about the effect of socio-demographic characteristics on environmental impact (Diamantopoulos et al. 2003; Hornsey et al. 2016).

Furthermore, the pressure to follow existing *social norms* similarly demonstrates the influence of the social environment. Norms represent customary rules of behavior that are central to interpersonal interactions and social organization.[5] Beyond the more social aspects involved, the decision by individuals to conform to a norm also makes it easier to gather and process information, especially for unfamiliar behaviors (Cialdini et al. 1990). Given that normative information exists for both desirable and undesirable behaviors, however, the environmental impact of norms depends on what exactly the norm communicates and the resulting template provided for individual behavior (Cialdini et al. 2006). In this regard, another crucial aspect of social norms is the implicit pressure exerted on individuals to follow the example of peers and role models. For instance, once individuals were informed about the average energy use of other members of their community, their behavior tended to conform to the norm, regardless of the impact on overall energy usage (Schultz et al. 2007). Exerting pressure to conform with existing norms has proven effective in encouraging individuals to undertake environmentally relevant behaviors like: littering (Cialdini et al. 1990, 1991); water conservation (Aronson and O'Leary 1983); public transportation (Heath and Gifford 2002); and recycling (Schultz 1999). Accordingly, Welsch and Kühling (2009) identify the example of significant others (i.e. friends, neighbors, and relatives) as the most significant determinant for decisions to consume organic food. In fact, this factor is identified to have an explanatory power equivalent to attitudes, price, income, and socio-demographic variables combined. Given the frequent opposition to taxes and direct regulations, norm activation thus represents a viable alternative that can be used to promote environmental behavior (Vandenbergh and Steinemann 2007). Nevertheless, the influence of the social environment on an individual's actions can further vary depending on what it is that one holds to be most personally relevant. For this reason, it is not accurate to expect all individuals in a given societal context to be similarly affected by the presence of social norms. In particular, the perceived persuasiveness of social norms is found to critically depend on the degree to which individuals have internalized the feeling of obligation or responsibility, resulting in the establishment of a *personal norm* (Schwartz and Howard 1981). Across a number of studies, the existence of this deeper sense of responsibility is able to explain why the tendency to engage in pro-environmental behavior varies across individuals (Harland et al. 1999; Manstead 2000; Bamberg and Möser 2007).

Finally, the exclusive quality of environmentally significant products (or their carbon-intensive counterparts) is also useful as a means to signal their status and generosity to others. For this reason, the greater prevalence of costly and visible behaviors, e.g. owning a hybrid car or installing solar panels, serves as evidence of the increasing importance of *status considerations* in this consumption domain. In other words, it is the craving of "going green to be seen" rather than the degree of environmental concern, according to Griskevicius et al. (2010), which directly explains the rise of environmentally friendly consumption. Similar to social norms, however, it is possible for status symbols to work in the opposite direction as well, for instance, by giving importance

[5] A further distinction is made regarding the kind of information that is provided. Specifically, descriptive norms communicate how others tend to act in a given context, while injunctive (or prescriptive) norms attach a sense of approval or disapproval when expressing what ought to be done (Aronson et al. 2012).

to environmentally destructive behaviors (Thøgersen 2014). The ultimate effect of status considerations on environmental impact, like so many other socio-contextual determinants, therefore depends on the particular meaning with which such practices are invested in the relevant context (cf. Shove and Walker 2010).

5.5 Behavioral determinants and the techno-economic context

Residing at the level furthest from individuals, we have the determinants operating within the techno-economic context. Both the available decision alternatives and overall structure of incentives presented to individual consumer are an outcome of this highest level of the overall decision context. As such, this level of context is composed of the *policies and regulations* that constitute the wider frame of individual behavior, the general structure provided by the *institutional framework, technology, infrastructure*, and the (relative) *prices* of goods and services. In terms of our recurring example, policy instruments can be designed to incentivize cycling by subsidizing the purchase of bicycles, while advances in technology might make cycling more feasible for a broader range of individuals, e.g. via the development of electric bikes. Improvements in cycling-friendly infrastructure can also increase the attractiveness of cycling by, for instance, building wider gaps between cycle paths and automotive traffic to provide an increased sense of safety. Finally, in a more general sense, the effect of the techno-economic context functions through the cumulative effect of such factors on prices, so that the increasing (relative) price of gasoline provides further incentive to cycle to work.

With regard to *policies and regulations*, a number of tools and approaches have been implemented to increase the incidence and intensity of environmentally significant behavior. In general, such instruments can be distinguished into two categories. First, there are those targeted at individuals and seeking to affect decision-making processes directly, such as eco-labeling schemes. Second, there are those interventions that affect individual behavior more indirectly, notably, by influencing the actions of producers, retailers, and/or local and national authorities. As examples of this policy type, we highlight both the Emissions Trading Scheme in the European Union and regulatory interventions that establish new production standards.

At an international level, moreover, signatory agreements like the Paris agreement and Kyoto Protocol, which set broad emissions-reduction targets for countries, represent a vital feature of the *institutional framework*. On a more national and regional level, moreover, the need for institutional reforms to reduce environmental impact is generally demonstrated (e.g. Arrow et al. 1995). However, it is not necessarily true that wealthier nations have a lower environmental impact due to their more developed institutional structures. Instead, the lower energy intensity of developed countries is often the consequence of taking advantage of the weaker institutional contexts of developing countries (e.g. Peters et al. 2011; Gross 2012). As such, an alternate explanation for the correlation between relatively developed institutions and lower environmental impact might be that such institutions open up the possibility of richer countries to offshore a major share of their energy-intensive production. To give an example, while it is true that emissions have decreased in the signatory countries to the Kyoto Protocol,

this result corresponds not to smaller carbon footprints, but rather an increase in the relative share of imported emissions (Aichele and Felbermayr 2012).

The importance of *technology*, meanwhile, is most clearly apparent in the potential for energy-saving technological progress to reduce the energy intensity of goods and activities. Whatever the particular consumption patterns of individuals, technical advances like low-flow showerheads and efficient water heaters are able to reduce household energy consumption substantially (Vandenbergh and Steinemann 2007; Dietz et al. 2009). Hence, on the topic of time-saving technologies, Brencic and Young (2009) argue that the greater market penetration of such devices for general household use is expected to affect not only household energy use, but also time allocation between home production and leisure activities. Given that the gains from greater productivity are frequently utilized to purchase additional material goods, rather than increase leisure time, decisions of how to re-allocate time is another significant determinant of overall environmental impact (e.g. Reisch 2001).

The connections between *infrastructure* and behavior are most evident in relation to the availability of pro-environmental products and perceived inconvenience of undertaking certain pro-environmental activities. For instance, the relative inconvenience involved with purchasing a product that is either not widely sold or demands a special trip can explain why having substantial time and income are not sufficient to foster consumption (Scholderer and Grunert 2005). In addition, the link between infrastructure and perceived inconvenience is also apparent for behaviors such as recycling, the ease of which is heavily influenced by the nature of the existing infrastructure (Knussen et al. 2004; Ölander and Thøgersen 2006).

Finally, discussions of the relationship between *prices* and environmental impact are frequently conceived in terms of both the price elasticity of demand of an environmentally harmful good and the cross-price elasticity between an environmentally harmful good and its potential substitute. For instance, as an explanation for the limited change in driving behavior, Brons et al. (2008) conclude that, under normal circumstances, both the mean short- and long-run price elasticities of gasoline are not very sensitive to a change in price. In addition, the significance of price considerations is also demonstrated by the various studies investigating the cross-price elasticity between gasoline prices and vehicle purchases (e.g. Gallagher and Muehlegger 2011). With regard to the potential effectiveness of price signals for environmentally relevant activities, furthermore, it is noted that energy prices do not accurately reflect all external costs in the presence of subsidies and tariff regulations (Linares and Labandeira 2010). However, since customers have difficulty assessing the actual costs of their behavior (cf. Gifford 2014), their capacity to foster improvements in environmental quality is substantially reduced.

6 Contextual interactions and behavioral change

6.1 Interactions between contextual determinants

One of the most valuable insights to emerge from recent behavioral research is how changes occurring at the higher-order contextual levels can potentially affect the

lower-order context in which individual decision-making occurs. Consequently, the likelihood of reducing overall environmental impact generally depends on how well interactions between the distinct levels of contextual determinants are understood. Having assigned these factors to their three respective levels, the foundations are thereby established for a discussion of how the relevant interactions affect the potential for behavioral change—plus how the context itself can evolve because of such changes. In this sub-section, we utilize the examples of the *rebound effect, motivation crowding out, habit discontinuity*, and *norm activation* to investigate how and why such interactions are relevant for sustainability transitions (Table 4).

Beginning with the techno-economic context, the emergence of more energy-efficient technologies could paradoxically undermine efforts to reduce emissions from energy use. By making energy use cheaper for consumers, technological progress is likely to foster increasing demand. This turn of events has the potential to (partially) offset some of the immediate gains from energy efficiency. If this *rebound effect* is large enough in fact, it might lead to expected energy savings that never materialize. Consider the example of refrigerator efficiency. In spite of refrigerators being three to four times more efficient now than in the 1970s, the total demand for electricity from this source in the United States has not decreased (Barkenbus 2006). Instead, any improvements in energy efficiency in relation to total demand are obscured by increases in the size of refrigerators and the number of households that can afford to own more than one refrigerator (Barkenbus 2006; Saletan 2006; Vandenbergh and Steinemann 2007). Rather than an invitation to reduce their total electricity consumption, individuals tend to view this greater affordability as an opportunity to increase usage. As Vandenbergh and Steinemann (2007, p. 1727) explain, the same story is also apparent for central air conditioning in homes, air conditioning in automobiles, and car driving patterns—not only in the U.S. but also France and Canada. Nevertheless, recent literature reviews conclude that the extent of the rebound effect in domains like household energy use and transportation typically amounts to less than a third of overall gains (Sorrell et al. 2009; Gillingham et al. 2013). Though the level of emissions is still significantly reduced, this phenomenon illustrates the problem of assuming that changes to the context will eventually affect behavioral change in any sort of direct and predictable manner even if behavioral responses are not taken into account.

There is further debate in the literature regarding the reliance on monetary incentives to promote sustainability. In this regard, since financial incentives like deposit-refund systems for reusable packaging are widely relied upon, it is important to consider how such incentives potentially affect intrinsic motivations to behave more sustainably (Deci et al. 1999; Bowles 2008). First, recall that emphasizing the monetary benefits of energy conservation often has an adverse effect on both the environmental concern of participants and their willingness to enroll (Bolderdijk et al. 2013; Schwartz et al. 2015; Asensio and Delmas 2015). This behavior can be explained in terms of *motivation crowding out*, i.e. the diminishing significance of altruistic values, ethical norms, and pro-social preferences in the presence of external rewards (Frey 1997; Frey and Oberholzer-Gee 1997). In part, this phenomenon reflects the belief that peers will ultimately attribute this behavior to the pursuit of monetary rewards, even if this is not actually the case. Drawing on experimental evidence from rural Colombia, Cardenas et al. (2000) demonstrate that providing monetary payoffs to resolve an envi-

ronmental dilemma actually reduces social welfare, specifically by crowding out the other-regarding behavior of participants. Rather than an entirely social phenomenon however, an individual might also be encouraged to act in a given way because of the tendency to 'self-perceive' their attitudes from the behaviors in which they engage (Bem 1972). Similarly, Van der Werff et al. (2014) illustrate how simply reminding people of their past environmental behaviors can cultivate a stronger sense of environmental self-identity. Irrespective of the attitudes that one currently holds, there is thus an indication that, if a policy can be formulated to induce behavioral change in a persistent and recurrent fashion, changes in the level of motivation could follow. Consequently, Bowles and Polanía-Reyes (2012) assert that, so long as policies are designed appropriately, it is also possible to 'crowd in' individual motivation. For this to occur however, individuals must retain a sense of being internally driven to engage in sustainable behavior, in spite of whether external economic rewards are present (Green-Demers et al. 1997; Pelletier et al. 1999; Truelove et al. 2014). In other words, regardless of the specific policy instrument, greater consideration must be given to how its implementation can affect the inferences that people make about the reasons and motivations for their actions.

These examples briefly illustrate the types of interactions that the techno-economic context has with the other contextual levels. It is similarly important to consider interactions between the socio-cultural and individual-level contexts. In this vein, the *habit discontinuity hypothesis* is useful to explain how changes in the socio-cultural context can, and are in fact necessary to, open a window for behavioral change (Verplanken and Wood 2006; Verplanken et al. 2008). That is, since habit formation is contingent on actions being repeated within a stable set of circumstances, only changes of an exceptional nature, e.g. moving to a new city and switching jobs, can disrupt habitual behaviors. The implication for environmental impact is that changes in the situational context are more impactful than, for instance, promoting pro-environmental attitudes and higher levels of environmental concern (Wood et al. 2005). The resulting issue, however, is that such efforts have little influence on the feasibility or convenience of certain behaviors. Many studies have thus assessed the effectiveness of structural strategies for behavioral change, including the temporary closure of a freeway (Fujii et al. 2001) and gifting a one-month free bus ticket (Fujii and Gärling 2003). In both examples, individuals became much more sensitive to the information provided to them, and hence more amenable to attitude and behavioral change. Similarly, Bamberg (2006) explains that those individuals who had just re-located to an urban area could be more easily encouraged to increase their use of public transportation. In specific, a combination of free service and the relevant schedule information was sufficient to encourage a change in behavior. By considering how changes in the context affect behavior, even relatively affordable policy instruments can thus be made more effective than their more elaborate and technically informed counterparts.

Beyond disrupting habits, changes to the socio-cultural context, including geographic location, also have the potential to activate norms and values toward the environment. Using a sample of university employees who had recently moved, Verplanken et al. (2008) observe that it is only the more environmentally concerned participants who take the opportunity to change their habits and commute to work by car less frequently. In this respect, the change in context, by removing the obstacle of

Table 4 Behavioral phenomena and the primary and secondary effects of pro-environmental policies

Behavioral phenomenon	Policy intention	⇒	Primary effect: Behavioral determinant	Contextual layer[1]	Partial outcome	+/−	Secondary effect: Behavioral determinant	Contextual layer[1]	Partial outcome	=	Overall outcome
Rebound effect	Increase energy efficiency of energy system *i*	⇒	Technology	TE	Reduced impact per unit of system *i*	−	(Relative) Prices	TE	Drop in per-unit price encourages increased use of *i*	=	Efficiency-led reductions in environmental impact are less than expected
Motivation crowding out	Offer monetary incentives to reduce impact on environment	⇒	Income	IL	Affected behaviors then become more prevalent	−	Values Norms Preferences	SC IL IF	Lowered levels of intrinsic motivation reduce likelihood of behavior	=	Pro-environmental behaviors may actually be less prevalent than before
Habit discontinuity hypothesis	Foster general increase in pro-environmental behavior	⇒	Variety of possibilities	TE SC IL	Potential growth of pro-environmental behavior is offset by prevailing habits	+	Habits	IL	Disruption of habits via context change opens windows for behavioral change	=	Greater behavioral ease and information responsiveness makes broader reductions in impact possible
Norm activation	Activate norms to impart greater motivational impetus	⇒	Personal and social norms	SC	Foster behavioral change in the given domain	+	Values	IL IF	Deeper influence on awareness/concern for environmental consequences	=	Total reductions in impact on the environment likely to be larger than expected

Table 4 Behavioral phenomena and the primary and secondary effects of pro-environmental policies (continued)

Behavioral phenomenon	Policy intention		Primary effect				Secondary effect				Overall outcome
		⇒	Behavioral determinant	Contextual layer[1]	Partial outcome	+/−	Behavioral determinant	Contextual layer[1]	Partial outcome	=	
Indirect rebound effect	Increase energy efficiency of energy system *i*	⇒	Technology	TE	Reduced impact per unit of system *i*	+	Income	IL	Income saved from spending less on *i* is then re-spent on $j \neq i$	=	If impact of *j* is higher than *i*, policy may 'backfire' and overall improvements turn out to be less than expected
Foot-in-the-door effect	Promote recycling via information campaigns	⇒	Information Knowledge	IL	Growth in relevant behaviors achieves some reductions in overall impact	+	Knowledge Identity and Self-image Resources	IL	Ease of engaging in a behavior increases likelihood of change more generally	=	Environmental significance of a 'gateway' behavior can be higher than expected for the behavior on its own
Self-serving bias	Foster general increase in pro-environmental behavior	⇒	Variety of possibilities	TE SC IL	Expected reductions in environmental impact as a result	−	Identity and Self-image	IL	Desire to maintain one's self-image leads one to focus on what has already been achieved	=	Constraints on information perceived to be relevant and the likelihood of potential changes in one's behavior
Self-licensing bias	Foster general increase in pro-environmental behavior	⇒	Variety of possibilities	TE SC IL	Expected reductions in environmental impact as a result	−	Identity and Self-image	IL	Engaging in a single behavior affords the perception that one has done one's part	=	Behaviors of limited environmental significance become more prevalent

[1] *IF* internal factors, *IL* individual-level context, *SC* socio-cultural context, *TE* techno-economic context

existing car habits, creates a window in which values can express themselves more fully via behavior. Nonetheless, the fact that behavioral change is more feasible does not guarantee the reduction in environmental impact, nor that destructive habits might not also emerge in the window created. For example, expanding the extent of the public transport system—that is, by investing in existing infrastructure—might reduce car use in large cities. Instead of reducing overall environmental impact however, the existence of a more developed public transportation network could also make it easier to get to the nearby airport, thus encouraging habits that are ultimately more environmentally harmful. In sum, so long as the context in which behavioral change takes place is neglected, all that can be said is that the context change opens the space for new habits to emerge, though nothing about what such change entails.

Establishing the broader relevance of norms such as personal responsibility and carbon neutrality is therefore explored as another mechanism to promote pro-environmental behavior (Vandenbergh and Steinemann 2007). In particular, the interest in *norm activation* follows from the potential to cultivate stronger pro-environmental attitudes and the deeper awareness about environmental consequences. In contrast to more temporary measures, such change at the level of the socio-cultural context intends to establish deeper foundations for behavioral change, so that any change may persist over a longer period of time (see Staats et al. 2004). If this awareness is able to engender a greater sense of obligation to reduce overall carbon emissions, there is then increased likelihood that a wider range of more civic behaviors occur, e.g. supporting environmental policies such as carbon taxes and environmental activism (Stern et al. 1999; Vandenbergh and Steinemann 2007). By more closely attending to the important interactions between the distinct levels, the specific value of educational and cultural initiatives is able to come to the fore, namely as a means to create momentum for enduring and environmentally significant behavioral change.

6.2 Exploring behavioral spillovers

By focusing on individual behavior, our framework has the benefit of also being able to discuss an individual's impact on the environment in a more integrated and straightforward fashion. In this regard, the role of behavioral spillovers should be specifically underlined. Notably, it is possible for behaviors that are relatively insignificant in terms of their own direct environmental impact to ultimately become significant through their influence on other behaviors. In other words, the potential for behavioral spillovers describes how a behavioral change can foster an increase or decrease in overall environmental impact because of its relationships with other behaviors. On the one hand, if the two behaviors are positively related—say, because an instance of behavioral change results in a parallel shift in the other—the environmental impact will be greater than expected. Conversely, the increasing frequency of a behavior that negatively relates to another environmental behavior would, via a change in the decision context, result in a smaller-than-expected change in overall impact. In view of the potential relevance for sustainability transitions, numerous studies have therefore sought to explain the conditions necessary for spillovers to take place, ultimately highlighting features of both the individuals and behaviors involved (Thøgersen and Crompton 2009; Whitmarsh

and O'Neill 2010; Truelove et al. 2014). To further explore these issues, we take two examples of positive spillovers, the *indirect rebound effect* and the *foot-in-the-door effect*, and two examples of negative spillovers, *self-serving bias* and *self-licensing bias*.

The *indirect rebound effect*, or re-spending effect, is notable for its emphasis on the impact that behavioral change in a single domain can have on ostensibly unrelated behaviors. In this regard, an indirect rebound effect characterizes the possibility for behavioral spillovers across (at least) two distinct consumption domains, because of income savings in one domain helping to increase purchasing power in another. In contrast to their direct counterparts, these indirect effects are more driven by changes in disposable income than the changing costs that are involved (e.g. Gillingham et al. 2013).[6] As already highlighted, the exclusive attention to the benefits of behavioral change in a single domain is insufficient not only to capture its full environmental significance but also to ascertain whether any reduction in the environmental impact is likely to occur. After accounting for the savings from other products and services, Chalkley et al. (2001) thus observe that nearly a third of the environmental improvements of purchasing an energy-efficient fridge-freezer and installing a high-efficiency domestic boiler disappear. The potential consequences become even clearer from the extensive experimental research into household responses to the dynamic pricing of electricity. For instance, Faruqui and Sergici (2010) determine not only that higher prices bring about reduced energy usage but also that this relationship is intensified when enabling technologies are available—in their case those that allow multiple end-uses to be controlled remotely at the same time. However, it also emerges that declining out-of-pocket costs for the energy budget provide households with the additional scope to devote more funds to water consumption. Policy conclusions based on the consequences in the energy domain alone would therefore fail to take into account all the relevant information. On a more positive note, Murray (2013) concludes that the extent of the indirect rebound effect in the context of transportation, although important, falls well short of fully offsetting gains. Even after considering deliberate saving behaviors like driving fewer kilometers and turning down the thermostat, Antal and van den Bergh (2014) find the rebound effects for distinct types of fuel consumption to add up to less than a quarter of initial savings. The indirect rebound effect does however prove to be important for overall environmental impact when there is a substantial difference with respect to the environmental significance of two behaviors. For instance, it is conceivable for individuals to re-spend their additional income on either long-distance travel or less environmentally harmful goods such as pieces of art. As a result, Druckman et al. (2011) calculate indirect rebound effects on the magnitude of approximately one third of overall gains for a combination of abatement actions. However, when re-spending is more strongly weighted towards goods and services with a low level of pollution intensity, the size of the rebound effect turns out to be only half as large.

[6] From another perspective, this effect therefore represents the net result of the income and substitution effects of this behavioral change for all the other goods and services purchased by the household (Chitnis et al. 2013).

The possibility that rebound effects are lower than expected is also explainable from the *foot-in-the-door effect*. In specific, the adoption of a single pro-environmental behavior, especially one that is rather easier to perform, could pave the way for the later adoption of more difficult and more environmentally significant behaviors (Thøgersen and Ölander 2003; Whitmarsh and O'Neill 2010). The importance assigned to recycling, for instance, might not only be a reflection of its specific level of environmental impact consequently, but also how this behavior correlates positively with the avoidance of excess packaging (Thøgersen 1999) and increased levels of water and energy conservation (Berger 1997). Accordingly, the potential that certain behaviors could act as catalysts for further rounds of behavioral change indicates that overall environmental significance is contingent on the indirect influence on other behaviors. As a further illustration of a potential gateway effect, the direct and immediate savings in energy consumption also foster the emergence of both other related energy-saving behaviors and higher knowledge levels for energy conservation (Abrahamse et al. 2007). The potential spillovers of behavioral change can therefore correspond to not only other consumption behaviors but also the relevant individual-level determinants such as knowledge and self-identity (e.g. Van der Werff et al. 2014) and non-consumption behaviors such as environmental policy support (Thøgersen and Noblet 2012; Willis and Schor 2012).

Of course, the downside of behavioral spillovers is that behavioral changes spill over negatively as well. In particular, behavioral research provides two major explanations for why negative spillovers occur: *self-licensing effects* and *self-serving bias*. Regarding the former, individuals could justify, for instance, not engaging in pro-environmental behavior because they have already done their part (Bolton et al. 2006; Tiefenbeck et al. 2013). In this respect, people often attempt to do just enough to maintain their existing self-concepts (i.e. as environmentally conscious individuals) and avoid feeling bad about what they have not done. If one has recently performed an environmentally relevant behavior, then one's environmental self-image is therefore less likely to feel threatened by not taking the opportunity to engage in further behaviors of this kind (Zhong et al. 2009; Sachdeva et al. 2009). For this reason, it has been hypothesized that the value of behaving sustainably is actually to obtain the license to act amorally later (Mazar and Zhong 2010; Merritt et al. 2010, 2012). In support of this hypothesis, individuals that drive their cars more frequently are more likely to believe that recycling makes up for the negative consequences of driving (Bratt 1999). Another example in this vein comes from the behavior of environmentally conscious individuals on holiday. Those participants who are most likely to behave sustainably at home also often feel the least obligation to behave sustainably while on vacation, not to mention use the most carbon-intensive modes of transportation (Miller et al. 2007; Barr et al. 2010). Behaving in a sustainable fashion at home therefore seems to justify, in the minds of participants, not caring about such matters when on vacation. Thøgersen (1999) presents a crucial caveat to such thinking however. In this study, he finds evidence of a negative spillover between recycling and the perceived obligation of limiting packaging waste, such that individuals who recycle feel less compelled to make other changes to their lifestyle. In relation to how they actually behaved, conversely, there was a positive spillover between behaviors (Thøgersen 1999). This suggests, at least for the more environmentally inclined individuals, that it is vital to

differentiate between what they might feel or say is necessary and how they ultimately behave.

Similarly, *self-serving biases* further detail how decision-making is influenced by the need to maintain and/or enhance self-image. In specific, since individuals are likely to dismiss information that runs counter to how they view themselves, the existence of such biases establishes a constraint on the information perceived to be relevant and the types of behaviors likely considered feasible. In this regard, the perceived need to protect their egos from injury and threat specifically motivates individuals to focus on what they have personally achieved, perhaps to the detriment of being able to give credit to others (Sherrill 2008). In the context of environmentally relevant behavior, this might more readily foster beliefs that one has already done one's fair share, especially in comparison with others (Leary et al. 2011). Consequently, individuals are less likely to make corrections to other environmentally harmful behaviors, while even possibly explaining their inaction away as the result of having less control over the success of their pro-environmental efforts than their neighbors (Pieters et al. 1998).

Finally, regarding overall environmental impact, any behavioral differences in relation to environmental significance represent another cause for concern. Since pro-environmental attitudes are more strongly correlated with lower-cost behaviors like recycling (e.g. Diekmann and Preisendörfer 1998, 2003), even individuals with strong pro-environmental attitudes may be motivated to avoid costly behaviors—in spite of their environmental significance—if more effortless options exist. As such, the costs of performing a behavior represent a fundamental limitation for whether or not the level of environmental concern actually influences behavior. Accordingly, the particular sequencing of behaviors is also an important determinant of both the likelihood and the likely impact of behavioral spillovers. For instance, the occurrence of self-licensing becomes less likely whenever the initial behavior is more costly (Gneezy et al. 2012). Notably, Gneezy et al. (2012) explain that negative spillovers like self-licensing effects only appear to be so prevalent because of the tendency to begin with a relatively easier or less costly behavior. Contrary to the underlying argument for the foot-in-the-door effect, it is thus possible to induce positive spillovers between behaviors by ensuring that the initial behavior is somewhat challenging for individuals. In a similar vein, the strength of one's environmental identity is revealed to mediate the potential for positive spillovers to take place (Cornelissen et al. 2008; Van der Werff et al. 2014; Truelove et al. 2014). In other words, it is more likely for individuals who care about being perceived as environmentally friendly, even if only to themselves, to undertake further rounds of behavioral change. Recall in this regard that the level of intrinsic motivation to support the environment is a crucial determinant of behavioral frequency and behavioral persistence when the relevant behavior is more difficult to perform (e.g. Green-Demers et al. 1997; Pelletier et al. 1999). If we wish to improve the sustainability of behavior as a whole, 'simple and painless' changes are not sufficient as a result (Thøgersen and Crompton 2009). Instead, it is necessary to 'optimize' the likelihood of positive spillovers by setting the proper conditions, itself contingent on the understanding of the interactions that can occur between both individual behavior and the overarching context as well as between the distinct behaviors themselves.

7 Polycentric governance and behavior-informed sustainability policy

For much of the last quarter-century of UNFCCC-led negotiations, the prospect of a binding global agreement often seemed chimerical. As a result, the Paris COP21 agreement is not only a welcome culmination of these efforts but also paves the way for further meaningful climate action. Given threats of widespread free-riding behavior and the significant leakage of emissions across nations (Sovacool and Brown 2009a; Ostrom 2012), an international-level framework is vital to ensure a safe operating space for humanity (cf. Rockström et al. 2009; Steffen et al. 2015). Nonetheless, what has become increasingly clear in the wake of Paris is that any agreement of this nature is unlikely to be sufficient on its own. In the first place, the 'constructive ambiguity' that is required (Geden 2016) must result in there being substantial scope for disagreement over issues such as: the historical responsibility for CO_2 emissions, the most effective strategies to avoid and mitigate climate change, and even the specific target (and time frame) for the emissions reductions envisioned. Rather than enabling individual nations to respond flexibly and in accordance with their differing capacities, the absence of credible and explicit commitments instead signifies that the willingness and motivation of policymakers and citizens to follow through on the promises made in Paris is ultimately crucial.

If a global agreement alone is insufficient, we must ask what strategies are available to us to promote meaningful climate action. Given the criticism of top-down and technology-driven approaches (e.g. Jackson 2009; Smith et al. 2015; Antal and van den Bergh 2016), this paper has attempted to explore the environmental significance of more bottom-up approaches for sustainability transitions. Within the growing literature devoted to this topic, the potential has already been established for using targeted behavioral interventions to achieve reductions in environmental impact that are both affordable and have little impact on individual well-being (Vandenbergh and Steinemann 2007; Gardner and Stern 2008; Dietz et al. 2009). In specific, Dietz et al. (2009) identify a collection of cost-efficient 'near-term behavioral interventions' that use available technology to attain emissions reductions in the United States equivalent to about 7.4% of total emissions over 10 years—an amount that surpasses cumulative emissions from the heavy industries of petroleum refining, and iron, steel, and aluminum production. The potential capacity for these 'behavioral wedges' to ramp up to greater future reductions in environmental impact thus establishes them as a complementary measure for more long-term solutions like international climate agreements (Pacala and Socolow 2004; Dietz et al. 2009).

As demonstrated by the existence of both attitude-behavior and energy-efficiency gaps however (Bamberg and Möser 2007; Dietz 2010), it is not guaranteed that such behavioral change will take place at an equal pace across all individuals—nor that it will 'ramp up' in any sort of foreseeable fashion. As a result, it is necessary to better understand the range of factors that can either facilitate or constrain the potential for behavioral change. For instance, the significance of various 'non-price' incentives represents a limitation on the ability to rely on self-interest and financial incentives to promote energy conservation (e.g. Bolderdijk et al. 2013; Schwartz et al. 2015). What is more, even if the aforementioned behavioral wedges are successful, the evidence for (indirect) rebound effects and self-licensing effects illustrates that individuals might

respond to their greater level of environmental sustainability by purchasing more goods or shifting their environmental burden elsewhere.

When it comes to meaningful climate action and the development of more sustainable societies, it is of course true that individual-driven behavioral change plays a significant role. Nevertheless, fully realizing the environmental significance of behavioral change requires that we 'get the context right' so that significant behaviors can be repeated. Accordingly, our review of the behavioral research helps to explain processes of behavioral change more fully, establish the types of obstacles that exist, and what is more delineate a more significant role for individual-driven behavioral change. Toward this end, our behavior-informed approach makes use of the existing interdisciplinary literature to explore both the fluctuations in pro-environmental behaviors within populations and why the environmental impact of behaviors can potentially vary. To understand the relevance of context for sustainability policy, we outline how a richer understanding of the interrelationships between individual and contextual factors is necessary to cultivate behavioral change. In this regard, it is often the determinants operating within the different contextual layers, and not only the designs of actors, that ultimately establish the momentum for behavioral change. As a result, both the likelihood of behavioral change and overall environmental impact are dependent on interactions between individual and contextual factors. Such interactions are therefore essential to explain the potential for environmentally significant behavioral change, plus how likely such changes are to persist over time and prove resilient to other changes within the overarching context (Staats et al. 2004). In other words, from a better appreciation of the diverse interactions, it is possible to establish a stronger foundation for behavioral change that is environmentally impactful, and moreover for the individuals themselves to be directly engaged.

On a general note, our behavior-informed approach is thus distinctive in the context of sustainability policy by attempting to bridge the space between the 'top-down' and 'bottom-up' approaches. Specifically, its emphasis on the complex interaction between individual behavior and the multiple layers of context that frame its expression both sets it apart as well as opens the space for a further discussion of a potential role for individual-driven behavioral change. For instance, the fact that individual-driven behavioral change, like international climate agreements, is significant though not sufficient for meaningful climate action hints at a greater relevance of polycentric approaches. In the first place, polycentric governance represents a viable strategy to foster the immediate action that is required to reinforce and build upon the initial impetus of a global-level framework (e.g. Ostrom 2012, 2014). In the prescient words of Ostrom (2012, p. 366): "Building a global regime is a necessity… but building a polycentric system[7] starts the process of reducing greenhouse gas emissions and acts as a spur to national and international regimes to get their act together." Hence, rather

[7] According to Ostrom (1999, p. 57), a polycentric system is "one where many elements are capable of making mutual adjustments for ordering their relationships with one another within a general system of rules where each element acts with independence of other elements." Initially emerging in the context of metropolitan governance and police performance, such systems contrasted with the growing reliance on a consolidated, 'monopoly' form of governance seen to be more efficient and able to overcome the 'chaotic' overlap between small-, medium-, and large-scale governmental units operating in the same jurisdiction (cf. Ostrom et al. 1961).

than preoccupy ourselves with the shortcomings of any global-level agreement, we can begin to get the ball rolling by creating momentum for sustainability transitions at the other levels (national, regional, local). This therefore includes a greater role for individual-driven behavioral change, with collective action provided by simultaneous action from independent actors working at multiple scales.

In addition, polycentric approaches offer a view of climate action that is scale-specific. Notably, each specific activity has a suitable scale at which its governance should occur in order to be successful. Building stronger commitment for climate action, for instance, is effectively undertaken at a more small- to medium-scale since this activity often benefits from person-to-person interaction (Kates and Wilbanks 2003; Ostrom 2012). Instead of directly intervening in individual behavior, other levels of governance would then be tasked with activities such as information provision to make sure that actors at this scale have all the relevant information and monitoring to avoid the threat of free-riding behavior. In sum, through its greater appreciation of the varying roles of actors operating at different scales and the interactions between them, polycentric governance aspires to increase the effectiveness of climate action using "a behavioral theory of human action and a recognition of the importance of context in affecting levels of trust and reciprocity of those involved" (Ostrom 2014, p. 104).

Presented in these terms, the correspondence with our behavior-informed approach becomes more obvious. Similarly, Ostrom (2014, p. 104) asks "whether small-scale externalities exist from the use of energy by individuals and firms and whether that may form a different foundation for future actions." Recall in this regard that another implication of our framework is the potential for feedback loops to be cultivated between behaviors—that is, contingent on suitable conditions being in place. In particular, it is envisioned that stronger foundations for behavioral change can be established, whether by policymakers or individuals themselves, by better understanding the factors (e.g. behavioral difficulty and environmental identity) that are relevant for behavioral spillovers. Although our particular focus is on reductions in overall environmental impact and not facilitating trust or compliance, the two approaches therefore share an interest in how changes in the decision-making context can affect individual behavior.

By portraying the distinct layers of context from the perspective of individual behavior moreover, our behavior-informed approach can expand on the insights of polycentric systems of governance, as well as sustainability transitions more broadly. Take the issue of 'emissions leakage' as an example. It is specifically observed that emissions can leak either between two different locations (e.g. the pollution haven hypothesis) or because of changes in the price structure due to enacted regulations (e.g. market leakage). Such leakages thus illustrate the problems with more local approaches and the need for more global-level climate policies (Sovacool and Brown 2009a; Ostrom 2012). More importantly for our purposes, the two cases of leakage broadly correspond to our foregoing discussion of behavioral spillovers. Resorting to a global/local dichotomy, while appropriate for the discussion of the costs and benefits of actions undertaken at different scales, however fails to consider the control that individuals might potentially exert on such spillovers. That is, such spillovers are not necessarily a result of governance at different levels but rather of the decisions and actions of individuals—decisions that are themselves taken because of their relevant goals and priorities and in response to their particular circumstances. If we wish to

avoid shifting burdens between environmental issues and across key economic sectors (Antal and van den Bergh 2014; Thøgersen 2014), it is thus necessary to explore the potential for behavioral spillovers precisely from the perspective of individual behavior. If we envision sustainability transitions in terms of the reductions in the environmental impact of key economic sectors like energy, food, and transport for instance (e.g. Geels 2004; Markard et al. 2012), we lose sight of the fact that sustainable improvements in one sector can be offset by regressions in another. Notably, if individuals are likely to see a pro-environmental behavior (e.g. using public transport) as a reason to behave less sustainably elsewhere (e.g. finally taking that weekend getaway), those reductions in the transport system can only offer a misleading and impartial version of things. The potential for cross-sectorial spillovers thus demands that we also account for dynamic interactions among the behaviors themselves, including how likely it is that decreasing consumption in a specific sector results in increasing consumption within others.

Furthermore, if we wish to cultivate a basis for a stronger form of sustainability so that individual action is more effective (e.g. Thøgersen 2005), the knowledge and information that exist at the other scales must be delivered to individuals directly. Oftentimes, the outcome that polycentric systems ultimately seek is to increase the trust and compliance of citizens with regard to broader policy actions. As a result, individuals remain passive recipients or users of sustainability policy rather than engaging in environmental activism and other activities that more effectively 'make the global local' (cf. Kates and Wilbanks 2003). In order to encourage a greater degree of individual-driven behavioral change, it is thus necessary to consider what kinds of factors tend to diminish scope for individual action. For instance, our review finds the strength of existing habits to be a major obstacle for behavioral change. Accordingly, the use of 'downstream-plus-context-change' interventions is recommended as a viable strategy to provide informational guidance directly where habits are most vulnerable to change (Verplanken et al. 2008; see also Swim et al. 2011). In this regard, it is precisely the change in the socio-cultural context—by disconnecting individuals from their habitual circumstances—that makes lasting behavioral change possible. Such policies therefore reflect the combined importance of emphasizing the contextual determinants of individual behavior and the more information-driven approach of polycentric systems. Secondly, the prevalence of motivation crowding-out effects in the literature demonstrates the importance of considering how certain policies affect the intrinsic motivation to behave sustainably (e.g. Deci et al. 1999; Bowles 2008). Notably, in order to limit the potentially negative consequences of financial incentives, individuals must retain the sense of being internally driven to engage in sustainable behavior (Green-Demers et al. 1997; Pelletier et al. 1999; Truelove et al. 2014). Moreover, the prospect of positive behavioral spillovers is similarly contingent on the strength of one's environmental identity (e.g. Cornelissen et al. 2008; Van der Werff et al. 2014). If individuals are to exert a more meaningful impact on sustainability policy in the future, we must ensure that any influence of policy interventions on the degree of individual identity and motivation is well understood. The practical and moral significance of individual-driven behavioral change necessitates that individuals not take a backseat in ongoing efforts to tackle climate change.

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