

Behavioral Economics and Environmental Policy

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Abstract

This article provides an interpretive survey on implications of insights from behavioral economics for environmental policy. In particular, it discusses whether, and if so how, policy implications based on conventional economic theory have to be modified when insights from behavioral economics are considered. More specifically, it discusses concerns for cooperation, fairness, self-image, social approval, and status. Moreover, it addresses potential crowding-out effects, context-dependent and incoherent preferences, risk misperceptions, ambiguity aversion, and regulator bias. We conclude that behavioral economics has a lot to offer environmental economics and that some normative policy recommendations have to be modified. Yet the most fundamental policy recommendations in environmental economics generally prevail and are sometimes even reinforced through behavioral economics insights.

1. INTRODUCTION

Behavioral economics (BE) has recently attracted an increased interest within the economics community. In contrast to conventional economic theory, BE emphasizes the following:

1. People's behavior is not motivated solely by their own material payoffs, and issues such as perceived fairness and social norms often influence human decisions.
2. We act in a social context, and issues such as social approval and status are central motivators of human behavior.
3. People have cognitive limitations and therefore sometimes make seemingly irrational decisions.

In the present paper we consider each of these three characteristics of BE, for which there is a great deal of empirical evidence, and reflect on potential implications for environmental policy.

As noted by Ashraf et al. (2005) and Evensky (2005), Adam Smith emphasized that people's behavior is not motivated solely by their own material payoffs and that factors such as perceived fairness and social norms often influence human decisions. This is particularly clear in his work *The Theory of Moral Sentiments* (Smith 1759). Such prosocial behavior is of particular relevance for environmental policies because behavior with environmental consequences is often considered to be of moral concern. Regarding limited cognitive limitations and irrationality, we here focus on context-dependent preferences. For other recent survey treatments in behavioral and environmental economics, see, e.g., Brekke & Johansson-Stenman (2008), Carlsson (2010), Gowdy (2008), Johansson-Stenman & Konow (2010), List (2006), and Shogren & Taylor (2008).

Some areas of environmental economics adopted insights from BE quite early on, whereas there has been much more hesitation to do so in other areas. The stated-preference (SP) literature was early on influenced by both behavioral and experimental economics, and BE may have been influenced to some extent by the SP literature; indeed, some economists, including Glenn Harrison, Jack Knetsch, John List, and Jason Shogren, have made important contributions in both behavioral and environmental economics. One reason for this mutual interest was most likely the anomalies found in SP studies. For example, the empirical findings regarding the huge differences between willingness to pay (WTP) and willingness to accept (WTA) (Hammack & Brown 1974, Horowitz & McConnell 2002) resulted in a number of experimental studies (see, e.g., Bateman et al. 1997, Kahneman et al. 1990) and theoretical model developments (see, e.g., Hanemann, 1991, 1999; Tversky & Kahneman 1991). A second reason was the similarities of the experiments and valuation exercises and the use of experimental methods to test the validity of hypothetical surveys (see, e.g., Carlsson & Martinsson 2001, Cummings et al. 1995, Frykblom 1997, Lusk & Schroeder 2004, Neill et al. 1994).

The remainder of the paper is organized as follows. Section 2 discusses voluntary cooperation and fairness perceptions, i.e., implications of the fact that we sometimes act on the basis of motives other than our own material payoffs. Section 3 discusses the importance of self-image, social approval, and status concerns for human behavior and environmental policy. Section 4 discusses how our internal motives are sometimes crowded out by monetary incentives. Section 5 deals with context-dependent and incoherent preferences and Section 6 with risk misperception and ambiguity aversion. Section 7 discusses the behavioral limitations of the regulator. Section 8 provides some concluding remarks.

2. COOPERATION AND FAIRNESS

The distributional implications of both costs and benefits associated with policies designed to address environmental problems, such as car emissions, water pollution, toxic substances, and global climate change, are critical for policy makers across the world. Although fairness concerns are frequently discussed in many different public policy areas, they sometimes appear to be particularly important for environmental issues. Because the distributional implications differ dramatically between different policy instruments such as environmental taxes, fuel economy standards, and tradable emission permits (based on auctioning or grandfathering), this may not be very surprising.

2.1. Cooperation Based on Conventional Economic Theory Versus Behavioral Economics

Conventional economic theory presupposes that people free ride when it is in their material self-interest to do so and that they do not care about issues such as perceived fairness. Yet we know that people sometimes do cooperate, even when it is not in their own narrow self-interest, and that they often care about perceived fairness in addition to their own payoff. In BE there is a large experimental literature trying to understand under what conditions people cooperate. The environment-related literature is smaller, but rapidly increasing.

Most of the literature on negotiations related to transnational pollution is based on the assumption that each negotiating country cares solely about its own material payoff; see, e.g., Carraro & Siniscalco (1998) and Asheim et al. (2006). Some of the literature allows for collusion, i.e., the possibility that some countries cooperate with one another against other countries. Carraro & Siniscalco (1993) and Barrett (1994) provide the standard approach to studying coalition formation in the climate change context. In this two-period noncooperative framework, countries first decide whether to join a coalition. Those who join will then behave cooperatively with one another in a second stage, and both the coalition (as an entity) and the remaining countries choose their emission levels noncooperatively. Carraro & Siniscalco (1993) and Barrett (1997) demonstrate that the resulting coalition size in this framework tends to be rather small. However, Lange & Vogt (2003) show that when countries care about fairness, and hence not only about their own payoffs, the coalition size tends to be larger. Yet in the generalization by Lange (2006), which allows for asymmetries such that countries are different, it is no longer obvious that fairness concerns increase the coalition size. Moreover, Lange et al. (2008) study fairness bias in international climate policy on the basis of a survey of approximately 200 climate policy negotiators on three continents. The results indicate that these negotiators generally favor fairness rules that impose lower costs on their region and hence higher costs on those in other regions. This finding suggests that self-serving bias, i.e., an unconscious distortion of the individual's own beliefs about what is fair in the direction of his or her material interests, plays a nonnegligible role, which is further supported by the finding that respondents tend to view their own preferences as less self-interested than those of others.

In contrast, Oberholzer-Gee et al. (1997) analyze fairness views of different procedures for the siting of nuclear waste, on the basis of survey evidence from a sample of the general Swiss population, and find strong support for processes that respect impartiality, information, consent, and fairness. In addition, people were more willing to accept a burden in the presence of processes that respected such values.

Many experimental results can be interpreted in terms of conditional cooperation, suggesting that many people are willing to choose the cooperative alternative, but only if others do too (Fischbacher & Gächter 2010). Shang & Croson (2009) and Alpizar et al. (2008a) investigate, by using natural field experiments, how contributions to good causes—a public radio station and a natural park, respectively—are affected by information about a typical contribution by others. Both studies find a positive relationship.

There is also much evidence that people care about social norms, such as the norms to recycle or to conserve energy. The explicit use of social norms has recently been analyzed by economists, and for a longer time by psychologists, in the context of energy conservation. This literature demonstrates that reminders about environmental effects related to energy use as well as information about self-consumption and others' consumption of energy can substantially affect self-consumption of energy; see, e.g., Schultz et al. (2007) and Allcott & Mullainathan (2010). Ferraro et al. (2011) and Ferraro & Price (2011) analyzed both short- and long-term effects on water consumption. They find that both information about the negative effects of water consumption on the environment and information about self-consumption of water compared with others' water consumption have a sizable short-run effect on self-consumption of water. However, these researchers also find that only messages augmented with social comparisons have a lasting effect. Environmental labeling, or ecolabeling, is a related policy instrument that makes use of people's willingness to behave—voluntarily or perhaps via the influence of peer pressure—in an environmentally friendly manner; see, e.g., Cason & Gangadharan (2002) or Stephan (2002) for an overview.

To achieve prospering economic and social development, a prerequisite is being able to handle social dilemma-type situations, such as providing an adequate amount of public goods (Hall & Jones 1999, La Porta et al. 1999, Ostrom 2009). In industrialized countries, this is dealt with largely by formal institutions. However, most poor countries have weak or badly functioning governments. Thus, a large share of public goods has to be provided privately with the help of local institutions and mechanisms; see Olken & Singhal (2011) for a recent overview of local public good provision in rural areas in developing countries. Over a long period, Ostrom and coauthors have also carefully analyzed the effects of different institutional settings on the abilities of local societies, in particular in developing countries, to effectively handle social dilemma-type situations (see, e.g., Dietz et al. 2003; Ostrom 1990, 2009; Ostrom et al. 1992).

Moreover, when one is considering the global environment, it is not sufficient to have well-functioning national institutions. Rather, we have to solve problems internationally, meaning that we need some kind of effective transnational institution. In addition, we are not dealing with individual decision making, at least not in the sense that the decisions are made with respect to personal consequences. Although generalizing the experimental findings from individuals to a multicountry negotiation setting is not straightforward, we believe that some insights can be generalized, at least qualitatively. From the literature on group decision making, it is not clear whether people become more or less cooperative in a group decision situation relative to when they are acting as single individuals. Cason & Mui (1997) find that teams tend to be more altruistic and other-regarding than individuals, whereas Luhan et al. (2009) argue that the Cason & Mui study constitutes an exception and that most studies find that groups of people are typically less altruistic and less cooperative than individuals. However, Dannenberg et al. (2007) find in an experimental study that climate policy negotiators

have stronger preferences for equity compared with students, who are typically used as subjects.

2.2. Less Encouraging Insights on Cooperation from Behavioral Economics

BE does not bring only good news about human behavior and our ability to cooperate. For example, as discussed above, there is also plenty of systematic evidence in favor of self-serving bias. Babcock & Loewenstein (1997) observe that in wage negotiations, when facts or principles are ambiguous, both employers and employees seem to focus on the ones that favor their own interest. Thus, although people typically care about fairness, our perception of what is fair tends to be influenced by what is in our own interest, and this view often affects our actions. According to Elster (1999, p. 333), “*Most people do not like to think of themselves as motivated only by self-interest.*” They will, therefore, gravitate spontaneously towards a world-view that suggests a coincidence between their special interest and the public interest” (italics in original). Although a preference for equity may improve the possibilities for cooperation in climate negotiations, as analyzed by Lange & Vogt (2003), this picture is much less clear when the equity principles used are influenced by self-serving bias (Lange et al. 2010).

Somewhat similarly, we often try to avoid situations in which we know that we will feel the pressure to act in accordance with norms that are inconsistent with our own material self-interest. This was tested by Dana et al. (2006), who offered their subjects the choice between playing a \$10 dictator game and a \$9 exit option: If the dictator chose the exit option, the receiver was not told about the existence of a game (or about a potential sender). Many subjects chose the exit option. This was despite the fact that this alternative was Pareto dominated (if the subjects cared only about the material payoffs) because the subjects could have played the game and either kept \$10 or kept \$9 and sent \$1 to the receiver. Hence, the decision to choose the exit alternative cannot be explained either by standard selfish preferences, in which case all subjects would have preferred the \$10 dictator game and kept everything for themselves, or by a combination of preferences for one's own payoffs and payoffs for the other player. Instead, it seems that most of us dislike when others think badly of us, even in anonymous situations. An implication of this conclusion is that people, including policy makers and politicians, in the richer parts of the world may simply try to avoid thinking about the ethical implications of their behavior, or they may avoid discussions with poorer countries about the issue.

Cognitive dissonance (Aronson 1992) constitutes a related negative insight from BE regarding our possibilities to deal with environmental issues in a responsible way. Cognitive dissonance means that an inconsistency between beliefs and behavior causes an uncomfortable psychological tension, sometimes implying that people change their beliefs to fit their behavior instead of changing their behavior to fit their beliefs (as is conventionally assumed). With respect to climate change, this principle may imply that people who cause large greenhouse gas emissions, e.g., people in the Western world, tend to believe that climate change problems are exaggerated; see, e.g., Stoll-Kleemann et al. (2001).

Finally, there is ample evidence that people's behavior in repeated games tends to become less cooperative over time and converge toward the conventional Nash equilibrium, unless there is a possibility to punish free riders so that cooperation can be maintained (Fehr & Gächter 2000, Fischbacher & Gächter 2010). Ostrom (1990) provides extensive real-world evidence that sanction possibilities are essential for successful

common property resource management. Thus, although people sometimes cooperate voluntarily, even when it is not in their own material self-interest, such cooperation tends to dissipate over time with repeated interaction, unless some kind of policy instrument, formal or informal, is applied.

Taken together, what can we learn from the BE literature on cooperation and fairness for environmental policy? First, individuals and groups, including countries, are able to make decisions that are not in their own material interest if they perceive that it is possible to obtain an outcome that is socially desirable by means that are considered reasonably fair. Therefore, policy instruments such as labeling and voluntary recycling are often considerably more effective than what the conventional theory would predict. Second, when people or countries are affected in a nonnegligible way, they, through a combination of mechanisms, will likely gravitate toward free-riding behavior unless sufficient policy instruments are applied. This means that the conventional economic wisdom regarding many environmental problems, including climate change—i.e., that it is important to “get the prices right” through economic policy instruments and that exceptions to these policy instruments are avoided as much as possible—is reinforced rather than made obsolete by insights from BE.

3. SELF-IMAGE, SOCIAL APPROVAL, AND STATUS CONCERNS

Most of us care about who we are, how we perceive ourselves, and how others perceive us. Indeed, when Brekke et al. (2003) investigated people’s motivation behind recycling in a Norwegian survey, as many as 73% of the respondents answered that one of their main reasons was that they would like to see themselves as responsible citizens. Johansson-Stenman & Martinsson (2006) asked people about what characteristics they considered important when buying a car. Most claimed environmental characteristics to be very important, but very few emphasized the status associated with a specific car or model. Yet when people were asked about what characteristics they believed were important for others, the reverse pattern emerged insofar as status became much more important and environmental aspects less important. This finding underlines both the importance of seeing ourselves as responsible individuals and the reality that we like to see ourselves as better than others in many dimensions, including social responsibility.

The self-image motive should not be confused with the willingness to impress or provide informative signals to other people. For a recent analysis of the latter motive for prosocial behavior, see, e.g., Ellingsen & Johannesson (2011). In an environmental context, List et al. (2004) show that respondents are much more willing to vote in favor of a costly environmental project if others are informed about their choice. The self-image motive can also be seen as self-signaling (Bodner & Prelec 2003, Benabou & Tirole 2006), implying that opinions and actions provide signals to ourselves about what kind of person we are, including our intentions toward the matter at stake. This distinction is far from new, as is evident from the following characterization by Adam Smith some 250 years ago (Smith 1759, p. 170):

Nature, accordingly, has endowed him, not only with a desire of being approved of, but with a desire of being what ought to be approved of; or of being what he himself approves of in other men. The first desire could only have made him wish to appear to be fit for society. The second was necessary

in order to render him anxious to be really fit. The first could only have prompted him to the affectation of virtue, and to the concealment of vice. The second was necessary in order to inspire him with the real love of virtue, and with the real abhorrence of vice. In every well-formed mind this second desire seems to be the strongest of the two.

Thus, according to Smith, the self-image motive tends to be the stronger of the two motives, which is an empirical question that may vary from case to case.

The existing literature on ecolabeling and green consumerism, as well as that on fair trade, has often been framed within a classical market context in which price and quality are the drivers of consumer choice. However, consumers may also be concerned with the choices made by other consumers, and people's consumption decisions may therefore not be independent of social context. Numerous recent experimental studies show that conformity to what others do is one important factor affecting people's charitable giving (e.g., Alpizar et al. 2008a, Shang & Croson 2009, Frey & Meier 2004) and contributions to public goods (Bardsley & Sausgruber 2005). On the basis of an SP survey on coffee consumption, Carlsson et al. (2010) find that information on the choices made by other consumers significantly affects the choice of ecolabeled coffee for women but not for men.

Of course, people can gain status and reputation from many sources other than unselfish behavior. Indeed, material wealth and conspicuous consumption are often seen as prime ways of obtaining social status (e.g., Frank 1999). The type of consumption that creates status varies between contexts and time. Although driving a Toyota Prius may, at least in some contexts, provide social status, driving a Rolls-Royce or a new Ferrari contributes more to social status in other contexts. Indeed, a growing empirical literature shows that in addition to the absolute level of consumption, people are concerned with their consumption relative to that of others; see Clark et al. (2008) for a good overview. For the particular example of the Toyota Prius, Sexton & Sexton (2011) show that the willingness to pay for the "green halo" of driving a Prius varies significantly with the environmental friendliness of one's neighbors. Correspondingly, a growing public finance literature deals with the normative implications of relative consumption concerns. It is usually assumed that people care intrinsically about relative consumption but not about relative leisure, implying that there are negative (positional) externalities from the consumption of goods but not from leisure. This implies an efficiency reason for taxing consumption that has to be compared with the conventional tax-wedge argument that goes in the other direction; the latter argument suggests that because we cannot tax leisure directly, we tend to have too much leisure (e.g., Boskin & Sheshinski 1978). Aronsson & Johansson-Stenman (2008) argue, on the basis of empirical evidence, that such a positional externality motive may imply substantially higher marginal income taxes than what would result on the basis of the conventional optimal nonlinear income taxation model.

Relative consumption concerns also have implications for the optimal provision of public goods, including environmental public goods. Wendner & Goulder (2008) show that the optimal provision of public goods tends to be larger when people are motivated by relative consumption concerns than when they are not. The intuition is that there is a zero-sum-game element in private consumption because my increased consumption implies lower utility for you, whereas there is no such element in public consumption. Aronsson & Johansson-Stenman (2008) show that the optimal public good provision rule tends to be affected correspondingly such that, in the first-best case, the optimal provision

should exceed the level at which aggregate marginal WTP for the public good equals its per-unit price. Yet this is the case only when each individual's marginal WTP is measured *ceteris paribus*, i.e., holding everything else fixed. If WTP is measured conditional on making all other individuals pay the same amount for the increased public good provision on the margin (which corresponds to a referendum payment vehicle in the contingent valuation literature), then the first-best provision rule coincides with the basic Samuelson rule. The intuition is that in the latter case, an increased public good provision comes together with a decreased consumption for you but also with a decreased consumption for others, whereby the latter is good for you through decreased positional externalities.

What about policy implications related to status effects of prosocial behavior? At the current level of normative economic theory, we cannot say much here. The same applies to the issue of changing fashion with respect to what contributes to status. One might suggest that it would be socially advantageous if it became more fashionable to drive a Toyota Prius than to drive a Hummer, but even so, we have limited knowledge about how environmental and economic policies affect such trends.

4. CROWDING OUT VERSUS CROWDING IN

Much research and most textbooks in environmental economics stress the efficiency advantages of market-based policy instruments, such as taxes, subsidies, and tradable permits, as opposed to command-and-control-based policy instruments. The main reason is well known: Market-based instruments imply that additional abatement activities are undertaken when a firm's marginal abatement costs are lower than what the firm would have to pay for these emissions otherwise, e.g., in terms of environmental taxes. If, in contrast, the marginal abatement costs are larger than the per-unit tax on the emission, additional abatement activities will not be undertaken. In this way, the least expensive abatement activities, per unit of abatement, will be undertaken in the economy. The crucial point is that the government does not need to have any information about how costly certain abatement activities are to obtain such cost efficiency. With a command-and-control system, the government may in principle also decide that all abatement activities for which the marginal abatement costs are lower than a certain predetermined value should be undertaken. Yet in this case the government needs detailed information about the costs of these abatement activities to implement this decision. Moreover, individual firms generally do not have incentives to reveal their true abatement costs.

However, the standard model of environmental regulation is of course based on a number of simplifying assumptions. One of these is that firm decisions are made purely on the basis of profit maximization and that individual decisions are made purely on the basis of material self-interest. In a strict sense, this assumption is not correct. Indeed, many of us try to a varying degree to behave in an environmentally friendly way, even when we have no monetary incentives for doing so, as discussed above.

Yet that people are motivated by objectives other than pure material self-interest is no argument against market-based policy instruments. What is essential is instead the interaction between market-based policy instruments and nonmaterial motives. In this regard, it has been argued that monetary incentives may potentially undermine individuals' moral or intrinsic motivation to contribute to a better environment. For example, Frey & Oberholzer-Gee (1997) provide empirical support for such crowding-out effects using a survey related to the location of a nuclear waste repository facility. These

researchers find that individuals are less willing to accept siting of the facility in their community if they are offered monetary compensation. If such crowding-out effects are present, they may reduce, or potentially even reverse, the positive environmental impacts of green taxes.

There is also evidence from so-called natural field experiments of crowding-out effects. In an often-cited study, Gneezy & Rustichini (2000a) find that imposing a fine on parents arriving late to pick up their children at day care increases the number of late-coming parents. The intuition is straightforward: If you have paid a fine for picking up your kid late, you feel that you have the right to do so. Without such a fine, you instead feel that you must do your best to prevent lateness. Similarly, Gneezy & Rustichini (2000b) find that among high school students collecting donations for a charitable cause, those students who were paid a small percentage of their collections (financed by the researchers) collected less than those who were not paid. The authors also find that those students who were paid a large percentage of their collections collected more than those who were not paid, in line with what the standard model predicts. Together this finding shows that in the case considered, two effects are at play: a positive direct effect of incentives and a negative indirect effect of crowding out intrinsic motivations. Mellström & Johannesson (2008) analyze experimentally a classic issue in the crowding-out literature (cf. Titmuss 1971), namely whether offering monetary compensation for donating blood increases or decreases the amount of blood donated by the general healthy population. They find that women who are offered a monetary compensation for donating blood donate less than half the time compared with those who are not offered monetary compensation, whereas there is no statistically significant effect for men.

However, do monetary incentives always crowd out intrinsic motivation? According to a careful reflection on the literature by Nyborg (2010), this is certainly not the case. Nyborg discusses that possible crowding-in effects may be less mentioned in the literature because such effects are harder to disentangle empirically from the direct effects of economic incentives; these effects go in the same direction.

Next, on the basis of fundamental psychological mechanisms and insights from BE, we reflect on both potential crowding-out and crowding-in effects. Let us start with crowding-out effects. A first condition for crowding out to occur is that the individuals have intrinsic motivation such that there is something that can be undermined. Given that such intrinsic motivation exists, the most obvious crowding-out reason is that introducing a price may psychologically transform the decision from an ethical one to an economic one. Second, according to cognitive evaluation theory (Deci 1975, Deci & Ryan 1985), which is a theory in psychology designed to explain the effects of external consequences on internal motivation, intrinsic motivation is undermined if the public perceives the environmental tax as controlling. Third, if an individual has a preference for a self-image as a morally responsible person, economic incentives may undermine moral motivation as the individual becomes unsure about whether environmentally friendly behavior is driven by intrinsic motivation or by economic incentives.

Next, we consider potential crowding-in effects. First, cognitive evaluation theory predicts that an extrinsic motivation such as a tax reinforces one's intrinsic motivation if the tax is perceived as acknowledging rather than as controlling. Second, because an environmental tax makes it relatively cheaper to behave in an environmentally friendly way, it becomes more economically attractive to have a self-image as an environmentally friendly

person. Third, the case for adjusting the perception of reality due to cognitive dissonance, in the sense that one may doubt the existence of an environmental problem rather than change one's behavior, becomes weaker for the same reason, i.e., that environmentally friendly behavior becomes relatively cheaper. Fourth, for the same reason, other people are likely to behave in a more environmentally friendly manner, which is likely to promote such behavior due to conditional cooperation.

If the above factors are taken together, there is not a strong case for arguing that economic policy instruments would crowd out intrinsic motivation. This is not to say that economic policy instruments are always superior to command-and-control policies. Indeed, the latter may sometimes be superior for other reasons, e.g., reasons related to measurability or administrative costs. Yet in cases in which economic policy instruments appear superior when crowding effects are disregarded, we see no reason that such effects would make economic policy instruments less attractive. Crowding effects sometimes make such instruments slightly more attractive and sometimes make such instruments slightly less attractive.

5. CONTEXT-DEPENDENT AND INCOHERENT PREFERENCES

People's behavior and preferences are affected by the context, and even subtle cues affect behavior. Context is a broad concept and includes aspects discussed in other parts of this article. For example, information about what others do affects whether and how much people donate to charitable organizations (Alpizar et al. 2008a, Bardsley & Sausgruber 2005, Frey & Meier 2004, Shang & Croson 2009). Shang & Croson (2009) find that contributions to a radio station were affected by information about a typical contribution. They find that the highest reference amount (\$300) resulted in a significantly higher contribution than when no information about contributions was given. Whether others observe the action in question is also important under certain circumstances (e.g., Alpizar et al. 2008a, Hoffman et al. 1996, Legett et al. 2003, List et al. 2004). For example, Soetevent (2005) find that the use of open baskets, such that close neighbors in the church could identify a donor's contribution, increased overall contributions by approximately 10% in the second offering of the service compared with the use of closed baskets.

What are the implications for environmental economics if preferences are context dependent? In the area of environmental valuation, context dependence is not really something new. There has always been an awareness that, for example, how information is presented and whether the action is observed by others affect respondent behavior. What we have learned from the BE literature is that context dependence is not unique to SP methods or to environmental goods. At the same time, context dependence has implications for validity tests of SP methods (Carlsson 2010): Comparisons between hypothetical and actual behavior should be done for a given context. For example, comparing or combining results from SP and travel cost studies could be problematic due to large contextual differences. The observed difference may be due not to the standard explanation of hypothetical bias, but instead to important contextual differences, such as a difference in the extent to which the actions are observed, or are perceived to be observed, by others. As discussed in Carlsson (2010), one interesting question is whether behavior is more context sensitive in the hypothetical (survey) domain than in the domain of choices involving real payments. Another question is to what extent we can use hypothetical

research methods to investigate the role of context dependence.¹ One of the few studies that compare context dependence in both a survey setting and a natural field experiment is Alpizar et al. (2008b). In this study, some subjects made actual contributions, whereas others stated their hypothetical contributions. Both the degree of anonymity and the information provided about the contributions of others influenced subject contributions in the hypothesized direction. This study concludes that the influence of the social contexts was approximately the same when the subjects made actual monetary contributions as when they stated their hypothetical contributions, suggesting that SP methods could be used to make inferences about contextual effects. However, context dependence per se also has implications for the welfare analysis on the basis of, for example, SP studies. Again, these implications are not unique for SP methods but are a problem for any welfare analysis; see, e.g., Tversky & Simonson (1993) and Shogren & Taylor (2008).

However, people may not only act differently depending on the context; they may also act against what is in their best interest. It is often difficult to determine what is in the best interest of a person, and this reality is perhaps an additional complexity of the problem at hand; i.e., not only do people sometimes act against their best interest but it is also difficult to observe when they do so. If we disregard this aspect for now, the fact that people are incoherent or irrational allows policy makers to use their own judgment about what is best for people. At the same time, the government should not unnecessarily interfere with people's lives, as embodied in concepts such as libertarian paternalism (Sunstein & Thaler 2003a,b) and regulation for conservatives (Camerer et al. 2003). For example, if people stick with the default option, even if that option is the worst, there is room for a policy maker to affect the design of the default option. The literature on paternalism has received much opposition (see, e.g., Sugden 2008, 2010). We return to this issue in Sections 6 and 7, below.

One important question is why people make incoherent decisions. Beshears et al. (2008) discuss five factors: (a) limited personal experience, (b) complexity, (c) passive choice/defaults, (d) third-party marketing, and (e) intertemporal choice. These factors can drive a wedge between revealed preferences, i.e., those that rationalize the observed behavior, and normative preferences, i.e., those that represent the individual's actual interest. Many of these factors are important or are present particularly in the context of actions and goods related to the environment. For example, many decisions concerning the environment are complex and involve a long time horizon; climate change is the most obvious example. Carlsson (2010) discusses the implications for the design of SP surveys. In particular, he suggests that surveys can be used to investigate the issues of complexity and experience. This suggestion is not very controversial in the field of SP surveys, in which these issues have long been discussed and investigated (see, e.g., Carlsson et al. 2011b, DeShazo & Fermo 2002, Swait & Adamowicz 2001).

What are other implications of incoherent preferences for environmental economics and environmental policy (apart from what we discuss above regarding paternalistic arguments for regulation)? One aspect with policy implications is the role of defaults and the reluctance to make changes. In many circumstances, subjects are more likely to choose a default alternative—irrespective of its characteristics—than if the same alternative had

¹The tools used in stated-preference (SP) methods are highly suitable for analyzing context dependence (Swait et al. 2002): The attribute-based random utility model can readily incorporate contextual elements, the survey instruments can be adapted to different contexts, and it is easy to design different treatments with different contexts.

to be actively chosen. This bears out, for example, in the areas of pension savings (Choi et al. 2004, Cronqvist & Thaler 2004, Madrian & Shea 2001), health clubs (DellaVigna & Malmendier 2006), and organ donation (Johnson & Goldstein 2003). In the area of green energy, Pichert & Katsikopoulou (2008) show that green defaults may significantly affect the choice of green electricity. Yet Löfgren et al. (2012) show that, in the case of default effects on the choice of CO₂ offsets for air transport, experienced subjects do not suffer from a default bias. There are two aspects of a default effect for environmental policy. The first is that economic incentives/regulation may have to be stronger if there are strong default effects on the market and the defaults are not environmentally friendly. The second is that the regulator can use the tendency to choose defaults to promote more environmentally friendly consumption such as, for example, forcing people to opt out from the most environmentally friendly option.

Another important area for environmental policy is intertemporal choice and discounting. The policy recommendation for global warming depends critically on the choice of discount rate (Nordhaus 2007, Stern 2007). One important question is thus whether the revealed discount rate should be the discount rate used for discounting future benefits and costs of an environmental policy. A second, and from a BE point of view more interesting, issue is that revealed discount rates are not constant. Many studies show that discount rates are higher in the short run than in the long run (see, e.g., Laibson 1997, Loewenstein & Prelec 1992). This finding raises a number of difficult questions. In particular, hyperbolic discount rates imply that preferences are dynamically inconsistent or present biased (O'Donoghue & Rabin 1999). Thus, when making decisions that involve intertemporal trade-offs, a person has two sets of revealed preferences. When evaluating future benefits and costs, the individual uses a lower discount rate for the future, which means that, for example, he or she will decide to invest in the future. However, when the future arrives, the individual will use a higher discount rate and may then end up not investing even if no relevant circumstances have changed. Therefore, we cannot simply apply the revealed preferences as normative preferences, because the revealed preferences are not dynamically consistent. O'Donoghue & Rabin (1999) discuss this in detail and argue for basing welfare analysis on long-run preferences. They also emphasize the underlying reason for the observed behavior. For example, in the case of obese persons, the welfare conclusions are very different if the obesity is due to self-control problems than if it is a result of a conscious decision that the benefits of eating the food are larger than the negative consequences of being fat.

The final aspect of incoherent preferences that we wish to discuss is the observed large differences between people's maximum willingness to pay for a good (WTP) and their minimum willingness to accept not having it (WTA). In most cases, WTA exceeds WTP by a substantial margin (Horowitz & McConnell 2002). It is doubtful whether standard theory can explain the large differences. Hanemann (1991) argues that the observed large differences are consistent with standard theory if the degree of complementarity between income and the good to be valued is sufficiently strong. However, others argue that this consideration is not sufficient to explain the observed results (Horowitz & McConnell 2003, Sugden 1999). Researchers have put forward a number of alternative explanations. One explanation in particular is that people have a loss aversion, which means that losses (reflected by WTA) tend to loom larger than gains (reflected by WTP) also for marginal changes; see, e.g., Kahneman & Tversky (1979) and Knetsch (1989). Although this explanation seems plausible, it does not show why the difference between WTP and WTA is

larger for public goods than for private goods (Horowitz & McConnell 2002). Biel et al. (2011) argue that differences in emotions and moral perceptions can explain the difference between WTP and WTA, which also explains why there is a difference between public goods, which have an ethical dimension, and private goods, which do not have an ethical dimension.

6. RISK MISPERCEPTION AND AMBIGUITY AVERSION

All areas of public policy in a modern society have to deal with risks, in particular when one is dealing with environmental issues. For example, how should we deal with issues such as global warming, biodiversity, and health effects from toxic substances in food? Similarly, how should we deal with uncertain positive effects associated with activities that cause potential environmental problems? Risk has long been incorporated into mainstream economic theory (e.g., Arrow 1971, Drèze 1987), yet there are many problems with applying the conventional approach in practice. In this section, we focus on two aspects of risk for which BE has much to say: risk misperception and ambiguity aversion.

6.1. Risk Misperception

The public's risk perception is often very different from that of experts, contrary to the assumption in conventional theory. Examples of risk perception biases have been identified in many areas, including air pollution and smoking. For example, researchers typically find that people severely overestimate risks associated with outdoor air pollution compared with risks associated with indoor pollution (Breyer 1993, Margolis 1996). Media attention given to certain spectacular risks is one important reason (Pidgeon et al. 2003, Slovic 1986), and research in psychology indicates that people have difficulty dealing with probabilities when strong feelings are involved (e.g., Lowenstein et al. 2001). There is also a general pattern that people overestimate small probabilities and underestimate large probabilities (Tversky & Kahneman 1992).

However, that people often misperceive the size of a certain risk does not necessarily imply that they also misperceive the size of a risk change. In **Figure 1a**, the risk belief s is simply a proportional amplification of the actual risk r , implying both that the risk belief is larger than the actual risk and that $s_r > 1$ so that a change in the real risk implies a larger perceived risk change. Similarly, in **Figure 1b** the risk belief is smaller than the actual risk, and $s_r < 1$ so that a change in the real risk implies a smaller perceived risk change.

However, there is plenty of evidence that people systematically overestimate small risks and underestimate large ones. If the pattern is as in **Figure 1c** (see, e.g., Viscusi 1992, p. 117), then $s_r < 1$ such that an objective risk increase (or decrease) will always imply a smaller perceived risk increase (or decrease) regardless of whether people over- or underestimate the risk. Thus, people's risk belief may be much larger than the actual risk, yet they may perceive the size of the risk change to be smaller than the true risk change. According to Tversky & Kahneman (1992) and Gonzalez Wu (1999), a relationship as that shown in **Figure 1d** is more realistic. Here $s_r > 1$ for sufficiently small risk levels and $s_r < 1$ for larger ones.

Taking the four cases in **Figure 1** together, we can conclude that if $s < r$, then $s_r < 1$. However, the opposite does not hold; i.e., $s > r$ does not imply that $s_r > 1$. In other words,

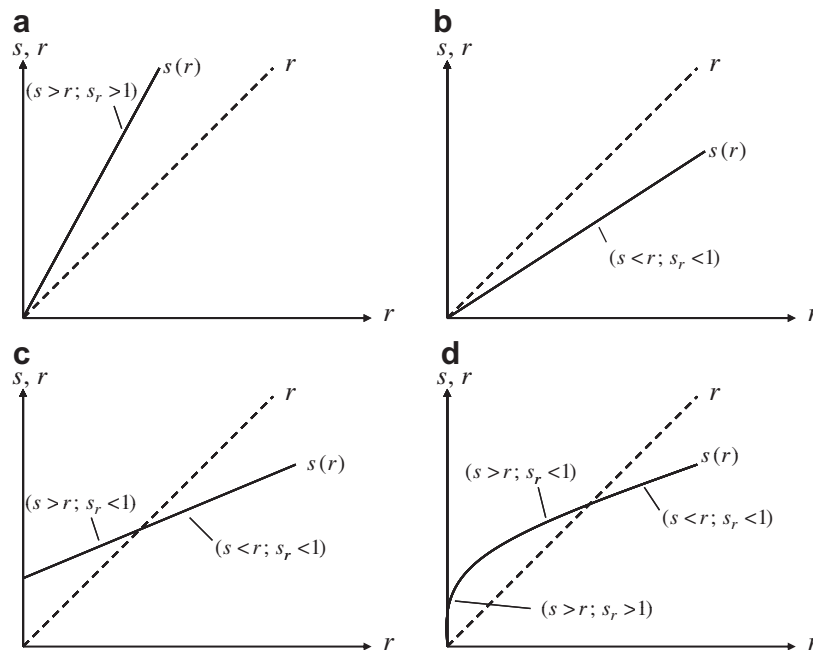


Figure 1

Possible relations between the subjective risk and the objective risk. The scale on the horizontal axis reflects the actual risk, and the solid curve reflects the risk belief (or the subjective risk) as a function of the actual risk. From Johansson-Stenman (2008).

if people underestimate the risk, they will also underestimate the risk change, but if they overestimate the risk, they will not necessarily overestimate the risk change.

From a policy perspective, it is not sufficient to know how people misperceive risks. We also need to know what to do with this information. Should public policy in such situations be based on the public's risk perceptions, on risk perceptions of experts, or on other criteria?

The issue of whose risk perceptions should ultimately count in public policy is not new; see, e.g., Pollak (1998), Viscusi (2000), Johansson-Stenman (2008), and Salanie & Treich (2009). According to Pollak (1998), most analysts agree that differences in risk perception reflect differences not in values but in the understanding of the risk-related facts and that public policy should be based on these facts rather than on people's (mis)perceptions. Along these lines, Viscusi (2000, p. 867) argues that to reduce illusory fears, rather than real risks, "is a form of statistical murder in which lives are sacrificed." More fundamentally, the question is how the government should act when people make mistakes or when the government believes that people make mistakes. According to Harsanyi (1995, 1997), what should matter in social decision making is informed or true preferences, i.e., the preferences a rational individual who is equipped with perfect information would have. Broome (1999) and Ng (1999) argue similarly. Recently, a literature in which policy measures are based on different kinds of paternalism has emerged. For example, Gruber & Köszegi (2001) argue in favor of cigarette taxation, not to internalize

externalities (which they argue are limited) but to internalize what they denote as internalities, i.e., to help people act in accordance with their own ultimate will and interest. See also Sugden (2008, 2010) and Bernheim & Rangel (2007, 2009) for different arguments and alternative choice-based approaches when people are to some extent irrational. Regardless of how one feels about such paternalistic policies, it is not easy to argue in favor of time-inconsistent public policy to mimic the time inconsistencies of citizens.

If we intrinsically care about welfare rather than about choice, how will risk misperceptions affect environmental policy? In a cost-benefit analysis, the government would then base its analysis on experts' risk judgments rather than on those of laypeople. Moreover, when cost-benefit analysis relies on people's valuation, e.g., through contingent valuation studies, these valuation numbers will be biased in the sense that they may not reflect the monetary values of the corresponding welfare effects. However, again, that people may overestimate a certain risk will not necessarily imply that they will overestimate a risk change. However, if the patterns between subjective and objective risk follow **Figure 1**, then if people underestimate a certain risk, they will also underestimate a risk change.

There are also some caveats. First, as argued, e.g., by Johansson-Stenman (2008), fears constitute real welfare effects, and fears are often related to subjective risk rather than to objective risk. Second, fears may induce people to change their private behavior in a way that has welfare effects. For example, Blalock et al. (2009) find that after the 9/11 terror attacks, many travelers increased road transportation (which is less safe than air travel) due to their decreased use of (the still) much safer air travel. Blalock et al. estimate that as many as 2,300 traffic deaths may be attributable to the effect of 9/11. For both of these reasons, the government should care about subjective risk, and not only about objective risk, if they care only about welfare effects and hence put no value on freedom of choice or similar values.

6.2. Ambiguity Aversion

Evidence suggests that people often deviate systematically from von Neumann and Morgenstern's expected utility theory; see Starmer (2000) for a good overview of non-expected utility theory. However, that people behave in ways that seem inconsistent with rationality assumption does not necessarily mean that governmental policy should also change its normative underpinnings. However, it has been argued that ambiguity aversion does not imply irrationality and that governmental decision making should correspondingly reflect people's ambiguity aversion rather than governments seeing ambiguity aversion as irrational.

Before we continue, let us explain that by ambiguity we mean uncertainty with respect to the true underlying probability. On the basis of this definition, people often tend to be ambiguity averse (Camerer & Weber 1992). A frequently used way to test whether people are ambiguity averse is the following experiment: Consider an urn in which 30 balls are red and 60 balls are either black or yellow. You do not know the relative shares of black and yellow balls. How would you choose between gamble A and gamble B?

Gamble A	Gamble B
You receive \$100 if you draw a red ball	You receive \$100 if you draw a black ball

Consider next the choice between gamble C and gamble D. Would you choose gamble C or gamble D?

Gamble C	Gamble D
You receive \$100 if you draw a ball that is not black	You receive \$100 if you draw a ball that is not red

Most people would choose A over B and D over C, which is denoted the Ellsberg (1961) paradox (e.g., Becker & Brownson 1964, Slovic & Tversky 1974), because these combined choices violate subjective expected utility theory. If you prefer A to B, your subjective probability that the ball is red must be larger than your subjective probability that the ball is black. If this is true, then the probability that the ball is either red or yellow (which is the same as the probability that the ball is not black) must be larger than the probability that the ball is either black or yellow (which is the same as the probability that the ball is not red). Therefore, preferring A to B and D to C implies a contradiction.

This behavior can be explained as follows: In gamble A, the probability that the ball is red is known and is given by $20/60 = 1/3$. In gamble B, the probability that the ball is black is not known; it can be either lower or higher than $1/3$ and can take any value from 0 to $2/3$. If you are a bit pessimistic, you might conjecture that it is lower than $1/3$, and you will hence go for A.

Similarly, in gamble C, the probability that the ball is not black (i.e., either red or yellow) is not known and can be anything from $1/3$ to 1. In gamble D, in contrast, the probability that the ball is not red (i.e., either black or yellow) is known and equals $40/60 = 2/3$. In the choice between gamble C and gamble D, an individual who is a bit pessimistic regarding the probabilities in gamble C will go for gamble D.

Choosing A over B and choosing D over C, if these choices are taken separately, are not inconsistent with subjective expected utility theory, and both choices may indeed seem perfectly reasonable in isolation. If a firm offers you the choice to sell gamble A and to instead obtain gamble B, it makes perfect sense to believe that the objective probability that the ball is black is lower than $1/3$. Hence you should turn down the offer; otherwise, the expected profit for the firm would be negative. Similarly, if a firm offers you the choice to sell gamble D and to instead obtain gamble C, it is reasonable to expect that the objective probability that the ball is not black is lower than $2/3$. Hence, you should turn down this offer too. The violation of subjective expected utility theory is thus related to simultaneously choosing A over B and choosing D over C, and not to each of these choices separately.

Ambiguity aversion has been identified in many different experimental settings and samples (Gilboa 2004, Sarin & Weber 1993), and researchers often find that people are willing to spend substantial amounts of money to avoid ambiguous processes in favor of processes that are equivalent in terms of expected utility theory (e.g., Chow & Sarin 2001). There is also evidence in terms of conventional empirical studies that observed behavior cannot be explained by conventional theory but is consistent with theories incorporating ambiguity aversion (see Camerer & Weber 1992, Gilboa 2004, Mukerji & Tallon 2001). Riddell & Shaw (2006) find, on the basis of survey evidence from Nevada residents, a large effect of ambiguity on attitudes toward risks related to nuclear waste transport. Theoretically, Treich (2010) shows that ambiguity aversion tends to increase the value of

a statistical life. For theoretical models that can reflect ambiguity aversion and hence explain the Ellsberg paradox, see, e.g., Gajdos et al. (2008) and Klibanoff et al. (2005).

As mentioned above, there is evidence that people are ambiguity averse. There is also evidence that policy makers sometimes make decisions that seem to reflect ambiguity aversion; see, e.g., Viscusi & Hamilton (1999) and Sunstein (2000, 2005). However, just because we cannot derive an “ought” from an “is” does not necessarily mean that policy making should reflect ambiguity aversion. Should it? More specifically, should ambiguity aversion be seen as some kind of cognitive limitation and as such a reflection of irrationality, or at least bounded rationality, or should it be seen as reflecting some kind of genuine preference that ought to be respected? This is no trivial question, and highly intelligent analysts have come to different conclusions. Our view, following, e.g., Al-Najjar & Weinstein (2009), Drèze (1987), and Savage (1972), is basically in line with the former. We think it is difficult to find good arguments in normative analysis against the axioms underlying subjective expected utility theory, including Savage’s sure-thing principle, which is typically sacrificed in alternative axiomatically motivated models of ambiguity aversion. We also find no convincing argument for why compound lotteries should be evaluated fundamentally differently than the resulting simple lotteries. However, the normative literature on ambiguity aversion is increasing; see, e.g., Gilboa et al. (2009) for arguments that it is not more irrational to be ambiguity averse than to be a subjective expected utility maximizer.

Nevertheless, there are also some caveats here, of which some are similar to the ones dealing with risk misperceptions. First, choice situations under ambiguity may induce fear to a larger extent, and it appears just as reasonable to deal with this kind of fear as to deal with other kinds of negative welfare effects, as recently argued also by Treich (2010). More generally, people may experience feelings such as regret (Loomes & Sugden 1982) through the decision processes *per se*. In principle, one can describe the different states of the world to which subjective expected utility theory applies in a comprehensive way that includes such feelings. Second, effects of fear and other feelings may induce indirect welfare effects through consumer adaptations, and such effects should, in principle, be considered. Third, there are always a large number of risks involved in decision making. For practical reasons, most of these risks are typically ignored, implying that for some variables we tend to rely on best guesses, which tend to be that nothing bad will happen. Such a systematic pattern implies that the overall social risk tends to be biased downward. One could therefore argue that ambiguity aversion may be a way to correct for neglect of some risks involved in situations that are more complex. However, whether it is a good way is less obvious.

7. BEHAVIORAL LIMITATIONS OF THE REGULATOR

So far in this review we focus on the behavioral limitations and biases of the market actors. We also suggest above that because of these limitations and biases there is room for a regulator to improve the welfare of the people. The basic argument in the literature is that—because people are not always rational but instead suffer from a range of biases such as context dependence, optimism bias, present bias, and status quo bias—the government can intervene and improve the welfare of the people. However, the proponents of such interventions typically emphasize that the government should not unnecessarily interfere with the lives of the individual and argue that its policy suggestions should be

minimal and affect only things such as the default alternative. Leading proponents of this type of libertarian paternalism include Sunstein & Thaler (2003a,b) and Camerer et al. (2003). In one sense, this view is in stark contrast with the central elements of public choice theory, with its focus on the possibility that regulators serve their own self-interest and hence do not act in the interest of the public (Brennan & Buchanan 1980, Mueller 2003).

Of course, arguing for a policy intervention is not in direct contrast to the view that regulators may act in their self-interest. However, one of the main arguments against these types of soft paternalism regulations is that, although these regulations are not intrusive, they open up the possibility for more undesirable policies in the future. Whitman & Rizzo (2007) argue against soft paternalism regulations largely on the basis of such a slippery-slope argument. Thus, their argument against the regulations does not concern the regulations per se—they may in fact be welfare improving—but rather that these regulations pave the way for other types of regulations that are not welfare improving. In particular, they argue that the theoretical and empirical vagueness of the BE literature is problematic when one is making a distinction between soft and hard paternalism. In addition, that policy makers can be bounded rational and suffer from the very same biases, such as context dependence and optimism bias, increases the risk that more intrusive regulations could follow from soft paternalism.

However, most environmental policies cannot be considered soft regulations; the main motivation for the policies is not bounded rationality of the individuals but that consumption and production in society are associated with negative externalities. In addition, environmental problems are often complex and are associated with large uncertainties or even unknown risks, factors that we discuss above as being important in explaining the occurrence of bounded rationality and errors in decision making. Obviously, not only private decision makers but also government decision makers could suffer from such problems. A number of interesting issues then arise. It is realistic to assume that people working with environmental management and regulation have more information about environmental problems than does the public. However, this assumption does not mean that such experts do not suffer from cognitive limitations when making their decisions or recommendations.

Moreover, Gleaser (2005) argues that government decision makers have smaller incentives than do private decision makers to overcome errors. This argument is based on the fact that errors are endogenous and can be corrected with costly effort (Frey & Eichenberger 1994). Thus, individuals have stronger incentives than do government decision makers to invest in information that improves decision making, even if the government decision maker is altruistic. A counterargument is that the government may have access to better information from the start, for example, through better learning technology. This argument at least limits the implications of behavioral limitations for environmental policies, but the standard externality argument is still valid.

What types of biases are likely to be important for government regulation? Tansic (2011) discusses a number of biases, including action bias, focusing illusion, and illusion of competence. Action bias is the tendency to overreact to risks and uncertainties (Patt & Zeckhauser 2000). Thus, when faced with new information or unexpected events, policy makers may have a tendency to overreact and take action, in particular because they often get credit from media and voters for taking action. A focusing illusion implies that individuals overestimate the impact of one factor on the overall situation (Kahneman et al. 2006). With respect to government regulation, there is a risk that regulators focus on

one, potentially important, aspect of the regulation and disregard all other aspects. Finally, an illusion of competence, or overconfidence, is that people tend to overestimate their own knowledge or competence (Fischhoff et al. 1977). Tansic (2011) argues that regulators exceedingly believe that they understand how complex markets work and therefore how welfare-improving policies could be implemented.

Another question that environmental policy making raises is to what extent government decision makers have preferences that are similar to those of the public regarding environmental policies. Only a few recent economic studies have investigated this question. For example, Colombo et al. (2009) find relatively similar rankings of attributes of environmental policies between citizens and experts, whereas McConnell & Strand (1997) find differences in the WTP between scientists and the general public. Finally, both Carlsson et al. (2011a) and Alberini et al. (2006) find that not even the rankings of attributes of policies are the same between citizens and decision makers in the area of environmental policies. Thus, even if the policy maker is trying to make decisions that are good for citizens, his or her priorities are likely to differ from those of citizens.

8. CONCLUSIONS

This article discusses how insights from BE may affect policy recommendations in environmental economics. BE enriches environmental economics in bringing environmental economics closer to reality and thus becoming more relevant. We also show here non-negligible policy implications, although some of these are smaller than previously claimed. For example, it is sometimes argued that crowding-out mechanisms make economic policy instruments less suitable to deal with environmental issues and that the observation that people sometimes cooperate even when it is not in their narrow material interest to do so is an argument for less stringent official policy instruments. However, although intrinsic motives can sometimes be crowded out by monetary incentives, we argue above that monetary incentives will sometimes amplify intrinsic motivation and that, despite the fact that people sometimes cooperate voluntarily, such cooperation is rarely sustained in the long run without some kind of sanction against free-riding behavior. Overall, insights from BE tend to reinforce, rather than make obsolete, the conclusion that we need explicit incentives to effectively as well as efficiently deal with environmental problems.

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Errata

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