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Behavioural Economics and Environmental Incentives

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BEHAVIOURAL ECONOMICS AND ENVIRONMENTAL INCENTIVES

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JEL codes: D70, H30, H41, Q28, Q58

Keywords: behavioural economics, environmental policy, mechanism design, institutions.

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ABSTRACT

This review aims to improve our understanding of the implications of the insights from behavioural economics for environmental policy design. The review focuses on the question of incentive design in two broad areas — risk, conflict and cooperation; and mechanism design. A number of lessons for policy design emerge from the literature and are highlighted in the paper.

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RÉSUMÉ

Cet examen vise à améliorer notre compréhension des implications des perspectives de l'économie comportementale pour la conception de la politique environnementale. L'examen porte sur la question de la conception d'incitation dans deux grandes zones: (A) le risque, les conflits et la coopération et (B) la conception du mécanisme. Des leçons émergent de la littérature pour la conception des politiques et sont mis en évidence dans le document.

Classifications : JEL: D70, H30, H41, Q28, Q58

Mots-clés: l'économie comportementale, la politique environnementale, la conception du mécanisme, les institutions.

FOREWORD

This report has been prepared by Professor Jason F. Shogren (Stroock Professor of Natural Resource Conservation & Management, Department of Economics, University of Wyoming), is a contribution to the OECD Environment Directorate project on "Behavioural Economics and Environmental Policy" (www.oecd.org/environment/behaviour).

A version of this report was presented at the June 2012 meeting of the OECD Working Party on Integrating Environmental and Economic Policies and it has benefited from the comments received. It represents the views of the author, and not necessarily those of the OECD or its member countries.

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EXECUTIVE SUMMARY

Numerous empirical studies over the last four decades reveal that rational choice might, in some circumstances, be a poor guide for economics in general, and for environmental economics in particular. Assuming rational behaviour for environmental policy decisions may be problematic because nature's goods and services frequently lack the active market-like arbitrage needed to encourage consistent choice. So-called "anomalous behaviour" may arise in private and public decisions, undercutting the rational underpinning of environmental policy. As such, questions arise as to whether we could create more effective incentive mechanisms, or more generally, increase social well-being by designing environmental policy differently.

Does behavioural economics have a role in the economics of incentives designed to protect the environment? The answer can be "yes" if we find that psychological insight filtered through an economic lens generates more environmental protection at lower cost. Environmental policy might well be more cost-effective if we transform our rational choice models to include bounded rationality, bounded self-interest, and bounded willpower.

However, behavioural economics has not gained much in-roads into designing incentives for environmental conflicts and cooperation, Pigouvian taxation and cap-and-trade systems. For instance, research exploring how to best correct market failures through market incentives like Pigouvian taxes or tradable permits has not replaced rational choice theory for a behavioural alternative, e.g., prospect theory or other non-expected utility models. On the other hand, behavioural economic ideas have worked their way into environmental issues that involve risk and strategic interaction, e.g., risk reduction strategies, public good games, common property resources, Coasean bargaining, and coordination games.

Given the body of available evidence, how can environmental policy draw on these insights? Can economists use the insight from the bounded self-interest literature to design more effective self-enforcing environmental agreements or treaties? Can policy-makers "supercharge" incentives systems by using behavioural economics to identify situations in which people respond better to indirect targets and contingent rewards rather than punishment?

This review focuses on the question of incentive design in two broad areas—risk, conflict and cooperation; and mechanism design. A number of "lessons" emerge from the literature and these are summarized below:

Environmental risk, conflict & cooperation

- Experimental evidence shows that people systematically misjudge the expected impact of low-probability, high-severity events (such as catastrophic climate change, biodiversity loss, pest/disease invasion or nuclear disaster). These misperceptions can lead to inefficient levels of insurance and risk prevention, as well as incorrect economic valuations of environmental risks.

- Moreover, people systematically avoid making decisions in situations where the consequences of their actions do not have known probabilities. This means individuals may be overly cautious in preventing or insuring against risks with ambiguous probabilities.

- When attempting to reduce the expected impacts of a risk, people tend to prefer private reductions of probabilities over collective reduction of damages (e.g., adaptation). This contrasts with standard economic models used in policy analysis, which assume preferences should be neutral about the mode of risk reduction.

- Evidence shows that people are concerned with unobservable payoffs such as reputation, fairness or the well-being of others. Furthermore, people typically do not apply sufficient cognitive effort to calculate an optimal strategy, and resort to heuristics or "rules of thumb" which can be influenced by context. This contrasts with economic models of strategic interaction, which assume people are (a) only concerned about bettering their own material situation, and (b) able to calculate the optimal strategy for doing so.

- In many problems of cooperation, people are willing to sacrifice personal wealth to punish non-cooperators for the greater good of the collective. This is important because the credible threat of punishment can provide a bottom-up incentive for individuals to behave more cooperatively than what traditional theory would predict.

- Economic incentives which reward cooperation can be an efficient means of addressing complex environmental problems (such as biodiversity protection and habitat fragmentation).

- The effectiveness of collaborative processes designed to address environmental problems can be improved by drawing on recent behavioural research into how people bargain: Individuals' altruism, experience with property rights structures (or lack thereof), and preferences for fairness all affect bargaining outcomes.

- Introducing communication rules in negotiation can generate efficiency gains, which can offset the adverse impact of transaction costs. This suggests that building trust, a common goal of a collaborative process, can be an important means of enhancing efficiency.

- In implementing national environmental regulations, granting more authority to collaborative groups of local stakeholders can improve efficiency. However, stakeholders participating in a collaborative process should be selected carefully to maintain a power balance within the group.

- Rationality is a social idea. In economics this idea means we have to judge rationality in the context of markets and exchange. As individuals become more experienced with markets for environmental services, their aggregate actions will be more like what traditional economic theory predicts: in aggregate they behave more rationally, which can increase the efficiency of these markets. But they also become less concerned about fairness and the preferences of others, which can attenuate private contributions to public goods.

- Market experience does not always eliminate behavioural anomalies. Preferences among individuals for others' welfare can persist in communities with markets that are more integrated into the local culture.

- People discount the near term at higher rates than they do the far distant future. This hyperbolic discounting can lead to various forms of inconstant dynamic choices, such as procrastination and the lack of self-control. Time-inconsistent choices can lead to too little investments in current savings and too little concern about current stocks of natural resources and ecosystem services.

Mechanism design, taxation, and tradable permits

- If people behave as if they are "addicted to" the good generating the negative environmental impact, an optimal environmental tax should exceed the standard Pigouvian tax. Analogously, encouraging less environmentally-damaging substitute behaviour might be achieved through policies that incorporate mechanisms which provide incentives to pre-commit.

- Regarding tax policy, research suggests that complexity can trigger different behavioural responses than simpler taxes which have the same effect on relative prices. Complexity can be used as a screening mechanism to promote efficiency to attain social goals.

- People's preferences for taxes and charges as environmental policy instruments are affected by their beliefs about the use to which the revenue is likely to be put – whether to achieve environmental or social objectives.

- Monetary incentives may 'crowd out' some people's willingness to protect the environment 'voluntarily', with possible implications for policy choice and stringency. However, since it is difficult to know whose behaviour is likely to be 'crowded out' by a given policy instrument and for which reasons (intrinsic or social) this remains an area requiring further research.

- And finally, designing efficient policy instruments that account for both – behavioural and market – failures is difficult. What we need instead are flexible institutional designs or adaptive regulatory schemes which would allow policy-makers to adjust market-failure regulation for behavioural biases that may become apparent in the future.

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1. Introduction

1. Economic theory is used to promote cost-effective environmental policy. We can "fix" market failures with policies that create new markets or market-like incentives. Economic advice rests on models that presume rational behaviour—people facing these new incentives will act with purpose and make consistent choices that take into account the consequences of their choices. But relying on rational choice theory to guide environmental policy makes sense if people make, or act as if they make, consistent and systematic choices. That is the issue—do people make or act like they make rational choices toward environmental protection?

2. Numerous empirical studies over the last four decades reveal that rational choice might, in some circumstances, be a poor guide for economics in general, and for environmental economics in particular (see Tversky and Kahneman, 2000). The problem is that rationality in economics is a social construct based on active market exchange, not an individual construct based on isolated introspection (Arrow, 1987). Assuming rational behaviour for environmental policy decisions may be problematic because nature's goods and services frequently lack the active market-like arbitrage needed to encourage consistent choice (Crocker et al., 1998). So-called "anomalous behaviour" may arise in private and public decisions, undercutting the rational underpinning of environmental policy. Perhaps we could more accurately estimate environmental benefits if we treat preferences as context-dependent (i.e., she values gains differently than losses)? Perhaps we could create more effective incentive mechanisms if we treat preferences as having a social element (i.e., some people do the right thing for the right reason)? Perhaps we might increase social well-being by designing policy to help people overcome their tendency to not follow up their own best future plans to protect themselves or their progeny (i.e., he will donate to the cause…tomorrow)? A gap exists between theory and behaviour in environmental policy.

3. The field of behavioural economics has emerged to fill this gap. Behavioural economics applies psychological insight to *reshape* economic principles; environmental economics applies economic principles to *sharpen* environmental policy. By *reshape* we mean adding more humanity to rational choice theory; by *sharpen*, we mean making environmental policy more efficient. Does behavioural economics have a role in the economics of incentives designed to protect the environment? The answer can be "yes" if we find that psychological insight filtered through an economic lens generates more environmental protection at lower cost. Environmental policy might well be more cost-effective if we transform our rational choice models to include bounded rationality, bounded self-interest, and bounded willpower (see Mullainathan and Thaler, 2000; Thaler and Sunstein, 2008).

4. Behavioural economists categorize and catalogue the expanding list of deviations from rational choice theory. Examples of anomalous behaviour are numerous, including the status quo bias and endowment effect, loss aversion, framing effects, anchoring, preference reversals, the willingness to accept (WTA)-willingness to pay (WTP) gap, self-control, time inconsistency, and coherent arbitrariness.[1] McFadden (1999) provides a useful catalogue of these and other biases. Behavioural economics identifies

[1] An endowment effect suggests people become overly attached to some goods; loss aversion is when people are risk averse for potential gains, but risk seeking for potential losses; framing effects suggest that how a question is asked matters as much as what question is asked; anchoring implies that people lock on to the external prices or information given to them; time inconsistency implies that people make a choice today about tomorrow, but when tomorrow comes they change their minds; and coherent arbitrariness means people will focus on a arbitrary starting point, but will then make coherent choices. See McFadden (1999) for more explanation.

and rationalizes empirical pattern recognition to help challenge existing ideas of rational choice and guide the foundations of new theories of choice (see Starmer, 2000). In Shogren and Taylor (2007), we lump all the deviations together as *behavioural failures*. The term behavioural failure reflects a parallel and familiar idea of market failures. Behavioural failure means a person fails to behave as predicted by rational choice theory. A behavioural failure is also referred to as an anomaly, paradox, bias, heuristic, misperception, fallacy, illusion, or paradigm.

5. The term behavioural failure is chosen with purpose, and we use it to be a bit provocative. A failure arises from whatever source (i.e. market, coordination, behavioural) if actions or a policy does not achieve the efficient policy baseline as defined by rational choice theory. We use failure here to stress how economic inefficiencies arise in environmental policy due to factors other than just traditional market failure. Behavioural failure reflects the idea that departures from predicted efficient resource allocation can arise when people behave differently than rational choice theory assumes. For example, does this mean we should consider the decisions of someone who has "bounded self-interest" as reflecting "failure"? No, of course not - it is no failure for people's behaviour to reflect both efficiency and fairness objectives. The failure arises when policy is designed assuming exclusively 'rational' decisions rather than decisions which also reflect people's social preferences. We use the term 'behavioural failure' throughout the paper to highlight departures from decision-making which are dictated solely by efficiency.

6. As summarized by Metcalfe and Dolan (2012), some fundamental behavioural patterns have emerged from behavioural economics: People dislike losses, we focus on changes, we overweigh small chances, we think in discrete bundles/mental accounts, we value the present highly and inconsistently, we care about other people, and our good intentions can be negatively impacted by financial incentives. We also know that the context of choice matters—who gives us the information, social and cultural norms, the default choice and status quo reference point, what draws our attention—uniqueness, access, simplicity—how we are subconsciously primed to make certain choices, emotional responses to goods and information, the degree of commitment to overcome bounded will-power, and ego/self-image (see Metcalfe and Dolan, 2012).

7. Even with this additional insight, the interface between behavioural economics and public policy in general and environmental policy in particular remains scattered and fragmented when compared to the more well-established neo-classical literature on revealed preferences. General lessons are hard to come by given the context-specific nature of theories and observation within behavioural economics. Numerous psychological explanations can be used to explain the same phenomenon. For instance, when considering the low rate of savings relative to rational choice theory, behavioural economics points to inattentiveness to incentives, over-confidence in future earnings, and present-biased toward current consumption—all three can be used to rationalize low savings rates (see Mullainathan et al., 2012).

8. In environmental policy, people frequently point to a few examples to motivate how "behavioural anomalies" can affect behaviour toward green policy. The classic example is energy efficiency and climate change risk. An "Energy Paradox" is said to exist when people buy less energy conservation than predicted by a present value calculation given say a tax on carbon. Behavioural anomalies that could explain this result include people discounting the future too highly, people who have trouble calculating expected fuel savings, people who focus too intensely on the status quo, and people who rely on heuristic decision making strategies rather than optimizing net benefits. But all these ideas have rarely been tested within the same experimental design. They are a collection of ideas, in which the policy-maker does not know which effect, if any, dominates choices of energy conservation, and why this effect(s) is the key (see Gillingham et al., 2009). If evidence is found that people are not responding rationally to pricing changes, green taxes will not have the intended consequences, either in efficiency or distribution of burden (Galle 2011). In such cases policy options such as education, information, and standard-setting may have to be applied, and their relative success evaluated.

9. One has to go beyond the fragmented anecdotes to understand how and if departures from individual rationality in market settings matter for non-market allocation choices. The challenge to environmental economics is that these behavioural failures need to be evaluated systematically to determine if behavioural insight can improve environmental policy.[2] Behavioural economics has not gained much in-roads into designing incentives for environmental conflicts and cooperation, Pigouvian taxation and cap-and-trade systems (see e.g., Frey and Oberholzer-Gee, 1997; Ostrom, 1998; van den Bergh et al., 2000; Brekke and Johansson-Stenman, 2008). For instance, research exploring how to best correct market failures through market incentives like Pigouvian taxes or tradable permits has not replaced rational choice theory for a behavioural alternative, e.g., prospect theory or other non-expected utility models (also see Shaw and Woodward, 2008). On the other hand, behavioural economic ideas have worked their way into environmental issues that involve risk and strategic interaction, e.g., risk reduction strategies, public good games, common property resources, Coasean bargaining, and coordination games.

10. For environmental conflicts, another open question is whether economists can use the insight from the bounded self-interest literature to design more effective self-enforcing agreements or treaties. Does behavioural economics offer additional insight into how to design rules to improve coordination and cooperation over the provision of public goods? Alternatively, perhaps the reality of bounded rationality undercuts the government's ability to leverage social preferences for benefit of the common good? In addition, does behavioural economics imply economists should revise the principle of revealed preference we use to guide welfare analysis? (see e.g., Bernheim and Rangel, 2005; Sugden, 2005). Should decision-makers account for behavioural biases in environmental policy with a "soft paternalism" approach?: "you know what is good for you, and we are here to help you achieve your target." Can policy-makers "supercharge" incentives systems by using behavioural economics to identify situations in which people respond better to indirect targets and contingent rewards rather than punishment? (See Thaler and Sunstein, 2008.)

11. In this review, we focus on issues that arise and lessons that have emerged when thinking about incentive design given the intersection of behavioural and environmental economics.

2. Framing a Behavioural Environmental Economics

12. First, we believe it helpful to frame the discussion. Consider the matrix developed in Shogren et al. (2010) that captures the interaction between behavioural and environmental economics. Table 1 groups environmental economics into seven categories: defining failure, reducing risk and timing, conflict, improving coordination and cooperation, designing control, measuring values, and promoting prosperity. Behavioural economics will be useful for environmental economics if it can help us:

- Better prevent failures
- Reduce more environmental risk
- Ease environmental conflict
- Foster more environmental coordination and cooperation
- Supercharge environmental incentives

[2] Historically, this evaluation process began within the stated preference literature (see e.g., Knetsch and Sinden, 1984). Contingent valuation work, for example, has long worried about whether behavioural biases might systematically bias people's stated preferences for nonmarket goods. Researchers have questioned whether stated preference measures of value suffer from numerous behavioural factors: hypothetical bias, starting point bias, information bias, interviewer bias, framing bias, surrogate bidding, scoping bias, and more (see Cummings et al., 1986). Behavioural economics provides alternative models and modes to think about how people form and state preferences under different contexts and exchange institutions.

- Better measure environmental values
- Create more prosperity in a world of environment scarcity

13. The first column in Table 1 reflects the current benchmark model—the rational choice approach to environmental economics; the next three columns represent the main themes within behavioural economics: bounded rationality, bounded self-interest, and bounded willpower. Given limits on time, money, and cognitive power, bounded rationality implies people use seemingly sensible heuristics that lead to systematic biases in judgment and choice. Bounded self-interest captures the idea that people have social preferences, i.e., altruism and fairness. Bounded willpower says people lack self-control, sacrificing long-term permanent benefits for short-run transient gains. Herein we focus on *the question of incentive design* in two broad areas—risk, conflict and cooperation, and Mechanism Design.

Table 1. Behavioural Economics & Environmental Economics

Environmental Economics Question	Rational choice theory	Bounded Rationality	Bounded Self-interest	Bounded Willpower
What has failed?	Market failure • Externalities • Non-rival • Non-excludable • Non-convexities • Asymmetric information Coordination failure Institutional failure	Information processing Cognitive limitations Preference reversals Coherent arbitrariness Reference dependence Choice bracketing Anchoring Vividness Representativeness Cognitive dissonance	Emotions Visceral factors Self-esteem Social status Pride Defer to groupthink	Self-control Herding behaviour Commitment problem
What is at risk and when?	Expected utility theory Bayesian updating Exponential discounting	Non-expected utility Loss aversion Overweighting low probability events Ambiguity aversion Belief heuristics Hyperbolic discounting Regret Disappointment aversion	Self-sacrificing Optimism	Present bias
What is the conflict?	Non-cooperative games Nash equilibrium Sub-game perfection Perfect Bayesian Cheap talk	Weak backward induction Weak iterated reasoning Credulity	Social preferences Fairness Loyalty Costly signalling	Present bias Commitment problem
Can we coordinate or cooperate?	Coordination games Focal points Coasean bargaining	Self-serving bias Anchoring Availability Status quo Reactive devaluation	Unconditional love Human decency Honesty Trust Altruism	Framing Commitment problem
Can we control through better incentives?	Mechanism Design Pigouvian taxation Tradable permits Liability rules Performance bonds	Tax Aversion Information programs Relative use programs	Willing punishers Crowding out Reputation	Dynamic inconsistency Present-bias preferences
Can we measure values?	Demand theory Welfare theory Surplus measures Use and non-use values Context-independent preferences	Context-dependent preferences Endowment effect Preference formation Starting point bias Information bias	Social preferences	Commitment problem
Can we increase overall prosperity?	Trade Growth Productivity Innovation Capital markets Credit markets Asset pricing	Limited attention Fads Manipulation Conservatism bias Procrastination		

3. Incentives: Risk, Conflict, and Cooperation

14. Behavioural economics affects how we think about how to frame policy and incentive issues related to environmental risks, conflict, and cooperation. What we will consider here are behavioural anomalies that are potentially relevant for environmental policy making. These anomalies are presented below as a series of lessons that can inform environmental policy design.

Lesson 1. Experimental evidence shows that people systematically misjudge the expected impact of low-probability, high-severity events (such as catastrophic climate change, biodiversity loss, pest/disease invasion or nuclear disaster). These misperceptions can lead to inefficient levels of insurance and risk prevention, as well as incorrect economic valuations of environmental risks.

15. The biggest initial impact of behavioural economics was on how economists think about decision-making under risk; in our case, risks to human and environmental health. The goal of environmental policy is to reduce risks to human and environmental health. Policy is essentially trying to create a new safer "lottery" toward health since a zero risk outcome typically costs too much. Policy-as-lottery implies people think about a combination of probabilities and consequences that define the risks to human and environmental health. Behavioural anomalies arise when thinking about environmental risk and public policy because many risks are low-probability/high-severity events when current decisions are made. Policy-makers need to better understand how people react to the baseline lottery and how they respond to changes from this baseline due to private and collective risk reduction investments.

16. The expected utility model is the basis for how environmental economists think about how to control risks to health and nature. Behavioural economists have documented substantial evidence to suggest that expected utility might be a biased guide when approaching environmental risk policy. A good example of behavioural failure is when an outcome is potentially very bad but the probability of its realization is low, i.e. climate-induced shift in the Gulf Stream. Experience tells people little about how to react to these low-probability high-consequence risks. Behavioural studies reveal that people tend to overestimate the chance they might suffer from such a risk, or they seem to have loss aversion—they tend to deal differently with potential losses than with equivalent gains. A descriptive model like prospect theory might be a better guide than expected utility.

17. To illustrate, Mason et al. (2005) designed an experiment to test the usefulness of the expected utility model in low-probability/high-loss environmental scenarios. These experiments ask people to make choices between a pair of risky lotteries defined over potential losses. Mason et al.'s results support the behavioural economics literature—when the probabilities of both the best and worst outcomes are relatively small, expected utility theory performed poorly. Their results suggest that a policy based on expected benefits and costs could underestimate the real values people assign to reduced environmental risk.

18. But adding non-expected utility models into the environmental economics literature has been relatively slow. One exception is Ranjan and Shogren (2006), who construct a behavioural model to explain the sluggish development of water markets given water scarcity, e.g., California agriculture. Farmers have been reluctant to participate in water markets because they fear that their participation today will lead to a loss of water rights to urban users tomorrow. A farmer assigns greater weight to low probabilities of future water rights loss and lower weights to high probabilities. Their results suggest that subjective weighting of probabilities leads to discounting of resources when farmers overestimate probabilities of loss. When farmers have idiosyncratic time preferences, total water supply in the market depends on the level of heterogeneity in the population.

19. In sum, expected utility has limits when predicting behaviour for environmental risks defined by low-probability/high severity as people tend to de-couple probabilities and severities and treat them separately and in isolation (not simultaneously as expected utility theory assumes).

Lesson 2. People systematically avoid making decisions in situations where the consequences of their actions do not have known probabilities. This means individuals may be overly cautious in preventing or insuring against risks with ambiguous probabilities.

20. Most decisions people make about environmental protection are over ambiguous probabilities. The expected utility model assumes that probability ambiguity does not affect decisions under risk—choices are independent of the source of uncertainty. But fifty years ago Ellsberg (1961) showed that ambiguity matters. Using urns with known and unknown distributions, people preferred drawing from the urn with the known distribution. Hogarth and Kunreuther (1989) tested professional actuaries, business executives, and MBA students. The test consisted of two different questionnaire scenarios concerning insurance from the purchaser and insurance company sides. They found universal ambiguity to low probability of loss events. They also found that ambiguity aversion decreases as the probability of loss increases. Consumers showed a preference for ambiguity for high probability of loss events even though firms did not. Firms did, however, show a greater aversion to ambiguity than consumers; they also decreased their aversion as the probability of loss increased.

Lesson 3. When attempting to reduce the expected impacts of a risk, people tend to prefer private reductions of probabilities over collective reduction of damages (e.g., adaptation). This contrasts with standard economic models used in policy analysis, which assume preferences should be neutral about the mode of risk reduction.

21. Context is a key behavioural issue when analyzing the environmental risk reductions. People reduce the expected damages of an environmental risk by using either self-protection or self-insurance, either privately or collectively. Self-protection reduces the probability of the loss, while self-insurance reduces its severity (Ehrlich and Becker, 1972). Understanding how these private risk reduction mechanisms affect behaviour matter when thinking about public policy. Although a person can access combinations of these risk reduction mechanisms, little is known about how these substitution opportunities affect rational choice under risk. The results suggest the risk reduction mechanism matters more than standard theory would suggest. Reducing risk by altering the probability or severity of an undesired event through a private or a collective mechanism has been shown to generate significantly different values (Shogren, 1990).

Lesson 4. Evidence shows that people are concerned with unobservable payoffs such as reputation, fairness or the well-being of others. Furthermore, people typically do not apply sufficient cognitive effort to calculate an optimal strategy, and resort to heuristics or "rules of thumb" which can be influenced by context. This contrasts with economic models of strategic interaction, which assume people are (a) only concerned about bettering their own material situation, and (b) able to calculate the optimal strategy for doing so.

22. Economists use game theory to examine the incentives that exist and the equilibrium outcomes that might arise when two or more groups have strategic interactions. The behavioural economics literature has found that people frequently violate game theory assumptions (see Camerer, 2003). First, people do not always perceive the game clearly and consistently. Evidence suggests that people's behaviour changes when the description of the game changes even though outcomes do not change. Second, the literature suggests that players are overconfident about their own relative skill. In addition, many theoretically useful principles on strategic reasoning that underpin game theory are irrelevant to the average person.

23. Also behavioural game theory has stressed the role of context-dependent preferences. Economists visualize a person's preferences for risky events as either fixed or fungible. Environmental economists typically view preferences as fixed, and a valuable precept to describe behaviour within active exchange institutions. Behavioural economists, however, counter with the idea that preferences are fungible. Non-economic contextual cues affect preferences more than economists have acknowledged (see e.g., Tversky and Simonson, 1993). The question of context dependence matters for environmental policy—if preferences are transient artefacts contingent on context, so are our welfare measures. The debate is far from being resolved; both sides have found evidence to support their assumptions. In our own work, we have found evidence of both context-independence and -dependence…in different contexts. In a valuation exercise, Gunnarsson et al. (2003) report evidence that preferences for risk and skewness remained stable as arbitrage removed preference reversals. People just stopped overvaluing the risky long shot. In contrast, in a dictator game, Cherry and Shogren (2008) observed people were significantly more generous financially to another person if he "did not have the opportunity to work" relative to if he "chose not to work." In theory, the receiver context should play no role in this game of voluntary donations, but it does. Understanding when the neoclassical presumption of context-independence holds up and when it fails under alternative institutional structures remains a critical area of research for environmental economics.

24. To summarize, in non-cooperative games of strategic interaction people's limited cognitive ability to solve games implies that context affects behaviour in unpredictable ways—sometimes for the worst; sometimes for the best.

Lesson 5. In many problems of cooperation, people are willing to sacrifice personal wealth to punish non-cooperators for the greater good of the collective. This is important because the credible threat of punishment can provide a bottom-up incentive for individuals to behave more cooperatively than what traditional theory would predict.

25. Conflict in the use of common-property resources or free-riding in public goods provision are major social dilemmas. Behavioural economics advocates a more pragmatic approach to addressing these dilemmas which takes observed behaviour, rational or otherwise, and re-constructs incentives to improve the efficiency of some programme (see Ledyard, 1995; Ostrom, 2006). For example, international environmental treaties between sovereign nations frequently suffer from weak enforcement and non-binding voting rules, e.g., the Kyoto Protocol for climate change. Under rational game theory, free riding should dominate the behaviour of the people in the group because there is no punishment for deviation. Evidence suggests that one can introduce an enforcement regime that emerges endogenously (i.e. bottom-up) from the participants themselves (see the examples in Ostrom et al., 1994). But the problem here is that endogenous enforcement is costly to each person. A person who chooses to punish a violator bears all the marginal costs himself, but earns only a fraction of the marginal benefits, which are shared throughout the group. No one individual should be willing to expend his own resources to punish violators since his net benefits at the margin are negative.

26. Behavioural research has revealed that such people—the willing punishers—do exist in experimental settings, along with rational egoists and conditional co-operators (those who initiate cooperation when they expect others to reciprocate). These willing punishers will pick up the tab to punish violators even though they know they will not recoup all the benefits of their actions. By "taking one for the team," they can increase the overall efficiency of the institution designed to reduce the costs of non-cooperative behaviour. Fehr and Gächter (2000) observed cooperation rates increased when the willing punishers could police the collective. The simple threat to punish was enough to coerce others to cooperate. For example, Kroll et al. (2007) created a non-binding voting public goods game with and without punishment. They found that willing punishers seem to drive the other players to increase their contributions, leading to increased cooperation and greater social efficiency. Including behavioural factors

in institutional design suggests one can correct for a global public goods problem more effectively by accounting for the behavioural 'failure' of these willing punishers (also see Noussair and Tucker, 2005).

Lesson 6. Economic incentives which reward cooperation can be an efficient means of addressing complex environmental problems (such as biodiversity protection and habitat fragmentation).

27. Many social dilemmas in environmental policy can be modelled as coordination "games", in which planners seek to provide incentives for cooperation among private agents. Conservation easements, biodiversity protection, habitat fragmentation can be all modelled as such games, where the planner's objective is to coordinate individuals to maximize collective well-being. Examples include coordination to protect biodiversity hotspots in densely populated areas. Such coordination requires the creation of landscape-scale contiguous reserves and corridors to support viable species populations and ecological processes. Creating contiguous protected areas cannot be accomplished, however, without the voluntary cooperation of private landholders. Their cooperation is more likely if they are compensated for financial losses, e.g., US Conservation Reserve Program. Parkhurst and Shogren (2007) explore whether a *smart subsidy* can be used to provide incentives for players to create contiguous habitat voluntarily. The smart subsidy creates an explicit network externality between neighbouring landowners by paying an additional *agglomeration* bonus when they retire land adjacent to other conserved parcels, both their own and their neighbours (Parkhurst *et al*., 2002).

28. Their design follows the tradition set in the experimental economics literature on "smart" markets, in which the exchange institution is designed "smart" to explicitly account for interdependencies between traders in water and electricity markets (see McCabe *et al*., 1991). These markets provide feedback on physical constraints (e.g., congestion) to buyers and sellers, which then allows them to increase efficiency of trades beyond that usually attainable by the market itself. Similarly, the "smart" subsidy accounts for the biological connection across landowners otherwise not explicitly addressed in typical incentive schemes.

29. They test-bed a smart subsidy proposal relative to two standard policy options: compulsion and a standard fixed-fee subsidy. From a behavioural perspective, the open question is how robust coordination remains as one moves away from the traditional normal-form setting into a more complex gaming environment.[3]

Lesson 7. The effectiveness of collaborative processes designed to address environmental problems can be improved by drawing on recent behavioural research into how people bargain: Individuals' altruism, experience with property rights structures (or lack thereof), and preferences for fairness all affect bargaining outcomes.

30. Resolving environmental conflict frequently requires researchers to understand how people cooperate and negotiate a solution. Some people see collaboration as the future of environmental policy. Examples of devolution in the environmental arena abound. Refinement of the more traditional decision-making processes grew primarily out of dissatisfaction with their costly consequences. Heavy reliance on litigation from both sides in the environmental debate began to escalate legal fees and prompt long delays in enacting changes in the environmental arena. As a result, less adversarial methods of problem solving are attracting considerable attention in the environmental arena. Negotiation, mediation, arbitration and

[3] Their coordination game compares a normal-form game to a 4-player 100 cell spatial *grid game*. The grid game captures the explicit spatial dimensions arising in location and network problems. The challenge is now that neither the Pareto- nor risk-dominant strategies are spotlighted. Rather, a player has 68000+ choices, with over $(68000)^4$ potential outcomes; and from the 9000+ Pareto-ranked equilibria, only one is Pareto-dominant.

facilitation are just some of the techniques that are now used extensively in resolving environmental disputes and designing natural resource management plans. Furthermore, the use of relatively new decision-making processes—such as regulatory negotiation and collaborative decision-making—that incorporate these techniques is becoming more common.

31. The effectiveness of collaboration can be facilitated by a better understanding of behaviour within Coasean bargaining and transaction costs (Coase 1960). The Coase theorem says that disputing parties will bargain until they reach an efficient private agreement, regardless of which party initially holds the unilateral property rights. As long as these legal entitlements can be freely exchanged and transaction costs are zero, government intervention is relegated to designating and enforcing well-defined property rights. But Coase was not promoting a world of zero transaction costs. Instead Coase said that since a zero transaction costs world does not exist, we need to study the world that does exist—the one with transaction costs. A behavioural economist might say we also need to study the world of cognitive bounds (see Sunstein, 2000).

32. Policy-makers should be interested in how different bargaining rules and protocols affect behaviour and outcomes. Concerning environmental collaboration, behavioural economics has explored how rules affect or are affected by bounded self-interest (entitlements and fairness) and bounded rationality (endowment effects; self-serving bias leading to an impasse). The first behavioural-style paper exploring the Coase theorem (Hoffman and Spitzer, 1982) observed efficient outcomes, but found that bargainers were rather selfless, splitting outcomes equally rather than rationally. This suggested that other-regarding, or altruistic, behaviour was affected by the institutional context of policy. Harrison and McKee (1985) revisited the design, and showed that a person's selflessness could be manipulated by the order in which he or she was exposed to property right structures. Because bargainers who are first asked to bargain without property rights grasp the legitimate nature of unilateral property rights, these bargains were both efficient and mutually advantageous.

33. Since then, behavioural economics has, with limited success, pushed bargaining models to the limit in an effort to isolate and identify selfless versus selfish behaviour in bargaining games. The Dictator game is the extreme example of a bargaining game. Self-interested strategic behaviour is controlled by giving a person complete control over the distribution of wealth. While theory predicts that people with complete control will offer up nothing to others, Hoffman et al. (1996) found that they still share the wealth in about 40 percent of the observed bargains. Such other-regarding choice is another example of behaviour that differs from what is predicted by standard game theory models. The results in Cherry et al. (2002), however, suggest other-regarding behaviour arises from strategic concerns not altruism.

34. A test-bedding approach produced measures of efficiency and the distribution of wealth for certain rules present in the collaborative process. By generating experience and data in the experimental laboratory, this information serves as a means of examining and refining current negotiation methods in the environmental arena. The results from behavioural bargaining research suggest some useful lessons to apply when considering the collaborative decision-making process. In particular, that devoting more resources to the design of a collaborative process does not always produce comparable gains in efficiency due to either transaction costs or bounded self-interest or both.

Lesson 8. Introducing communication rules in negotiation can generate efficiency gains, which can offset the adverse impact of transaction costs. This suggests that building trust, a common goal of a collaborative process, can be an important means of enhancing efficiency.

35. While it is expected that some rules of the collaborative process will generate significant efficiency gains, the results from this research suggest that incorporating certain rules into the design of a collaborative process may not generate appreciable gains in efficiency. A relatively simple and inexpensive

collaborative process may provide an optimal negotiation framework for generating long-lasting solutions to concerns in the environmental arena. As such, careful design requires attention to the benefits and the costs of each element of the collaborative process. A test-bedding experimental approach can be used to flesh out those rules that add nothing of value to the operation of the collaborative decision-making process. Future test-bedding experiments will help to further refine Coasean bargaining in the environmental arena.

36. Transaction costs reduce efficiency in a Coasean bargaining setting. It is fully expected that successful implementation of the collaborative decision-making process will require significant funding for meeting and search fees. Policy-makers should limit the use of Coasean-style bargaining to those instances in which stakeholders are in relatively close proximity to each other and can meet rather inexpensively, keeping transaction costs low. But when high transaction costs are unavoidable, the results from our research suggest that "cheap talk" is a negotiation rule that can enhance efficiency in Coasean bargaining and partially offset the dampening effects of the considerable transaction costs present in collaborative decision-making. Cheap talk, which allows for non-binding communication of threat points, characterizes efforts that establish trust in collaborative efforts. While cheap talk (and building trust) can be considered important elements of successful collaborative decision-making, the level of resources that should be directed to these efforts remains an open question.

Lesson 9. In implementing national environmental regulations, granting more authority to collaborative groups of local stakeholders can improve efficiency. However, stakeholders participating in a collaborative process should be selected carefully to maintain a power balance within the group.

37. Efficiency is sensitive to the level of decision-making authority provided to the collaborative group. Our research suggests that efficiency drops significantly as soon as final decision-making authority is taken away from a collaborative group, because people tend to overestimate the low probabilities of contract failure. Efficiency can be maximized in these negotiations by granting final decision-making authority to a collaborative group. Policy-makers should therefore step up efforts to provide this authority to collaborative groups. For example, allowing local groups to determine liability shares for cleaning up hazardous waste sites (a local issue) that is driven by CERCLA (a national law) will produce more efficient outcomes if the local group is given final decision-making authority. While existing legislation does not currently permit this, USEPA pilot programs are moving in this direction and can be expected to produce a higher degree of cost-effectiveness in the Superfund program. This lesson can also be applied to other legislative mandates, such as the US Endangered Species Act and the National Environmental Policy Act. Future test-bedding experiments should be used to aid in developing efficient negotiation frameworks in amended or new environmental legislation.

38. When final decision-making authority is granted to a collaborative group, power balance among stakeholders produces significant efficiency gains. This suggests that efficiency of environmental negotiation can be enhanced by carefully selecting the stakeholders that are to participate in the collaborative process. The USEPA is already restricting certain potentially responsible parties (PRPs) from being assigned liability shares for Superfund clean-up. More generally, policy-makers should now begin to develop prerequisites for stakeholder participation in other environmental negotiations.

Lesson 10. Rationality is a social idea. In economics this idea means we have to judge rationality in the context of markets and exchange. As individuals become more experienced with markets for environmental services, their aggregate actions will be more like what traditional economic theory predicts: in aggregate they behave more rationally, which can increase the efficiency of these markets. But they also become less concerned about fairness and the preferences of others, which can attenuate private contributions to public goods.

39. Behavioural results suggest that learning through experience will generate distributions of wealth that look more like the Nash bargaining solution. The constrained self-interest characteristic in environmental negotiations today can be expected to give way to mutually advantageous splits of the gains from trade as environmental negotiation continues. Stakeholders not holding property rights to the assets in question will be left with negotiated settlements giving them a smaller share of the gains from trade than they had previously seen. The results suggest that as the collaborative decision-making process is used more in the coming years, wealthy landowners will demand more while other stakeholders will receive less. This development may prompt calls for the refinement of the collaborative process or the introduction of other negotiation procedures. Economic experimental research to test-bed alternative protocol strategies remains a useful tool for policy-makers to learn about the efficacy of current and proposed environmental negotiation methods.

Lesson 11. Market experience does not always eliminate behavioural anomalies. Preferences among individuals for others' welfare can persist in communities with markets that are more integrated into the local culture.

40. Another strategic behavioural question revolves around cultural and individual traits in exchanges and non-market allocations. These traits are embedded in and shaped by the structure and political economy of the exchange institutions in place. The need for market transactions depends on the efficiency of social and cultural norms to facilitate cooperation and endowment allocations across different parties. Market transactions are unneeded in certain situations because of efficient cultural and social rules governing resource allocation, which holds for people in both developed and developing countries.

41. The intersection of social preference measurement and market economics raises issues related to Smith's (2003) notion of *ecological rationality* and Bowles's (1998) argument that social preferences are shaped by the institutional transactions. While many individual decision-making outcomes may appear irrational or inconsistent in isolation, successful markets bring together decisions so that rational decisions dominate in aggregate. The market provides feedback to its participants, and it defines what behaviour evolves as rational and utility optimizing. The degree to which markets shape behaviour depends on the ability to decrease the transaction costs of social exchanges or make visible the opportunity costs of irrational decisions. In a developing country context, experiments can be a useful tool to define which transactions require greater market intervention and which ones are regulated through the adaptive symbols created by existing social preference mechanisms.

42. Experimental evidence supports this line of reasoning. Experiments in developed countries show how market experience and market institution structure shapes subject behaviour. Experienced subjects more familiar with certain market procedures and structure behave differently than the inexperienced. Overall market integration is cited as a variable to explain disparate location bargaining behaviour in field experiments in small-scale societies (Henrich et al., 2001). Tracer (2004) examines the question of market integration, reciprocity, and fairness in rural Papua New Guinea. He uses the now classic ultimatum game to explore whether people with more integration with markets behave more as rational choice theory predicts. The ultimatum game is an experiment in which one person offers to split some resources with another person. If he accepts, they both receive the offered split; if he rejects the offer, both receive nothing. Theory predicts the person will accept any positive offer, such that the person will offer up a 99-

1% split. Experimental evidence has not been kind to theory, however, as people usually reject such low offers. Most offers end up closer to a 60-40% split. Tracer runs the ultimatum game in two villages—Anguganak and Bogasip, which are differentiated by large disparities in market integration through cash cropping, education, and acculturation. His results suggest that there was a positive relationship between the amount offered and the level of market integration—more contact with the market as in Anguganuk, the less behaviour goes as rational choice theory predicts. Rather the people in the more isolated village Bogasip made lower offers more in line with *Homo economicus*. Understanding how bounded self-interest is affected by the institutional setting in a real community is crucial for environmental policy.

Lesson 12. People discount the near term at higher rates than they do the far distant future. This hyperbolic discounting can lead to various forms of inconstant dynamic choices, such as procrastination and the lack of self-control. Time-inconsistent choices can lead to too little investments in current savings and too little concern about current stocks of natural resources and ecosystem services.

43. People make economic decisions everyday about what goods to purchase, when to purchase them, and how much money to allocate to current consumption and save for future consumption. When making these inter-temporal choices, people implicitly discount possible future events to compare them to current benefits. The standard economic model suggests that dynamically consistent behaviour based on this implicit discounting assumes people have a constant marginal rate of time preference, or discount rate when determining the current value of future streams of benefits (Strotz, 1956). While the correct size of the discount rate to use in cost-benefit analysis has been discussed at length in the literature, including issues such as the social rate of discount versus producer and consumer rates, the social discount rate versus the social rate of time preference, tax-induced distortions, inter-temporal investment decisions, and imperfect markets, the form of the discount rate is assumed constant for cost-benefit analysis under each of these scenarios. Cost-benefit analysis uses constant discounting to determine present values.

44. But empirical evidence now suggests people do not use a constant discount rate when taking actions that affect the future. Evidence suggests people are less patient in the near term, implying higher discount rates relative to the discount rates they use for actions in the far distant future; here people seem more patient with lower discount rates. This behaviour is typically called hyperbolic discounting (see e.g., Laibson, 1997). Hyperbolic discounting implies people make inconstant choices and plans over time, e.g., "I will fix the water pipe …tomorrow". We believe that whatever we are doing later will not be as important as what we are doing right now (see Thaler and Benartzi, 2004). Such time-inconsistent plans help explain such behavioural regularities as self-control, addiction, low savings rates, and procrastination.

45. Such empirical evidence has led to a great deal of research, as well as disagreement, on the role of hyperbolic discounting in economic analysis. Most of this work on hyperbolic discounts looks for evidence to either support or reject the use of hyperbolic discounting, whether it is the choice of the correct discount rate or the correct discount model. Relatively few attempts have been made to assess how hyperbolic discounting can affect the outcomes of environmental and resource policy. Two notable exceptions are Settle and Shogren (2004) and Hepburn et al. (2010). Settle and Shogren examine how hyperbolic discounting affects behaviour within a bio-economic model of a fishery in Yellowstone National Park, Yellowstone Lake, Wyoming. They find that hyperbolic discounting increases the size of the net policy efficiency gains compared with constant discounting using the same initial discount rate. In addition, they estimate that hyperbolic and constant discounting can yield the same gains, but the results lead to different time frames for the policy. Hepburn et al. (2010) examine a fisheries model given hyperbolic discounting. They model a scenario that allows a social planer to either commit to a time-consistent policy or to re-evaluate the policy in the future. The planner's lack of self-control causes him to change policy in the future, which leads to the collapse of the resource stock.

4. Incentives: Mechanism Design, Taxation, and Tradable Permits

46. Now consider how behavioural failure can affect mechanism design to control for market failure. Mechanism design imposes constraints on individual rationality, and assumes rational responses to incentive-based menus/policies (e.g., Bénabou and Tirole, 2003). But we know people do not always react as predicted if their rationality and willpower are bounded. The economics literature contains a few attempts to account for such behavioural failures in mechanism design. Esteban and Miyagawa (2006) construct a mechanism in which a person suffers from self-control problems and temptation. Within this mechanism, this person prefers to choose from a smaller rather than a larger menu, even if the tempting alternatives are off the equilibrium path. This smaller-is-better finding also emerges in Gruber and Mullainathan (2005), who argue that US and Canadian smokers are happier with higher cigarettes taxes. Another example is Aronsson and Thunström (2006), who construct an optimal tax-subsidy scheme for people who suffer from self-control problems that lead to obesity and poor health (also see the optimal sin tax discussion in O'Donoghue and Rabin, 2006).

47. Few such examples exist in the environmental literature. They are reviewed below and lessons are presented that can inform environmental policy design.

Lesson 13. If people behave as if they are "addicted to" the good generating the negative environmental impact, an optimal environmental tax should exceed the standard Pigouvian tax. Analogously, encouraging less environmentally-damaging substitute behaviour might be achieved through policies that incorporate mechanisms which provide incentives to pre-commit.

48. Johansson (1997) considers how bounded selfishness—altruism—affects the design of a Pigouvian tax. However, in general he finds that the existence of altruism itself is insufficient to justify the use of a lower Pigouvian tax. Another exception is Löfgren's (2003) work on optimal green taxation given addictive behaviour, rational and otherwise. Using the theory of rational addiction, she considers how myopic and time inconsistent addictive behaviour might affect the design of an optimal environmental tax, given that consumption of the addictive good causes a harmful externality (e.g., car driving releases pollution).

49. An analogous example might relate to cases in which people choose to "pre-commit" to behaviour which is less environmentally-damaging – i.e. commuting via public transport or cycling. In policy terms this might include provision of a stream of benefits such as subsidies which are dependent upon habitual use.

Lesson 14. Regarding tax policy, research suggests that complexity can trigger different behavioural responses than simpler taxes which have the same effect on relative prices. Complexity can be used as a screening mechanism to promote efficiency to attain social goals.

50. Regarding tax policy, Congdon et al. (2010) address how behavioural economics might affect (1) the welfare consequences of taxation, (2) using the tax system as a platform for policy implementation, and (3) employing taxes as an element of policy design. Their message is that behavioural economics shows how people respond to taxes themselves, and how they interact with the features of the system in place for tax collection. They argue that the behaviour of imperfectly rational people is less straightforward than supposed by the standard models which, in turn, will possibly change the conclusions about optimal taxation in a wide variety of ways.

51. With regards to the aspect of tax simplicity, they demonstrate that the behavioural approach suggests that the degree of simplicity enters optimal tax calculation directly, contrary to the traditional case for indirect tax simplicity. While the traditional approach views complexity adding to the costs of tax

compliance and administration, behavioural economics allows for behavioural responses to complexity which in some cases, tend to overturn this result. To sum up, they conclude that although behavioural economics does not yet provide definite answers to the issue of how tax policy should best reflect the point that individuals are not always perfectly rational, it raises relevant and important questions.

52. Since many 'environmental' taxes and charges are complex this is directly relevant. For example, very few environment-related taxes and charges target the externality or resource directly and at a uniform price. Differentiated vehicle taxes and escalating water tariffs are just two examples. In other cases, the tax or charge may not be visible at all to those bearing the burden. More generally, direct, transparent and explicit 'pricing' of the bad (through a tax or charge) may generate behavioural responses which differ from those which would be predicted relative to a pure relative price effect.

Lesson 15. People's preferences for taxes and charges as environmental policy instruments are affected by their beliefs about the use to which the revenue is likely to be put – whether to achieve environmental or social objectives.

53. In case of environmental issues, there is also scope for incorporating inputs from behavioural economics to maximize the policy goals. Recent research of some of the environmental and ecological economists has used the alternative models of rationality in their analyses related to environmental policy. Kallbekken et al. (2011) examine behavioural economics and Pigouvian taxation in the laboratory. They consider how aversion to paying taxes affects the framing and functioning of the classic Pigouvian tax.

54. Two key results emerge from their laboratory experiments: First, people were not confused about the nature of Pigouvian taxation; they understood how these taxes work and why society might need them—they just did not like the "t-word"—tax, and; second, re-framing the tax as a "fee" increased support, especially when revenues were earmarked for the environmental problem. A targeted rebate that reduced inequalities in the distribution of wealth was also preferred by the subjects, which supports the behavioural economics notion of "inequality aversion".

Lesson 16. Monetary incentives may 'crowd out' some people's willingness to protect the environment 'voluntarily', with possible implications for policy choice and stringency. However, since it is difficult to know whose behaviour is likely to be 'crowded out' by a given policy instrument and for which reasons (intrinsic or social) this remains an area requiring further research.

55. We can further illustrate how one might use behavioural economics to design incentives for environmental protection. We consider Banerjee and Shogren's (2012) model of mechanism design for environmental protection given the existence of *social preferences* (also see Baliga and Maskin, 2003). Behavioural economics has worked to identify behaviour driven by self-interest and social motives such as altruism, fairness, isolation, norms, inequality aversion, reciprocation, and intrinsic motivation (see for example Charness and Rabin, 2002). People think about and act on other people's well-being or approval. The economic literature is substantial on social preferences such as fairness, altruism, and warm glow in public good provision (e.g., Bergstrom, 2006).

56. Less attention has been given to the behavioural role of social context like isolation and approval in environmental valuation (see e.g., Andreoni and Petrie, 2004). But examples exist—one recent study is Alpizar *et al*., (2008). They explore how social context affects actual contributions to a public good – a national park in Costa Rica. They find that contributions stated in public were 25% greater than contributions stated in private. If their findings are robust to alternative specifications, social approval/isolation could become a basic feature in stated preference work.

57. Mechanism design is a formal approach to understand how monetary incentives affect behaviour. We are concerned with how this mechanism affects behaviour given some probability exists that there is a non-monetary reason to do the job anyway. Consider a concrete piece of reality to help think about the relevance of the theory. People have social preferences to help out even though it is privately costly to them, e.g., a landowner who protects endangered species on his land even if it reduces his land rents. Some people have social preferences to protect the environment without pay. Paying them to protect nature might be counter-productive. Money "crowds out" their willingness to do the good deed (see Bowles, 2008; Bowles and Hwang, 2008).[4] Behavioural economists have argued monetary rewards weaken intrinsic motivation; their terms are dramatic—the *hidden cost of reward*, the *over-justification effect*, or the *corruption effect* (see Deci and Ryan, 1985). Here monetary rewards reduce the ability to indulge altruistic feelings; or cause others to doubt one's true motive for doing a good deed (Bénabou and Tirole 2006). If the crowding-out effect holds, monetary reward decreases effort—the exact opposite of what economics would predict.[5]

58. In contrast, other people do not have strong social preferences for the environment. They are unwilling to pick up the tab to protect a public good. Unfortunately it is difficult to identify who falls into each camp by observing people's behaviour with respect to a social project. Is their behaviour due to intrinsic motivation or social motivation, since people care about reputation too (Dana et al. 2003). These folks might want to protect the environment to "buy" a good reputation. A good reputation might be useful to attract new customers, better access to capital or credit markets, entice new property buyers, and so on. Offering up monetary rewards to these folks could be counter-productive if they wish to avoid being viewed as "greedy" not generous (Bénabou and Tirole, 2006).

59. The regulator's dilemma is that she does not know which person is which—social preferences or reputation buyer. How does she design a mechanism given she knows both types exist but she does not know who is who. She does not want to chase away the person with social preferences by crowding out their incentives to do the right thing; she does not want to reward the reputation seeker by paying out extra money that could be spent elsewhere. The open question is whether she can design a mechanism that specifies a menu of monetary transfer-to-effort that gets the best out of both types of people.

Lesson 17. Designing efficient policy instruments that account for both – behavioural and market – failures is difficult. What we need instead are flexible institutional designs or adaptive regulatory schemes which would allow policy-makers to adjust market-failure regulation for behavioural failures that may become apparent in the future.

60. The other key incentive mechanism is tradable permits, or cap-and-trade. We still have found no papers (as of February 2012) that examine the existence or implications of behavioural failure within a marketable permit system. In Shogren and Taylor (2007), we speculated that this may be because the tradable permit mechanism designed to correct market failure also works to correct behavioural failure. We raised the question about incentive design given the theory of second best as related to the interaction between market failure and behavioural failure. Recall that the theory of second best says if you have two imperfections, correcting only one failure does not guarantee that social welfare will increase. One could conjecture that if behavioural and market failures exist simultaneously for an environmental good, correcting one failure without correcting the other could actually reduce overall welfare.

[4]See for example Frey (1997), Frey and Jegen (2001), Milinski et al., (2002), and Bénabou and Tirole (2003).

[5] For example, in case of forest habitat preservation in Finland, private property owners with positive attitude towards environmental protection actually claim less monetary transfer (Mantymaa et al. 2009). Different factors motivate people to participate in social projects otherwise seen undesirable: expectations of future returns (Trivers 1971), indirect reciprocity (Alexander 1987), a warm-glow (Becker 1974); they enjoy donating and giving (Andreoni 1989); or they like the importance of the work (Martin-Lopez et al. 2007).

61. The set of challenges would be enormous if we had to design environmental and resource policy to correct simultaneously both market failure and behavioural failure. In the world of ex-ante policy design, where natural experiments are prohibited and ex-post policy changes are difficult if not impossible in the near-term, constructing policies or markets that promote efficiency without consideration of relevant behavioural failures would likely result in inefficient outcomes. For example, if a policy-maker introduces a Pigouvian tax/subsidy to address climate change externalities without accounting for the fact that people overestimate low probability/high severity events, he could create a behaviourally ineffective tax that reduces total welfare. In theory, the policy-maker might be able to resolve this problem by adjusting the tax to account for the probability weighting issue, which would generate a behavioural first best out of a market failure. But then he or she would need more information than is normally assumed about the representative person, i.e., what is the curvature of the probability weighting function.

62. Our arguments might not convince the reader to completely re-think economic analysis on account of the identified behavioural-environmental second best problem. But analysts should be aware of instances in which the evidence points to a problem, and they should rigorously address these realities to advance the science of economics. Considering all possible simultaneous behavioural-market failure combinations in ex-ante policy design is surely too costly to undertake in meaningful policy settings. This suggests the use of adaptive regulatory schemes in which policy-makers adjust market-failure regulation for behavioural failures that may arise. Researchers need to explore options for flexible institutional design that could be used to account for key failures – market, behavioural, or both. Perhaps this is all pointing to marketable permits as the best institution to avoid the behavioural second best problem in environmental policy. Marketable permit systems, provided they are active exchange institutions, could be the most effective behavioural disciplining device, or at a minimum, the institutional design least affected by behavioural failures.

5. Concluding Remarks

63. Behavioural economics can help guide how incentives are designed to protect the environmental good if the insight generated leads to lower health risks and environmental conflicts, encourages more coordination and cooperation, and helps us design better incentive systems. Three big challenges exist when thinking about all this: (1) markets and rationality, (2) the theory of second best, and (3) the moving baseline against which to judge success. Consider each in turn.

64. First, how big a role behavioural economics has in environmental policy depends on how one views behaviour inside and outside of market operations. If one believes that market experience pushes people toward more rational behaviour, behavioural economics has a limited role in incentive design. Market experience affects behavioural failure by focusing on poor choices with high opportunity costs; behavioural failure affects the creation of new markets if behavioural biases prevent policy-makers and people from realizing how to capture potential gains. Behavioural researchers interested in environmental policy might want to think more about the power and the limits of the ideas of rationality spillovers and rationality crossovers. Recent research shows that people respond to the feedback and discipline of an active exchange institution by adjusting their behaviour to more closely match rational choice theory (e.g., Chu and Chu, 1990; Cherry et al. 2003; Cherry and Shogren 2007).

65. Second, we reiterate our concern about the risk of a new problem of second-best problem. Again the question is if both market failure and bounded rationality exist, policy-makers need to think about designing incentives systems to correct simultaneously both an externality and the list of behavioural biases, e.g., our tendency to overestimate low probability/high severity risks. Otherwise, we are running the risk of unintended consequences associated with second-best.

66. Finally, a further concern with applying behavioural economics to environmental policy is the "ever expandable baseline." Science needs two baselines—an upper and lower bound—against which one can compare observed behaviour. In economics, rational choice theory sets the upper baseline; random behaviour the lower baseline. With rational choice theory the baseline is fixed and clear—predicted behaviour given optimization over fixed preferences, resource endowments, and relative prices. And for a century, the major modification to preferences was to allow for risk aversion. Today, researchers are assuming people are averse to more than just risk: aversion to loss, ambiguity, inequality, lying, myopic loss, guilt, regret, disappointment, inflation, and so on. The challenge is to justify why some aversions are in some models but not in others. The challenge is to separate out one aversion from another if they have similar behavioural effects, i.e., what is the structure difference between guilt aversion and lying aversion? Re-establishing a new upper behavioural economic baseline that meets various stress tests imposed by economists and policy-makers will require more evidence on robustness and more structural theory. In the meantime, behavioural economics does offer up some straightforward lessons on how to design more effective environmental policy for real people.

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