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Psychology and Behavioral Economics Lessons for the Design of a Green Growth Strategy

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Abstract

A green growth agenda requires policy makers, from local to supranational levels, to examine and influence behavior that impacts economic, social, and environmental outcomes on multiple scales. Behavioral and social change, in addition or conjunction with technological change, is thus a crucial component of any green growth strategy. A better understanding of how and why people consume, preserve, or exploit resources or otherwise make choices that collectively impact the environment has important and far-reaching consequences for the predictive accuracy of more sophisticated models, both of future states of the world and of the likely impact of different growth strategies and potential risk management strategies.

The prevailing characterization of human decision making in policy circles is a rational economic one. Reliance on the assumptions of rational choice excludes from consideration a wide range of factors that affect how people make decisions and therefore need to be considered in predictions of human reactions to environmental conditions or proposed policy initiatives. In addition, a more complete and more fully descriptive understanding of decision processes provide powerful tools for policy design that complement legal or economic instruments or may lead to more effective implementation of such policy instruments.

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PSYCHOLOGY AND BEHAVIORAL ECONOMICS LESSONS FOR THE DESIGN OF A GREEN GROWTH STRATEGY*

WHITE PAPER FOR WORLD BANK GREEN GROWTH KNOWLEDGE PLATFORM

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Green Growth Strategy

Green growth or the related notion of sustainable development refers to the management of natural resources (land, soil, water, forestry, etc.) and the natural environment (climate, oceans, etc.) in ways that ensure their continued existence and well-being, while at the same time also putting them to efficient use in advancing human welfare. Green growth is economic growth that ensures that natural assets continue to provide resources and environmental services necessary for well-being. It focuses on the tradeoffs and, more importantly, also the synergies among the environmental, social, and economic components of development.

A green growth agenda requires policy makers, from local to supranational levels, to examine and influence behavior that impacts economic, social, and environmental outcomes on multiple scales. Attempts to increase a country's productivity, for example, may generate multiple options that all satisfy this policy goal but can have varying impacts on unemployment rates, as well as air quality and CO_2 emissions. Custodians of scarce resources, such as the water available in a system of reservoirs, need to regulate release times and levels in a way that satisfies stakeholders with different needs and sources of power while safeguarding future availability of water, given projected future upstream rainfalls. Sustainable growth (or the current global status-quo, non-sustainable growth) is the emergent result of the actions of a large number of individuals (the more than 7 billion members of the human species) who organize themselves into familial, professional, religious, ethnic, recreational, local, regional, national, multi-national and supra-national groups. These groups, with their rich set of physical and intellectual tools, make small and large decisions that interact with each other and with the physical environment, itself a set of dynamic integrated complex-systems.

The above examples illustrate that green growth decisions (a) impact a range of dimensions, from economic to social and environmental ones and involve tradeoffs between these dimensions, (b) have distributional implications and involve considerations of fairness or equity, (c) involve uncertainty about the likely consequences of different actions and (d) require intertemporal tradeoffs on costs and benefits. Implementation of green growth policies in light of current nonsustainable consumption and growth typically requires persuading individuals or groups to reduce consumption in situations where economic models of rational behavior argue against such reductions. Environmental goods such as clean air, drinkable water, species diversity, and a life-sustaining climate are common pool resources, and rational economic analysis prescribes short-sighted, selfish depletion of such resources (and/or failure to invest in their upkeep to ensure their continued existence or quality) as the dominant behavior, even though more long-sighted and cooperative behavior would be socially desirable (Bowles, 2004). While most policy decisions have these characteristics to some extent, these obstacles to change loom particularly large in the domain of green growth.

If existing behavior lies at the root of current global and local environmental and socioeconomic threats, then massive behavioral change is required to address these looming problems (World Climate Summit, 2010). Behavioral and social change, in addition or conjunction with technological change, is thus a crucial component of any green growth strategy. A better understanding of how and why people decide to do what they do as they consume, preserve, or exploit resources or otherwise make choices that collectively impact the environment has important and far-reaching consequences for the predictive accuracy of more sophisticated models, both of future states of the world and of the likely impact of different growth strategies and potential risk management strategies.

The prevailing characterization of human decision making in policy circles is a rational economic one. Rational economic men and women update their beliefs objectively based on new information and compute the costs and benefits of different actions, to select the action that provides optimal returns to them, with no limitations in information availability or processing capacity. Reliance on the assumptions of rational choice excludes from consideration a wide range of factors that affect how people make decisions and that therefore need to be considered in predictions of human reactions to environmental conditions or proposed policy initiatives. In addition, a more complete and more fully descriptive understanding of decision processes provide powerful tools for policy design that complement legal or economic instruments or may lead to more effective implementation of such policy instruments, helping people, groups, companies, and governments towards decision that are in their own long(er)-term interest as well as contributing to greater public welfare.

Typical vs. behavioral-economic taxonomy of green growth target behaviors

Discussions of green growth initiatives typically divide the action space into resource sectors (with categories like agriculture, energy, and water) or into categories of action that can be taken by either policy makers (capacity building, education, climate change adaptation or mitigation) or members of the general public (transportation, housing, heating/cooling, or food decisions) that will lead to a more sustainable use of natural or social resources.

In contrast, psychology and behavioral economics approaches to green growth initiatives distinguish actions along more abstract dimensions, differentiating for example between interventions that target antecedents of decisions (e.g., commitment, information, or goal-setting) and those that target consequences of decisions (e.g., feedback, rewards) (Abrahamse et al., 2005). Other authors distinguish between promotion-focused actions that add positives (e.g., creating green energy technologies) vs. prevention-focused actions that remove negatives (e.g., reducing CO2 emissions) as different motivational systems are involved (Higgins, 2005), or between automatic behaviors (e.g., electricity use habits) vs. reflective and deliberate actions (e.g., the decision to switch to a green electricity

provider). More generally, categories by which potential green growth actions are differentiated typically relate to the specific interventions by which they might be modified. Because different processes and dynamics drive them, behavioral researchers also distinguish between actions at the individual, group or household, and firm or institutional level.

Psychological Processes Involved

Homo sapiens, i.e., the human species as we know it today, has undergone remarkable changes in its way of living over evolutionary history. From a nomadic life of subsistence as hunter-gatherers to greater geographic permanence and more controllable food supplies with the development of agriculture, humans have moved on to the present population-dense, technologically complex, and increasingly urban world. Fossil fuels and such innovations as steam power, the internal combustion engine, and electrical power generation gave rise to the industrial revolution of the 19th and early 20th century, and the scientific insights of nuclear physics of the 20th century allowed for space exploration, the electronics revolution, and emerging nanotechnology.

Along with these changes in living conditions and occupations, the mindset of homo sapiens changed from having subsistence (i.e., survival and procreation) on Earth as its most salient goal, to more ambitious goals like the constant improvement of living conditions and cross-national competition that require more aggressive exploitation of the Earth's resources. In the 1960s, space travel provided us with the indelible image of an unquestionably finite home planet, a landmark experience. With increasing evidence that resources may not be as unbounded as they must have appeared to the small population of hunters on the Serengeti or the American robber barons of the 19th century who built fortunes out of oil, coal, and steel, the mindset of at least a subset of homo sapiens has recently been changing yet again, this time to a focus on sustainability, that is, on a judicious balance between exploitation and preservation that will guarantee continued availability of resources into an ideally infinite future.

The body of research described in this report draws on the insights of two fields that have studied decision-making as a science: first, social cognition, which assumes that unconscious and conscious inference and decision processes determine behavior. These processes are elicited by conditions in the external environment in combination with internal variables that include prior experience, expectations, and goals. The second field is behavioral decision research, which has documented people's attentional, memory, and information processing limitations, often referred to as bounded rationality (Simon, 1957). This research shows that humans often construct their preferences while making their decisions, using processes that are typically different from the as-if calculations implicitly assumed by rational-economic models of choice.

Human brain structures and the cognitive and emotional processes with which the human brain responds to external events are evolving on an evolutionary time scale, with a lag in responsiveness to recent conditions. Existing human brain structures and response patterns evolved on the Serengeti, in an environment of simple goals and risks and with a small human population in the form of clans or tribes, and have not yet had time to adapt to the present high-density, high-complexity, resource-constrained world. Even though evolutionary (phylogenetic) adaptation of brain structures and processes to our current environment continues, the normal and unaided ways in which we respond to the uncertainties, risks, and challenges of our present life cannot be assumed to be entirely adaptive (Marx & Weber, 2007). Learning how to best deal with the complexities of our current world at the individual (ontogenetic) would be inefficient, if each individual had to discover good coping mechanisms for him- or herself. Cultural learning, which refers to the ways in which people pass on useful insights to others and often future generations, has been suggested as a way to make individual lessons have more far-reaching impact (Boyd & Richerson, 1995; Richerson & Boyd, 2005).

The remainder of this section describes four ways in which human behavior can be shown to exhibit greater complexity than the corresponding assumptions made about them by the rational choice model. The self-focused maximization of consequential material outcomes will be seen as only a small subset of goals that drive human behavior. Contrary to the assumption of unbounded processing capacity, attention is an extremely finite resource that needs to be husbanded carefully and strategically. Learning does not necessarily follow the rules of Bayesian updating of beliefs, and trust plays a complicated, but important role in information transmission, risk communication, and decision making, even though it does not feature in rational choice.

Goals

Taxonomies of human needs, from sociology (M. Weber, 1921/1984) to philosophy (Habermas, 1972) and psychology (Hilgard, 1987) suggest that human needs are far broader than the maximization of personal material needs. Many of our needs are material (sustenance, shelter, financial security) and many of our goals are instrumental (that is, designed to help us satisfy those needs), and these are the needs and goals that the rational-economic model emphasizes. However, other classes of needs also play important roles. Social needs, for example, include both affiliation (wanting to belong) and individuation (asserting one's autonomy and uniqueness). Materials needs give rise to material goals (e.g., for wealth, health, safety), social needs to social goals (e.g., for love, companionship, affiliation) but also ethical goals (e.g., equity, justice). A range of psychological needs (e.g., to feel effective; to feel in control) give rise to psychological goals (e.g., a minimal level of certainty or confidence in one's decisions).

Maslow's (1943) concept of a hierarchy of needs referred to different levels of needs within his theory of individual self-actualization, but a hierarchical structure of needs and goals exists in many other domains, including the goals associated with

green growth (Hofstede, 1984). To the extent that it is the economic pillar of sustainable development that ensures lower level material needs of both individuals and countries, one should expect individuals, countries, or regions at lower levels of socio-economic development to put greater emphasis on the goal of economic development than on the social pillar and even less so environmental pillar of sustainable development, with their associated goals and subgoals.

In any given situation, individuals or groups will pursue a wide range of goals. The rational-economic model assumes that people would consider all of these goals across all decisions and make tradeoffs between them, thus ensuring consistency in behavior. In contrast, people seem to use their goals in a way that is simpler, but also much more unsystematic. Some descriptive models of choice assume, for example, that we evaluate choice options one attribute at a time, in a lexicographic fashion starting with the most important attribute, eliminating options that do not satisfy requirements on the most important attribute(s) (Tversky, 1972). While such sequential elimination of choice options reduces awareness of tradeoffs between decision goals or choice attributes (which are often seen as personally painful or politically dangerous) (Payne, Bettman, & Johnson, 1993), such lexicographic processing also results in systematic violations of choice consistency (Tversky, 1969). Other models assume that we do not evaluate existing choice options on the degree to which they allow us to achieve our goals, but that we simply count how many currently active goals each choice option can sufficiently satisfy, and then pick the option with the largest count (Krantz & Kunreuther, 2007). Such models also postulate that new choice options may be generated if existing ones do not allow the decision maker to reach all important goals, instead of simply accepting and calculating the tradeoff between goals, and picking the overall-best one, crossing over from decision making (and choice option evaluation) into problem solving (and choice option generation) (Weber & Johnson, 2009).

Furthermore, goals in many situations are contradictory (e.g., we want to consume and conserve) and decisions typically require a tradeoff between the extent to which one or the other goal can be satisfied. As creatures who want to have our cake and eat it too, we dislike the realization that tradeoffs need to be made and have evolved ways of making decisions that minimize conscious tradeoffs (Payne, Bettman, & Johnson, 1993) Conflicts between technological elites and members of the general public often arise over the use of compensatory decision rules with their open acknowledgement of tradeoffs vs. noncompensatory decision rules that hide such tradeoffs (Keeney, 2001). Extreme cases are taboo tradeoffs, where members of the public and/or members of their governments feel that tradeoffs between competing goals (e.g., financial gain vs. physical well-being ensured by a full set of internal organs) may not be made (Fiske & Tetlock, 1997).

One way of guiding tradeoffs is by way of cultural norms, which not surprisingly vary between cultures (Weber & Morris, 2009). Given that (i) cultures differentially emphasize the importance and desirability of different human needs (e.g., autonomy vs. social connectedness) and (ii) people's different way of making decisions (the

decision modes discussed below) facilitate the attainment of different needs to different degrees, one would expect to find cultural differences in the frequency of decision modes hypothesized to contribute to the attainment of those needs. In a study of the decision modes used by characters in American and Chinese 20th century novels, decision makers in a collectivist culture (China) with its emphasis on affiliation were more likely to make role-based decisions which affirm social connection, while decision makers in an individualist culture (United States) were more likely to make affect-based decisions which affirm choice autonomy (Weber, Ames, & Blais, 2005).

Features of the external environment in which a decision is made, such as incidental visual displays or background music, can temporarily activate or prime specific needs or goals. For example, a backdrop spelling out "security" a couple of dozen times behind the lectern at a presidential press conference reinforces or activates concern about security. In the case of background music, researchers found that customers purchased German wines 73 percent of the time when German (rather than French) background music was playing in a wine store, and French wines 77 percent of the time when French music was playing, even though customers were not aware of any effect of the music on their purchase behavior (North et al., 1997). The nature of an incidental task conducted prior to making a decision can also temporarily prime specific goals that will carry over to the decision. For example, cooperation in a social dilemma game went up by 25 percent when the preceding task required cooperation between the members of the group in the form of writing a joint letter to the dean, relative to a control where individual students each wrote their own letters to the dean (Krantz et al., 2008). Another study showed that making a decision in a group setting facilitates greater attention to goals that transcend immediate and shortsighted self-interest, especially if the group setting is the first time that the decision is being considered, presumably because the presence of others primes goals that transcend the individual (Milch et al., 2007).

People are well aware that they possess a repertory of decision modes (further described below), ranging from quick intuitive responses based on either affective reactions or over-learned associations at one end of the continuum, to the more or less automatic application of rules of conduct or social obligations, to the conscious calculation of relative costs and benefits at the other end of the continuum (Weber & Lindemann, 2007). An examination of work relationships showed that people reported using different modes of making decisions, depending on how they characterized the nature of their relationships with other people and thus, presumably, the larger goals behind their decisions (Morris, Podolny, & Ariel, 2000). When making decisions in their personal relationships, respondents reported to be guided by considerations of affect, in legal-bureaucratic relationships by considerations of roles and obligations, and in market relationships by cost-benefit considerations.

An analysis of the ancillary functions filled by different decision modes (above and beyond determining the best choice option) can help explain observed relationships

between the domain, i.e., what the decision is about (e.g., investment decisions vs. romantic decisions) and mode usage. The relative importance or salience of different types of needs is often domain specific (e.g., material needs play a larger role in investment decisions than in dating decisions) and people tend to select or give greater weight to the mode(s) that help them satisfy the salient needs in a decision situation (e.g., calculation-based decision-making to optimally satisfy material needs) (Weber & Lindemann, 2007). Decisions that have environmental impacts and consequences for sustainable or nonsustainable development fall into several different domains and activate different types of goals to different degrees. At the policy level, they include economic, technological, social, and other dimensions. At the consumer or citizen level, they include consumption decisions, recreational decisions, and life style decisions, to name just a few. The class of needs and goals associated with decisions in a given domain will also differ by country or even socio-economic groups in a given country, as further described below.

Attention

A focus on attention as a scarce resource dates back to the beginning of scientific psychology. William James (1890) differentiated between voluntary and involuntary attention and suggested the use of eye movements to track attention. Kahneman (1973) emphasized the limited capacity and thus necessary selectivity of attention and distinguished between two determinants, situational voluntary task intentions and more enduring dispositions like the involuntary orienting response to novel stimuli.

As described by Weber and Johnson (2009), decision makers acquire and encode information about choice options in ways not captured by rational choice models, using goal-relevant and context-sensitive simplifications that are adaptive ways to cope with finite attentional and processing capacity. One such cognitive simplification is the encoding of the value of outcomes or choice options in a relative (rather than absolute) fashion. The humorist Thurber was once asked how he liked his new wife. His response "Compared to what?" reflects one of prospect theory's (Kahneman & Tversky, 1979) major insights, namely that evaluation is relative. Prospect theory (also see Tversky & Kahneman, 1992; Kahneman & Tversky, 2000; Wakker, 2010) builds on expected utility theory (von Neumann & Morgenstern, 1953), the normative model of decision-making under uncertainty, but updates it in ways that make the theory more predictive of observed choice behavior. One important innovation is the introduction of a reference point, by which outcomes are encoded as either relative losses (worse than the reference point) or relative gains (better than the reference point). In addition to the empirical observation of different risk-attitudes (risk-aversion in the domain of gains, risk-seeking in the domain of losses), prospect theory adds the concept of loss-aversion, i.e., the empirical observation that the impact of a loss of a certain magnitude is about twice that of a gain of the same magnitude (also see section below). In other words, the disutility of a relative loss outweighs the utility of the same outcome, if encoded as a

relative gain. The reference point used in such relative evaluation of outcomes includes the current status quo, but also other observed or counterfactual outcomes from the same or different choice alternatives, as well as expectations. Such relative encoding of the outcomes of choice options in conjunction with differences in risk attitude and the existence of loss aversion provides entry points for the design of presentation formats of green growth policy options that increase their perceived desirability, as further described below.

Another important factor that drives the allocation of attention and thus decision weight to different choice attributes (Weber & Kirsner, 1996) is the existence of easily quantifiable metrics on which an attribute can be evaluated and progress towards a goal can be monitored. This argues for the importance of developing metrics of environmental and social impacts that have the same level of sophistication and buy-in as existing metrics of economic impacts. At the individual consumer level, the introduction of the notion of a personal or household carbon footprint has been very helpful for raising people's awareness of the environmental impact of their consumption decisions.

Learning

Behavior change is most reliably seen when an existing behavior shows itself to have negative consequences. Psychologists refer to this process as learning. There are three principal ways humans learn: by being hurt, through observation and imitation, and by being told. Learning by being hurt is the most primitive and arguably most effective way of modifying behavior. The child who touches the hot stove and gets burned is not likely to ever do it again, but trial and error learning has costs in terms of individual mortality or morbidity. Learning from personal experience, where positive outcomes of an action increase its likelihood of being repeated and negative ones reduce this likelihood, has a strong recency bias, that is very recent events have a strong impact, and that impacts recedes over time (Hertwig et al., 2004). A recency bias is very adaptive for survival in nonstationary environments, where changes in the availability of nutrients from different sources, for example, change with the seasons in a cyclical way (Shafir, Bechar, & Weber, 2003). Its downside is that people's behavior in the face of small-probability high-severity events often appears erratic. On the one hand, people insufficiently incorporate the risks of rare events into their behavior because, by definition, rare events have a small probability of having occurred recently and thus have not shaped the behavior. On the other hand, they overreact when the rare event eventually does occur and they experience the full weight of its negative impact, and take a while to recover from that impact (Weber, Shafir, & Blais, 2004).

Observational learning and imitation is an evolutionary innovation available only to humans, primates, and a few other species (Zentall et al., 1988). Recently neuroscience has identified neural substrates for complex versions of such learning. Iacoboni et al., 1999). Mirror neurons in the parietal and frontal cortex, for example,

have been found to respond (in the form of empathetic emotional reactions or motor behavior) in the same way to events observed as happening to someone else or to oneself (Rizzolatti & Craighero, 2004). However, observational learning has also been observed in lower species (such as birds) that do not have such brain structures, and thus seems to be a very fundamental way to learn (Zentall et al., 1988). Sociologists and psychologists have long argued that modern notions of the autonomous self have falsely emphasized the role of individual decisions over that of social influences on human behavior (Ellwood, 1901; Sloate & Voyat, 2005). Copying the observed behavior of others is a widespread phenomenon of which the imitator is typically unaware and plays a large role in human development (Meltzoff & Moore, 1999).

Learning by being told adds yet another level of efficiency to human adaptability. Individuals who live in cooperative groups with the ability to communicate in symbolic form can capitalize on lessons from the experience of others by (statistically or more informally) combining and condensing those lessons into a recommendation, rule, or piece of advice. Examples include instructions of what to do (or not to do) by a driving school instructor or tennis coach. Lectures, textbooks, and scientific publications are less personal ways in which culture transmits observations, inductions, and deductions of some to others, for their personal or for social benefit. Executing a prescribed behavior (e.g., how to make a left turn) or putting into practice a provided rule (e.g., how to take a shower in a way that minimizes water usage) can initially take a lot of effort, especially if it means overriding other, more automatic but less effective or beneficial responses to a situation. Rules may need to be explicitly recalled, perhaps with external memory aids (e.g., an instruction sheet) and correct implementation checked step by step. However, rule activation and the implementation of new behavioral responses become (more) automatic with frequent repetition or practice (Schneider & Shiffrin, 1977). Social institutions like mandatory driving instruction, which not only transmit rules but also practice their implementation to the point where they become at least partial automatic, are an acknowledgement of the desirability of such automatization (which frees up cognitive resources to dedicate to other tasks and reduces errors in rule implementation) (Engel & Weber, 2007).

A final and important point to emphasize is that not all learning is conscious. Conditioned responses and habits acquired without conscious awareness probably determine more behavior than most people would be happy to acknowledge. Unconscious processes can be present during both the encoding stage of learning, where much information is stored for future use without our explicit intention and conscious awareness (Reber, 1996), and at the retrieval stage, where subliminal and supraliminal primes (i.e., prompts in the decision environment) increase the accessibility of a subset of information, goals, or intentions, leading to differences in observed behavior (Weber & Johnson, 2006). Priming, for example, either the dimension of comfort or price by exposing internet shoppers for sofas with an initial store website that featured either feathery clouds or dollar signs in its wallpaper, led to shoppers buying sofas that scored more highly on the primed dimension

(Mandel & Johnson, 2002). While conscious learning or problem solving typically requires that the individual perceives there to be a problem, learning or adaptation without awareness has the advantage that it can happen without a conscious diagnosis that something is wrong and requires action.

Trust

When it comes to making tradeoffs between different goals, people often do not trust themselves. In such cases, observation shows that people use precommitment strategies as a self-control device (Prelec & Herrnstein, 1991). Often these precommitments take the form of rules ("don't eat after 3 pm") that are followed when decision makers finds themselves in tempting situations. A recognition-and-rule based decision in such a situation will avoid any tradeoff between weight-reduction and pie-consumption goals late in the afternoon that the decision maker may resolve shortsightedly in favor of consumption.

Trust in the sources of information also plays a key role on green growth decisions where evaluations of the impacts of decisions are outside of the expertise of the policy maker in charge of the decision and require the input of domain experts. Political ideology plays a large role in policy makers' beliefs about the costs and benefits of green growth action alternatives, and problems with the adoption of such actions often are not the result of information deficits so much as deficits in trust in the conveyors of information about their impacts (Weber & Stern, 2011).

Constructed preferences and choice architecture

In many situations including those of intertemporal choice, people do not have firmly established preferences for choice options but instead construct them as they go, by recruiting arguments for different choice options, by examining external evidence and by recruiting internal evidence from memory (Payne, Bettman, and Johnson, 1993; Lichtenstein & Slovic, 2006; Weber & Johnson, 2009). Trope and Liberman (2003) show that when people recruit evidence internally, events in the future elicit different arguments for and against them compared with imminent events. Specifically, events in the distant future (e.g., an invitation to give a paper at a conference next summer, or the prospect of coastal flooding 30 years from now, to use an environmental example) are construed in abstract terms, whereas events close to us in time (the upcoming trip on Monday to attend the long-scheduled conference, or the prospect of a major hurricane passing through town this afternoon) are construed in very concrete terms. Abstract representations of consequences in the distant future lack the concrete associations that are connected to emotional reactions. In contrast, concrete representations of consequences in the present tend to be saturated with affective associations. This difference in the

affective richness and concreteness of the representation of temporally close vs. distant consequences may well lie at the root of observed problems of self-control, be they impatience and impulsivity in obtaining desirable outcomes (Laibson, 1997) or procrastination with undesirable tasks (O'Donoghue & Rabin, 1999). Actions designed to mitigate environmental problems are often perceived as requiring the sacrifice of concrete, immediate benefits for the sake of abstract, distant goals. As discussed below, there are other and more positive ways of framing such choices. However, when pro-environmental behaviors are framed as involving sacrifices, the strong negative affect associated with the concrete immediate costs in conjunction with the absence of feelings of worry about abstract and distant negative consequences of any failures to act will result in ecologically damaging consumption decisions and actions.

A large body of social science evidence shows that people's preferences and choices are the result of individual and social construction processes (Lichtenstein & Slovic, 2006; Weber & Johnson, 2009). This means that people's responses not only reflect external events and objective reality but also decision makers' internal states, needs, and cognitive and emotional processes. Individual and social preference construction makes it more malleable and labile, subject to variations in the situational context and elicitation mode, than the judgments and choices predicted and prescribed by the optimization models of statistics and rational choice and also more variable across different stakeholders than predicted by such models. Differences in responses are not only driven by differences in objective circumstances but also differences in processing capacity and styles, scientific training, social values and beliefs.

Query theory (Johnson, Häubl, & Keinan, 2007; Weber et al., 2007) is a framework that incorporates attentional processes and memory-retrieval operations into preference construction. Its assumes that people, when asked to delay consumption, first assess the evidence arguing for immediate consumption and only then assess evidence that argues for delaying consumption. Query theory postulates that, in order to help people reach a decision, evidence generated in favor of an action (e.g., immediate consumption) tends to inhibit or reduce the subsequent generation of evidence arguing against that action and for other actions. Weber et al. (2007) provided empirical support for both conjectures, and succeeded in drastically reducing the intertemporal discounting in people's choice by prompting them to first generate evidence in favor of deferring consumption, followed by a prompt to generate evidence in favor of immediate consumption. Query theory thus provides a tool that may help with the successful implementation of green growth policies as further discussed below.

Decision modes

Qualitatively different processes or ways of making decisions, sometimes referred to as decision modes, can be classified in many different ways. Dual process models

have a long history, e.g., Adam Smith seeing behavior as determined by the struggle between passions and an impartial spectator (Ashraf et al 2005). More recent psychological models have distinguished between a rapid, automatic and effortless, associative, intuitive process (System 1), and a slower, rule-governed, analytic, deliberate and effortful process (System 2) (Sloman, 1996; Kahneman 2003). There is debate about the extent and way in which the two systems interact (Keysers et al, 2008). System 2 can be seen in a supervisory role, since it knows the analytic rules that the intuitive System 1 is prone to violate, and thus can intervene to correct erroneous intuitive judgments (Kahneman, 2003), but other relationships, including simple horse race models, are also considered.

Dual-process models have enjoyed great success and popularity in behavioral economics (e.g., Laibson's (1993) beta-delta model of discounting, discussed below), and have been used to explain many judgment and choice phenomena (see Weber & Johnson, 2009, for a recent comprehensive review). The first class of processes (System 1) works by temporal and spatial associations and similarity, using real world experience as input. Its basic mechanisms are automatic, i.e., associations are established, stored, and retrieved essentially without effort and conscious awareness. Such associative processes teach us, for example, to dislike food eaten just prior to symptoms of food poisoning and to avoid foods of similar taste or smell in the future. Associative processes map uncertain and adverse aspects of the environment into affective responses (e.g., fear, dread, anxiety) and thus represent risk as a feeling (Loewenstein, Weber, Hsee, & Welch, 2001).

Many current environmental or technological risks (e.g., climate change or nuclear power) do not (yet) provide direct experience of adverse consequences most of the time, either because of successful risk management or because adverse consequences have a small probability of occurring and often lie in the future. Such risks, based on model-based predictions, are typically communicated to the public in an abstract and symbolic way, e.g., as probability distributions of possible consequences. Such information needs to be processed by the second class of processes (System 2) that people have at their disposal, which use the analytic algorithms and rules specified by normative models of judgment and choice (e.g., the probability calculus, Bayesian updating, formal logic, and utility maximization), but also simpler versions of such algorithms that explicitly combine information. They are slower than automatic associative processes and require conscious awareness and control. The algorithms that these analytic processes implement need to be taught explicitly, and the appropriateness of their use for a given situation needs to be apparent, i.e., does not get triggered automatically.

Dual-process accounts have been very useful as a conceptual framework, though one has to be careful not to take the dichotomy too literal. While elements of the two processing systems can operate in parallel, it is unclear that they can operate in isolation, and they also interact with each other in complex ways (Evans, 2007; Weber & Johnson, 2009). Analytic reasoning is often guided and assisted by automatic processes that include associations and affect (Damasio, 1994), and few

decisions are made in a completely reflexive way. When both types of processing are in operation but their outputs disagree, the associative system output typically prevails, because its output has greater vividness and emotional salience. Even in seemingly very analytic contexts such as financial investment decisions, subjective and largely affective factors have been shown to influence perceptions of risk (Holtgrave & Weber, 1993) and the choice of investment options (Weber, Siebenmorgen, & Weber, 2005). Hersch and Viscusi (2006) connect affective factors to seemingly analytic considerations in the environmental domain, showing that national differences in worry about global warming correlate with willingness to pay more for gasoline, if such price increases would result in less harm to the environment.

Other classifications of decision modes make finer distinctions than the analytic—associative one of Systems 2 and 1, further specifying and differentiating between different System 2 analytic processes or System 1 associative processes that are used to determine the preferred choice option. One such classification scheme distinguishes between calculation-based decisions (which map onto System 2), affect-based decisions (which map onto System 1) and some hybrid System 1 and 2 modes, namely and recognition- and rule-based decisions (Weber & Lindemann, 2007). Calculation-based decisions, or decisions made "by the head," involve analytical thought on part of the decision maker, who deliberately weighs potential rewards of choice options against potential costs to herself. Affect-based decisions, or decisions made "by the heart," are governed by drives or feelings, i.e., affective associations that are either hard wired or established by prior experience. Affect-based decisions include impulse shopping (approach behavior that is driven by positive affect towards the object of purchase) and decision avoidance (avoidance behavior that is driven by negative affect towards situations that offer no positive choice options or are too complex). Recognition-and-rule-based decisions involve the typically automatic recognition of the decision situation as one of a type for which the appropriate action is known. They are decisions made "by the book," in the sense that the decision maker carries out a behavior prescribed by an implicit rule (utilizing System 1 associations) or an explicit rule (utilizing System 2 awareness and processes). The decision-maker using this mode is not seeking a novel approach to a problem, but is relying on tried-and-true answers.

These qualitatively different modes of making decisions seem to coexist because they serve different functions, allowing the decision maker to satisfy different needs or realize different goals. If calculation-based decision making best serves material needs, role-based decision serve affiliative needs, since a decision that implements the prescribed rules of behavior associated with a social role reaffirms the decision maker's social identity (March, 1993). Affect-based decision making, on the other hand, is a way of reaffirming personal autonomy by doing something simply because one likes to do so, without any need to analyze or justify the decision to others or even to oneself (Weber, Ames, & Blais, 2005).

Calculation-based decisions

A large body of empirical research both in the lab and in the field shows that the explicit or analytic evaluations of green growth choice options by policy makers or members of the general public (rather than by domain experts, but see Section on Training/Education below) cannot be expected to conform to normative models of rational choice. The multiple ways by which lay calculation-based decisions deviate from rational-economic evaluation described in this section, help explain the handicap that environmentally- and socially-responsible green growth policy options face in calculation-based choice, as they typically involve immediate costs and sacrifices which loom large, while their much delayed and uncertain future benefits get irrationally discounted. The first set of behavioral regularities described below influence the valuation of outcomes of different choices. The second set of behavioral regularities bias people's evaluation of the probabilities of events.

Cognitive Myopia

Myopia or shortsightedness has been cited as an explanatory construct in the context of loss aversion, most prominently by Benartzi and Thaler (1995) in their explanation of the equity premium puzzle, i.e., of the puzzling fact that investors hold bonds to the degree that they do, given that the returns on stocks are significantly larger, albeit risky. The behavior, which is inconsistent with reasonable assumptions about risk aversion, can be explained by the assumption that investors do not apply sufficiently long time horizons to their investment decisions, but instead compare and contrast the outcomes of risk-free and risky investment opportunities on a quarterly basis and get disproportionately agitated by losses. Failure to integrate the outcomes of a series of decisions that should be considered in combination (e.g., the returns on an investment across a series of months or the returns across all investments in one's portfolio) is another example of myopia, which focuses attention on just the most recent return or the single investment (Read, Loewenstein, & Rabin, 1999; Thaler & Johnson, 1990). Cognitive myopia thus prevents people from accurately perceiving the future benefits of immediate costs or of reductions in immediate benefits. As a result, people fail to buy more energy-efficient appliances or a host of other energy-efficiency investments, for which higher upfront purchase costs are more than compensated by future energy savings (Gillingham, Newell, & Palmer, 2009).

Loss Aversion

Loss aversion is the label given to an important property that distinguishes prospect theory (Tversky & Kahneman, 1992) from expected utility theory (von Neumann & Morgenstern, 1944), namely a much greater (dis)utility for outcomes that are encoded as losses relative to a reference point than for outcomes of the same magnitude but encoded as gains relative to a different reference point. Loss aversion explains a broad range of choices observed in both the laboratory and the real world that deviate from the predictions of rational-economic choice theory (Camerer, 2000). Employees may be willing to forego projected future increases in

salary (foregone gains), but will fight tooth and nail to avoid any cuts in their current salary (losses). With the status quo as a very salient reference point, loss aversion makes it hard for policy makers to convince people to reduce consumption or, more generally, their standard of living below current levels. However, prospect theory also provides policy makers with a design tool, namely the ability to change decision makers' reference points, with implications for the way in which outcomes get evaluated. The purchase of an insurance policy against drought by a farmer, for example, involves a sure out-of-pocket loss of money (the insurance premium) for the unsure and low-probability benefit of avoiding a much larger loss in the case of drought. Prospect theory predicts risk-seeking in the domain of losses, which would mean choosing the probabilistic loss over the sure loss. Skillful insurance salespeople have long known that they need to move a farmer's reference point, away from its usual position at the status quo, down to the level of the possible large loss that could be incurred in case of drought. By focusing the insuree's attention on the severity of the possible loss and resulting consequences, all smaller losses (including the insurance premium) are to the right of this new reference point, making this a decision in the domain of (foregone) gains, where people are known to be risk-averse and will choose the sure option of buying the insurance.

Attribute framing can have similar effects. Levin and Gaeth (1988) showed that people rated the taste of minced beef higher when it was described to them as 75% lean than 25% fat, presumably because the discrepancy between 25% and 0% fat (a relative loss) is considered more severe than the discrepancy between 75% and 100% lean (a foregone gain). A recent study showed that Republicans were much more likely to purchase a more expensive plane ticket that included a fee to compensate the CO_2 emissions generated by the flight when that fee was called an offset (which was presumably encoded as a foregone gain) rather than a tax (which most people, and especially Republicans encoded as an out-of-pocket loss) (Hardisty, Johnson, & Weber 2010).

Hyperbolic Time Discounting

Future financial costs and benefits ought to be discounted in value (e.g., by the current rate of interest offered by banks), ideally by a constant amount per period of time delay, described by an exponential discount function. Empirical research shows, however, that people apply sharp discounts to costs or benefits that will occur at some point in the future relative to obtaining them immediately (e.g., a year into the future vs. now), but discount much less when both time points are in the future, with one occurring later than the other (e.g., two vs. only one year into the future) (Loewenstein & Elster 1992). Such behavior has been described by a hyperbolic discount function, which shows its steepest decrement in current value as we defer immediate consumption (Ainslie, 1975). Actions to mitigate negative environmental consequences are unattractive within this framework because they require immediate sacrifices in consumption that are compensated only by heavily-discounted and highly-uncertain benefits at a much later point in time.

Cognitive myopia and excessive discounting is arguably the biggest hurdle to rational choice in the domain of green growth decisions. Economic analysis allows for the discounting of future and distant costs and benefits by some amount (e.g., by the rate of interest offered by financial institutions) as a function of the time delay, a mechanism that is described mathematically by an exponential discount function. However, contrary to the assumptions of rational-economic discounting, people are inconsistent in their discounting, applying different discount rates to outcomes in different domains (e.g., financial, health, or environmental outcomes (Hardisty & Weber, 2009; Hendrickx & Nicolaij, 2004)), showing a strong present bias (i.e., strongly preferring immediate benefits), and discounting future benefits far more than future costs (Ainslie, 1975; Loewenstein & Elster 1992).

To explain people's large impatience when immediate rewards are an option, Trope and Liberman (2003) suggest that future events are construed differently from events in the present. In particular, events in the distant future (an invitation to give a paper at a conference two years from now, or the prospect of coastal flooding 30 or 50 years from now) are construed in abstract terms, whereas events closer in time (the upcoming trip on Monday to attend the long-scheduled conference, or the prospect of a major hurricane passing through town tomorrow) are construed in more concrete terms. Abstract versus concrete representation of the consequences of possible actions differ in their affective strength and impact. Abstract representations of consequences in the distant future usually lack the concrete associations connected to present or near-present events and thus may not be feared as much.

Forward-looking green growth decisions often involve the sacrifice of concrete, immediate benefits for the sake of abstract, distant goals. Negative reaction to the concrete, immediate costs and sacrifices, sometimes referred to as loss aversion (Kahneman & Tversky, 1979) can result in ecologically damaging consumption decisions and actions. However, this tendency is moderated by the way that people think about changing their consumption. When asked to delay consumption, people first generate arguments for the status quo, immediate consumption, and only then latter generate arguments for delaying consumption. Yet, argument generation for the first action considered (e.g., immediate consumption) tends to interfere with the subsequent generation of arguments for other action (Johnson et al., 2007). Weber et al. (2007) succeeded in drastically reducing people's discounting of future rewards by prompting them to first generate arguments for deferring consumption, followed by a prompt to generate arguments for immediate consumption. Specifying a default option (i.e., an option that will be implemented unless a different option is actively selected) directs decision makers' attention to that option, getting them to consider arguments for this option first. Social norms and/or positive or negative affective reactions to a choice option also determine which option is considered first, especially in those situations where no default action exists (Johnson et al., 2007; Weber et al., 2007). Thus Hardisty, Johnson, and Weber (2010) found that 65% of Republicans were willing to pay a CO_2 emission reduction fee on such purchases as airline tickets when the fee was labeled as a carbon offset

(and first generated arguments for purchasing it), but that this percentage dropped to 27% when the fee was labeled as a carbon tax, a label that generated negative visceral reactions in this group and led them to first generate arguments for purchasing a ticket without any carbon fee.

Risk and Ambiguity Aversion

Expected utility theory (e.g., von Neumann & Morgenstern, 1944) has been central in the analysis of choice under risk and uncertainty, for its compelling axiomatic foundation and mathematical tractability, but also for its ability to describe a large number of economic choices (Woodward, 1998). It describes deviations from expected value maximization by postulating a nonlinear and mostly concave utility function, going back to Bernoulli (1954/1738). Classical demonstrations referred to as the Allais (1953) and Ellsberg (1961) paradoxes, respectively, have given rise to additional theory (Camerer 2000; McFadden 1999). The Allais paradox demonstrates the certainty effect, an important feature of prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). The certainty effect, namely the fact that certain outcomes get more decision weight than they deserve based on their likelihood of occurrence, is captured by prospect theory's probability weighting function, which has a discontinuity before the endpoints, making events that occur or do not occur for sure far more impactful than those that occur with probability .999 or .001, respectively. Because sure outcomes in environmentally-relevant decisions (such as deciding between a more energy-efficient refrigerator with a higher purchase price and a cheaper refrigerator with higher energy consumption and thus CO_2 emissions) tend to be on the negative or cost side (i.e., the greater purchase price), while gains (i.e., the energy savings) are delayed in time and somewhat uncertain, it is easy to see that the certainty effect may introduce yet another bias towards environmentally less responsible choices in such decisions.

The Ellsberg paradox (1961) established the fact that decision makers distinguish in their decisions between well-specified probabilities (risk) and ill-defined probabilities (uncertainty), even if the best estimates of the latter have the same value as the former. Ellsberg (1961) referred to the dislike which decision makers have for options with ill-defined probabilities as ambiguity aversion, and Hsu et al. (2005) recently provided neuroimaging evidence that risky and uncertain choices are processed in different brain regions. Heath and Tversky (1991) demonstrated that ambiguity aversion is not universal and, in particular, is not found in situations in which decision makers believe they have expertise in the domain of choice, preferring, for example, sports gambles with ill-defined probabilities of winning or losing to money lotteries with well-specified probabilities. Whereas one can expect to find many members of the general public to think of themselves as experts in such domains as sports or the stock market, and thus to not shy away from choice options with ill-defined probabilities, the number of people who would believe themselves to be experts in environmentally-relevant technical domains (e.g., the pros and cons of hybrid electric vs. conventional gasoline engines in cars) has to be much smaller at this point in time. This suggests that for such decisions the

uncertainty and ambiguity of positive benefits of environmentally-responsible choice options will more likely be seen as a handicap rather than an opportunity. It also suggests a perhaps unexpected advantage of educating the public about technological innovations. Such education not only provides more accurate input for people's analytic processing of environmentally-relevant choice options, but will also help to remove negative affective reactions to uncertainty that are associated with not well-understood probabilistic mechanisms related to climate events and their consequences.

Effect of Small Probabilities

An important distinction has been recently made between uncertain or risky decisions made from personal experience and those made from statistical description, because the ostensibly-same information about possible outcomes and their likelihood of choice alternatives can lead to different choices depending on how the information was acquired (Hertwig, Barron, Weber, & Erev, 2004, 2006). Decisions from experience know about the range of outcomes of different choice options and their likelihood based on learning (by getting rewarded or by getting hurt), i.e., repeated personal encounters with the uncertain choice options and their realized outcomes, the way animals learn about different foraging environments in their risky foraging decisions (Weber, Shafir, & Blais, 2004). Even though the outcomes of choice options may initially be completely unknown (decisions under ignorance), repeated choices provide the decision maker with feedback about possible outcomes and their likelihood, in the limit with great objective accuracy. Decisions from description, on the other hand, are made based on outcome and probability information provided in some statistical summary that is communicated in verbal, graphic, or numeric form, i.e., learning by being told. This way of information communication and acquisition is available only to humans, with their ability for abstract, symbolic representation, but is the method by which almost all laboratory studies of risky decision making have communicated information about available choice options to respondents (Weber, Shafir, & Blais, 2004).

Knowing how people have come to know about the possible outcomes of real-world choice options and their probabilities matters, because choices differ quite dramatically under the two information conditions when choice options include small probability events. Members of the general public and domain experts often learn about choice option outcomes and their probabilities in different ways. In the case of insurance decisions (e.g., federally subsidized flood insurance (Kunreuther, 1984)), individuals considering the purchase of insurance appear to make their decision based on personal experience with flood events in previous years, whereas the industry experts have access to actuarial information and thus make decisions from description. In the case of childhood inoculation decisions, the situation is the opposite. The pediatrician who administers hundreds of inoculations per year knows about the outcomes and their probabilities of inoculating or failure to inoculate from personal experience, whereas parents make this decision based on a description of outcomes provided in AMA pamphlets or websites. Weber et al.

(2004) and Hertwig et al. (2006) describe the association- and affect-based learning mechanisms by which personal experience with low probability events leads to more apparent risk taking than that observed when the same options are presented by statistic summary descriptions. People's evaluation of risky options under repeated sampling follows classical reinforcement learning models where initial impressions are continuously updated in a way that gives recent events more weight than distant events. Because rare events have a small(er) probability of having occurred recently, they (on average) tend to have a smaller impact on the decision than their objective likelihood of occurrence would warrant. In those rare instances where they do occur, recency weighting gives them a much larger impact on the decision than warranted by their probability, making decisions from experience more volatile across respondents and past outcome histories than decisions from description. In contrast, the probability weighting function of prospect theory, which was developed to account for data sets that describe risky decisions from description, predicts that decision makers in decisions from description will overweight small probability events, i.e., give them more weight in their decisions than they deserve based on their likelihood of occurrence.

Consistent with these predicted differences in the weight given to rare events under the two information conditions, people living in flood plains who, as mentioned above, make decisions about flood insurance based on their personal experience with floods, a low base-rate event, have tended to turn down even federally-subsidized insurance (Kunreuther, 1984), consistent with an underweighting the actuarial frequency of such floods. Parents contemplating inoculations of their children against childhood diseases that have a low probability of life threatening side effects, who make this decision based on statistical summary information about benefits and side effects, have often turned down epidemiologically effective inoculations, consistent with an overweighting of the low probability of severe side effects.

Slovic, Kunreuther, and White (1974) argued over 30 years ago for the importance and utility of studying bounded rationality in field settings and already predicted that incremental personal experience of natural hazards and decisions based on such information may not be captured by expected utility models and their extensions. Recent work on important differences in decisions from experience and decisions from description confirm these predictions. The relative indifference with which most politicians and members of the general public consider small-probability high-consequence events like catastrophic rainfall and bursting levies, until and unless they have recently occurred, is much closer to the behavior one would expect based on predictions made by the reinforcement learning models of decisions from experience than to those of either prospect theory or expected utility theory for decisions from description.

Affect-based decisions

Affect—particularly negative affect—is the wellspring of action (Peters & Slovic, 2000). The feeling of fear powerfully motivates us to remove ourselves from a dangerous situation (Loewenstein et al., 2001). The absence of any affective or visceral response to such environmental risks as radon contamination, coastal plains flooding, or climate change may well be responsible for the arguably less than optimal allocation of personal and collective resources to deal with such issues (Dunlap & Saad, 2001). Behavioral decision research over the past 30 years provides some answers as to why the general population and their public officials show typically less concern than relevant scientists to some risks, but overreact to other risks.

Affective reactions to risky situations often do not agree with more objective measures of risk that quantify either the statistical unpredictability of outcomes or the magnitude or likelihood of adverse consequences (Sunstein, 2006). Instead, visceral judgments of risk are determined by other (psychological) risk characteristics that elicit affective reactions as part of our evolutionary heritage. The psychological risk dimensions that strongly influence judgments of the riskiness of material risks in ways that go beyond their objective consequences (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978) are summarized by two factors (Slovic, 1997). "Dread risk," the first factor, is experienced in the face of hazards associated with a perceived lack of control over risk exposure and with consequences that are potentially catastrophic: Terrorist attacks, nuclear reactor accidents, or nerve gas attacks. "Unknown risk," the second factor, is associated with how much is known about the hazard, how easily exposure and adverse consequences are detectable, and whether it is natural or man-made. At its high (top) end, we find chemical hazards and radiation, which might kill exposed parties without their awareness, and DNA technology, which might have serious consequences not yet tested by time. Slovic, Lichtenstein, and Fischhoff (1984) suggest that these more affective reactions to risk are forward-looking in ways not always captured by the expected value calculations of experts based on actuarial figures or scientific models. A large accident portends possibly even larger future trouble, and concern about catastrophic potential or lack of control may play a useful societal function. While some of the perceived control may be illusory, the perceived ability or inability to take corrective action is an important component of vulnerability.

Without sufficiently strong visceral reactions to many environmental risks (if they are considered "natural" and well-known), people may not be motivated to take corrective or evasive actions. However, risks can be reframed, and environmental risks presented as more uncontrollable and/or man-made can be expected to activate the feeling that something is amiss, known to result in risk management actions.

Fear appeals are problematic for reasons beyond the fact that people do not naturally worry about environmental risks like climate change. People appear to

have a finite pool of worry (Weber, 2006). As concern about one type of risk increases, worry about other risks frequently decreases, as if people had a limited budget to spend on worry. A Pew (2009) opinion poll found that levels of concern about climate change had declined in October 2009 relative to a high in 2006 that was still maintained in May of 2008. Presumably this recent decline in climate change concern is the result of recent increases in concern about the national and world economy and unemployment. Hansen, Marx and Weber (2004) found evidence consistent with a finite pool of worry among farmers in the Argentine Pampas. As concern about climate risk increased in the course of a two-day farm decision workshop that provided information about the potential impacts of increased climate variability, concern about political risk went down (post- vs. pre-workshop) even though the level of political risk had not changed over those two days. In addition, those who stated greater worry about political risk (either pre- or post-workshop) worried less about climate risk. If people's capacity for worry or concern is finite, then efforts to raise greater concern to motivate protective or mitigation action against some risk by, for example, providing concrete images of possible damages, comes at the cost of potentially reducing concern about other risks. The finite pool of worry concept is related to, though certainly not identical to the concept of risk homeostasis (Wilde, 1998).

Fear appeals are also problematic because of the single-action bias (Weber, 1997), which refers to the propensity to take only a single action in response to a fear signal, even in situations where a broader set of remedies might be called for. Taking the first action to respond to a problem at hand seems to reduce or remove the feeling of worry or concern. Without this affective marker, motivation for further action is reduced. Weber (1997) found that Midwestern farmers engaged in only one of three plausible classes of protective actions against climate change. Hansen, Marx and Weber (2004) similarly found that farmers in Argentina employed only one of several protections against climate variability and climate change. If they had the capacity to store grain, for example, they were less likely to also irrigate and invest in crop insurance. Thus fear appeals may also backfire because they motivate people to take simpler actions than warranted by the complexity of contemporary problems.

Rule- and role-based decisions

In recognition-based decision-making, the decision-maker recognises a decision situation as a member of a class for which a satisfactory action is known (Simon, 1990). Recognition-based decisions come in different variants. In case-based decisions, the decision-maker is typically an expert with a memory store full of specific situations in her domain of expertise, with the most appropriate action stored for each one. These mental representations can be thought of as "if-then" productions, where the "if" element is a set of conditions that must be met in order to trigger the resultant action represented by the "then" part of the production. The expert decision-maker is able to unconsciously apply these production rules, which

have been developed through repeated experience, as suggested in research with experts such as firefighters and jet pilots (Klein, 1999).

Another type of recognition-based decision are rule-based decisions, for which the decision-maker invokes an explicit rule of behavior. These rules may be laws ("if you are driving and come to a red light, then you must stop") or other types of regulations (parental rules, self-imposed admonishments, societal norms, or company rules) (Prelec & Herrnstein, 1991). While such rules may initially be invoked in a conscious and effortful way, involving System 2 processes, their repeated invocation will eventually result in their automatic activation in similar contexts, moving it into the domain of System 1 processes. A final type of recognition-based decision is role-based decisions, where the decision context elicits a rule of conduct that is derived from the decision-maker's social role (March, 1993). Roles include positions of responsibility within society (parent or friend), group memberships (Christian or Democrat), and self-defining characteristics (honest or responsible). Each of these roles has associated obligations which individuals (typically automatically and implicitly) recall and execute when they encounter a triggering situation.

Implicit rules and role-related obligations are instilled directly by parents, professional organizations, or other institutions over time. However, they are often also acquired through observational learning and imitation. Sociologists and psychologists (from Ellwood (1901) to Sloate and Voyat (2005)) have argued that modern notions of the autonomous self have falsely emphasized the role of individual decisions on human behavior over that of social influences. Copying the observed behavior of others is a widespread phenomenon of which the imitator is typically unaware and plays a large role in human development (Meltzoff & Moore, 1999).

Does It Matter How Decisions Are Made?

Some could argue that all of the decision modes mentioned above could be re-described as calculations and optimizations, albeit with different dimensions or currencies that are being optimized. While this is true at an "as-if" level, it turns out that people encode and use the processes by which decisions are made by others and use that information in their social inferences. Decision researchers tested a rational-economic as-if accounting model of instrumental outcomes against a psychological model of inferred motivations based on observed decision modes in the context of favor exchange (Ames, Flynn, & Weber, 2003). Social exchange theory assumes as-if cost-benefit calculations are used to decide whether to agree to a help request (Blau, 1964; Kelley & Thibaut, 1978). The help seeker is assumed to evaluate the person from whom help was requested based on whether (s)he agreed to help and on the magnitude of the favor. According to social exchange theory, it should not matter to the person who received help by which mode the helper

decided to provide help. Instead, Ames et al. (2003) found that people's attitudes towards their helper depended on the mode that they perceived their helpers had used to make the helping decision. Participants in this study reported most favorable evaluations of helpers whom they perceived as having helped "from the heart" and less favorable evaluations of helpers perceived to have been instrumentally concerned with what they would get in return, or who had simply considered role-related obligations.

To the extent that different modes of making a decision lead people to different actions, knowing which version of the "as-if" optimization models was used is of substantial help in predicting choice, accounting for 60 percent of the variance in choices in moral and ethical dilemmas, where perceived costs and benefits of choice options accounted for only 20 percent of the variance in selected options (Krosch, Figner, & Weber, 2011). Predicting behavior and reactions to new institutions or policies based on realistic assumptions about human decision making is, of course, an important role of decision models. It would be foolish not to use the full extent of what we know about when people decide how and why, as it would mean leaving some metaphorical money on the table when it comes to predicting decisions (Weber & Johnson, 2009).

Extensions from individual decisions to households and other groups

Research on the social amplification of risk (e.g., Pidgeon, Kasperson, & Slovic, 2003; Hulme, 2009) has examined dynamics and mechanisms beyond individual perception. Sunstein (2006) described differences in what is available to different groups and what gets amplified as a function of their deep-seated values and beliefs. More specifically, people's worldviews have been shown to shape how they develop attitudes about phenomena like climate change. The sociological theory of moral norm activation (Schwartz, 1977) describes how people decide to act out of a sense of obligation when they become aware of negative consequences to others from some state of affairs and ascribe responsibility for those consequences to themselves. This process affects concern with environmental risks (Dunlap & Van Liere, 1978), including those of climate change (Dietz et al., 2009). Differences in how individuals or groups value consequences to themselves vs. others and about personal responsibility (Schwartz, 1994) affect this process (Stern et al., 1999). A related analysis rooted in anthropology links environmentalism to egalitarian views (Douglas and Wildavsky, 1982; Dake, 1991; O'Connor et al., 1999).

While many of the cognitive and affective processes described above influence both members of the general public and scientists in some contexts, biases in perceptions and reactions tend to be more severe for nonscientists. As a result, scientists and non-scientists differ sharply in their perceptions of climate change. A Pew Research Center (2009) poll found that while 84% of scientists said the earth was getting warmer because of human activity such as burning fossil fuels, just 49% of non-scientists in this U.S. representative sample held this view. Weber and Stern (2011)

summarize physical, psychological, and social factors that together help explain why public understanding in the United States (and presumably in other countries, see point below on need for more behavioral research in developing countries) has not tracked scientific understanding.

Another way of reframing green-growth relevant choices made, for example, by consumers in different countries, is by changing the focus of such decisions from the individual to groups. Decision makers' default focus of attention may be on themselves (i.e., on their needs, goals, and interests), since processing limitations guide into the direction of minimal effort, and personal needs, goals, and interests are most easily ascertained and most important. However, both the immediate decision environment and the more chronic surrounding cultural environment can modify this attentional focus on the self. Priming of broader social identities (e.g., national identity by a country's flag or other cultural icons) has long been used in times of war or other conflict to induce people to incur personal sacrifices for the sake of larger collectives and future times. Milch et al. (2007) showed that something as simple as the decision-making unit can focus attention on different goals and motivations. When groups of three people considered a delay of gratification decision (that affected each of them individually as well as the group as a whole) for the first time collectively, they showed much greater patience and less time discounting than either individuals alone or in a group after they had first considered the decision individually.

The "us" in a broader frame does not even need to be interpreted as "I and others." It can also refer to "my current self and my future self." Thus Bartels and Rips (2010) showed that individual differences in perceived closeness to future selves had implications for how much people were willing to sacrifice current consumption for future consumption. When people make choices for their future selves, those choices tend to be affected more by rational and less by affective considerations and tend to resemble the choices they would make for other people (Pronin et al., 2008). In an extension, Wade-Benzoni (2009) found that people's perceived distance to future generations was inversely related to their generosity towards those generations.

Social psychological research has shown that group identity that turns the decision maker and actor from an "I" to a "We/Us" can be induced by very minimal manipulations (Brewer, 1979). In any given decision, such changes in focus from individual identity and individual goals to group identity and group goals will be transient. However, as with any repeated execution of a process or behavior, initially transient and effortful processes become more chronic and automatic over time (Schneider & Chein, 2003). Cultures that emphasize the importance of affiliation and social goals over autonomy and individual goals have been shown to influence the way in which decisions under risk and uncertainty get made (Weber & Hsee, 1998), and different cultural emphases on individualism vs. collectivism are reflected in cultural products that shape chronic attention, from children's books, to

proverbs and novels (Weber, Ames, & Blais, 2005; Weber et al, 1998) and in cultural institutions and other affordances (Weber & Morris, 2010).

Individual, group, and cultural differences

Individual differences

Individual differences in risk aversion and time discounting, as measured by either normative or descriptive choice models, as well as additional parameters of the descriptive models of choice described above, including loss aversion, ambiguity aversion, and recency biases, can be expected to influence green growth decisions. Podesta et al., (2008) provide an example of how differences on such variables might affect the planting decisions of cash-crop farmers in the Argentine pampas.

Individual and group differences in cognitive abilities and the use of different cognitive and affective processes have additional implications for green growth decisions, as they will influence by which processes or modes decision makers make their choice, which in turn often influences which choice option is selected. Numeracy, the ability to reason with numbers and other mathematical concepts, is a particularly important construct in this context (Peters et al., 2006), which has implications for decision makers' tendency to engage either System 1 or System 2 processes discussed above, and/or to their ability to derive meaning from likelihood information using either numbers (e.g. 90%) or words (e.g. very likely or likely) or pictorial formats (e.g. graphs, box plots, diagrams).

Cultural differences

Sunstein (2006) examines the use of the ready cognitive availability of information as a heuristic in judgments and choice and its connection to differences among groups, cultures, and nations in how they perceive and react to climate change and other risks. Employing the precautionary principle as an example, he argues that, contrary to conventional wisdom, there are no general country-level differences in the use of the precautionary principle (e.g., Europe embracing, but the USA rejecting its use), but that instead its use depends on some intuitive cost—benefit balancing. Wiener and Rogers (2002) show that the United States in the early twenty-first century has taken a highly precautionary approach to risks associated with abandoned hazardous waste dumps and terrorism, but not to the risks associated with climate change, indoor air pollution, poverty, poor diet, and obesity, suggesting that differences in the availability and vividness of these risks account for the differences in response (Rohrmann & Renn, 2000). If a particular risk is cognitively "available"—both vivid and salient— then people will have a heightened fear of the risk in question. If people in one nation fear the risks associated with climate change, and people in another nation fear the risks associated with terrorism, the availability heuristic, interacting with the cultural environment, is likely to be the reason. Sunstein (2006) argues that cultural differences in both risk perception and in precautions are produced, in large part, by availability, which operates in the

context of social influences and intuitive attention to both costs and benefits. In the context of climate change, many Americans believe that far more would be lost than gained by extensive precautions; in Europe, the opposite is true, in part because the risks associated with climate change are not salient to most Americans.

Group polarization is another process operating at the group level and refers to the fact that when like-minded people deliberate with one another, they typically end up accepting a more extreme solution or choice option than the one with which they began (Sunstein, 2006). Thus juries typically produce punitive damages awards that are significantly higher than the awards chosen before deliberation by their median member (Sunstein et al., 2002). People who believe that some risks are trivial or not worth addressing often speak largely with one another, intensifying their antecedent belief. Group polarization helps to account for cultural and even national differences in perceptions of risk, e.g., of climate change.

Different stages of economic development

Countries at different levels of economic development clearly have different needs and thus goals and can be expected to put different weights on the economic, social, and environmental components of the objective function that would evaluate their green growth choice options, if evaluated analytically. In addition to differences in goals, countries differ on a range of value dimensions (Schwartz, 1994; Hofstede, 1984) that have been shown to influence decision processes and outcomes in various ways, with the individualism/collectivism dimension being the one most studied (Weber & Morris, 2010). Country-level differences in history, governmental structures, religion, and other such factors can be expected to give rise to different evaluations of the costs and benefits of different green growth action alternatives. Consumption decisions will be driven by material needs and more immediate, self-centered maximization of material outcomes to a much greater extent in developing countries and less affluent segments of society, whereas developed countries and more affluent segments of society have the luxury to focus on higher level goals that have longer time horizons and consider impacts on society and future generations.

Different training/education

Intuitive perceptions of climate change are vulnerable to systematic distortions. Judging climate change from personal experience can easily mislead; availability biases can more generally distort risk judgments; simple mental models are likely to be wrong when applied to climate change; and judgment can be driven more by affect, values, and worldviews than by scientific evidence. For a valid understanding of climate change, most people must rely on secondary sources, but these information sources are not always trustworthy. Whereas both scientists and nonscientists show distortions in their perceptions and reactions to climate risks and uncertainty, scientists' greater reliance on analytic processing, accumulations of data, statistical descriptions and model outputs, and scientific deliberation and debate can be expected to dampen these tendencies. Without such correctives, nonscientists often accept evidence that confirms preexisting beliefs and fail to

search out disconfirming evidence (Baron, 2000).

Designing a Green Growth Strategy

The successful design and implementation of a green growth strategy at either global or more local (national or regional) levels will involve the synergistic use of different tools and instruments. Economic and political instruments are clearly important. However, in the same way in which contributions from different camps (e.g., technological vs. behavioral "wedges") can help to achieve desirable targets in CO2-emission reduction to mitigate climate change, better insight into the psychology of human choice and action can make additional contributions towards the achievement of sustainable growth. In addition, the tools of behavioral economics and psychology can be put to use to present and implement price-based policy instruments or regulatory interventions in ways that will maximize their positive impact and minimize decision maker resistance to change.

Behavioral tools

Green growth presents a challenge for two reasons. The first is the fact that two of its three goals—economic development and environmental conservation—are typically framed as standing in opposition to each other. As conventionally conceptualized, economic development requires consumption, and environmental conservation calls for, sometimes drastic, reductions in the consumption of resources. The second problem is the fact that all the cards may appear stacked against conservation in Western, consumption-oriented societies. The pervasive mindset of capitalist societies is one of competition, both against other economic or political players and against oneself over time. Success and progress are seen as requiring constant growth and development, and environmental conservation is seen as either a luxury of affluent societies, the preoccupation of suspect subcultures, or strategic attempts on the part of developed countries to constrain the economic growth of developing countries.

How then can attention to the goal of environmental or resource conservation be increased? Who can convince decision makers (and how) of the necessity to make tradeoffs between economic growth and resource conservation in the same way they unquestioningly make tradeoffs between price and quality in the purchase of consumer goods because of limitations in individual spending capacity? The answers to these questions are different for the individual level and for the political, national or international level. What will convince individuals of the need to attend to conservation and preservation and to change ingrained and largely automatic behavior patterns that have been shaped and reinforced by a culture interested almost exclusively in economic growth? If people were solely rational-economic decision makers, scientists or policy makers would simply have to provide them with new or more information about possible risks of the status quo to themselves

or future generations. Many public education campaigns implicitly assume that people calculate and integrate costs and benefits of different actions in order to decide on the best course of action. Such rational calculation-based approaches will not likely succeed, however, in bringing about sustainable growth, since almost all of the potential benefits and some of the costs of different behavioral options lie well into the future, with the result that the relative expected utility of different options depends critically on almost only one factor, namely the rate at which society should discount future outcomes (Weitzman, 2007). This effectively turns calculation-based decision making in this domain into a philosophical or ethical question about the "correct" discount rate to use, under the most rational of circumstances. In addition, people (including policy makers) are known to discount future consequences much more steeply than rational-economic considerations would justify (Weber et al., 2007; Hardisty & Weber, 2009). Since it is the benefits of green growth strategies that lie more into the future, while many costs (both economic and social, e.g., life style changes) occur almost immediately, such policy options are seriously handicapped in calculation-based decisions.

New goals and new metrics

Changes in the mindsets of citizens, social and physical scientists, politicians, or policy makers towards the realization that development, by necessity, will need to be sustainable to avoid hardships and catastrophes in the future, and will need to be translated into new or modified social meta-goals. Implicit assumptions about what contributes to the well-being of a country and its citizens are being expressed by such cultural products as the indices on which a country measures itself and its progress. Use of the gross national product (GNP) for this purpose in the U.S. sets a very different agenda than use of the gross national happiness index (GNH) by the kingdom of Bhutan, for example. To reach a broader range of the population, such shifts in meta-goals need to be transmitted and amplified by the media, advertising, and educational institutions.

Abstract meta-goals also need to be translated into more concrete and specific goals with respect to national or regional energy, technology, economic, or foreign policy, and into more concrete and specific goals regarding responsible consumption on the part of individuals, groups, and institutions. While there is nothing wrong with the communication of costs and benefits of different actions by domain experts (e.g., in economics, climatology, or ecology) to other domain experts, politicians, policy makers, and citizens, behavioral economics evidence suggests that this rational route to persuasion and behavior change is not the only route and probably not the most effective one. Designing or redesigning formal and informal institutions in ways that promote more chronic awareness of the effects of individual actions on others and for longer time horizons may show more lasting effects, as will the judicious use of decision defaults that promote sustainable practices. Getting opinion leaders and individuals in the public spotlight to model behavior conducive to sustainable development will lead to the spread of such practice through

imitation and gradual changes in social norms (Cialdini, 2007). The list of required actions at these different levels is obviously far too broad to be delegated or entrusted to a single group. On the positive side, top-down and bottom-up initiatives will most likely complement and reinforce each other, and tipping points in public attitudes required for broad-based behavioral change may be reached more quickly than a purely rational analysis of the problem suggests.

Another way towards green growth progress is to substitute new metrics into existing goals. The desire to express status and one's position in a social hierarchy is a deep-seated goal not just for Homo sapiens but also for many other species. Conspicuous consumption, including the use of energy inefficient cars has long been one of the signaling mechanisms for status in Western societies. Rather than fight people's desire to express their status, it is most likely more effective to substitute expressions of status that are more green-growth compatible, i.e., to change the social norms such that energy-conservation and the ownership of cars signaling such motives is seen as a status symbol (Griskevicius, Tybur, & van den Bergh, 2010).

Mental accounting, or people's tendency to post financial and other income and expenses to separate accounts with different rules (Thaler, 1980), has often been depicted as a somewhat irrational adaptation to finite mental capacity and to self-control issues (Heath & Soll, 1996). However, the principle of psychological judo can be applied to this behavioral regularity as well, and somewhat dysfunctional behavior can be used at times as a tool that helps decision makers achieve their own best long-term interests. Just as new life events and attendant new goals result in the setting up of physical accounts (e.g., a savings account to pay for future college expenses of a new baby), goals can be made more salient to decision makers by helping them set up mental accounts for them. Concrete and vivid concepts like a person's carbon footprint which can be measured using simple web tools (e.g., http://www.carbonfootprint.com/calculator.aspx) have played an important role in raising awareness among members of the general public in at least the Western world about their personal impact on local and global CO_2 levels. Whereas much remains to be done to make existing personal carbon footprint calculators consistent and transparent (Padgett et al., 2007), these physical accounts facilitate the establishment of a mental account and, more importantly, provide a metric on which personal progress can be tracked. Setting up such accounts is especially effective if paired with actionable suggestions about how CO_2 emissions can be reduced, with no financial penalties (Granade et al., 2009). Websites or personal consultants (e.g., http://www.carbon-partner.com/?gclid=COjPuqjF7J0CFVw55QodHRfOLw) who provide calculation aids to determine one's carbon footprint help individuals overcome attentional and information processing limitations. Organizations that provide low-transaction cost, web-based ways of offsetting CO_2 producing activities are an easy way for individuals to alleviate the guilt produced by an affective processing of the situation or to put their CO_2 account back into the black if the situation is processed analytically, though some have recently questioned whether these solutions are too

"easy" (Allianz, 2008) and may actually result in increased CO_2 emissions, likening such offsets to modern indulgences.

Keeping socially desirable goals active, with or without people's awareness, either chronically or at strategic moments of important decisions, can be accomplished by designing decision environments in which people get exposed to reminders of these goals or where the nature of common tasks requires these goals and thus keeps them active. The fact that economic development of countries or regions is related to the degree of civic engagement of its population, for example, can be explained by the greater chronic accessibility of economic-development enhancing goals as the result of recreational activities that require and foster these goals. Putnam himself, a sociologist, explains this mostly in terms of social networks and incentives, but also acknowledges the role of more psychological factors: "Networks of civic engagement foster sturdy norms of generalized reciprocity and encourage the emergence of social trust. Such networks facilitate coordination and communication, amplify reputations, and thus allow dilemmas of collective action to be resolved. When economic and political negotiation is embedded in dense networks of social interaction, incentives for opportunism are reduced. At the same time, networks of civic engagement embody past success at collaboration, which can serve as a cultural template for future collaboration. Finally, dense networks of interaction probably broaden the participants' sense of self, developing the 'I' into the 'we'." (Putnam, 1995, p. 67) The challenge for the promotion of sustainable economic development consists in identifying the dimensions of social capital that will encourage and enable not just development but also recognition of its costs and constraints and in determining how to foster those dimensions in different societies around the globe.

Framing of options in calculation-based decisions

People have been found to represent choice options in different ways, which, while normatively equivalent, nevertheless affect their decisions. Our neural system is set up in ways that makes the relative evaluation of outcomes much easier and more accurate than absolute evaluation (Weber, 2004). As a result, people can be expected to search for implicitly or explicitly provided reference points in the environment, by which to judge the value of outcomes (Hsee, 1996). Shifting decision makers' perspective in ways that change their subjective evaluation of choice options is referred to as framing (Kahneman & Tversky, 1984). Such changes in perspective are typically brought about by moving the decision maker's focus of attention. Given that people have different risk attitudes for gains vs. losses and show loss aversion (i.e., a stronger impact of losses than gains), as formalized by prospect theory, it is obvious that choice selection can be influenced dramatically if upfront costs can be reframed not as losses but as foregone gains. Podesta et al. (2008) examine the effect of different reference points in the decisions made by cash crop farmers in the Argentinian Pampas about how to optimally allocate their land to different crops, in a simulation that used realistic assumptions about

economic and physical soil and climate conditions and crop models. They showed that changes in the reference point by which farmers encoded farm profits as either gains or losses strongly affect what combination of crops turn out to be optimal, if farmers were assumed to optimize their returns as evaluated by a prospect theory value function rather than an expected utility function.

Another variable that differs quite significantly as a function of the reference point for returns (and thus the region of the return distribution that is encoded as a loss and subject to loss aversion) is the value of information (VOI) of available seasonal climate forecasts that tell farmers probabilistically, but with some measure of skill, whether the coming growing season is of an "el nino," "la nina," or "normal" type. Whereas the VOI of such climate forecasts is on average positive, in the vicinity of 6-7% (meaning that farmers' satisfaction with their returns can be expected to improve by this percentage if they use the climate forecast in an optimal fashion), for some combination of parameter values (high reference points or aspiration levels and large loss aversion), the VOI can actually be negative (Letson et al., 2009). These results suggest more generally that policy makers need to better understand decision makers' utility function and reference points in order to evaluate the impact of technological innovations and policy interventions.

Use of comparisons and regret

The outcomes obtained by others provide a very salient reference point for relative comparisons. Regret theory, independently first proposed by Bell (1982) and Loomes and Sugden (1982), assumes that people not only make such comparisons after the fact (feeling somewhat good when they fared better than others, and very bad when they fared worse), but that they anticipate these comparisons and incorporate them into their original decision of what to do. If regret about worse and rejoicing about better outcomes were of equal magnitude, anticipation of such emotions would cancel each other out. The assumption that regret is stronger than rejoicing puts regret theory into a the class models that assume that people often operate under asymmetric loss functions, where an error in one direction is seen as resulting in more severe consequences than an error in the opposite direction (Weber, 1994). The experience of strong regret following the mental comparison of an unfavorable outcome following a decision with better outcomes that would have been obtained had a different decision been made has obvious learning functions and can improve the quality of decisions. The prominent use of available climate change adaptation technologies by trusted opinion leaders (e.g., seasonal climate forecasts that help adaptation to the greater climate variability known to accompany climate change, or the use of more drought-resistant seed corn, in the agricultural sector) can be a way of putting experienced and subsequently anticipated regret about worse outcomes to work to help later adopters of such technologies modify their practices in a more timely fashion.

Advocacy of the precautionary principle to guide action in situations of highly uncertain but potentially very high-stakes decisions has numerous political and otherwise strategic motivations (Löfstedt, Fischhoff, & Fischhoff, 2002). These do not exclude, however, an intuitive psychological appeal of the principle, based on the anticipation of regret that could be extremely large, even if only experienced under a low-probability future state of the world, if human habitability of planet earth were to be compromised by the failure to take action based on the desire to not incur manageable economic costs.

Careful use of affect

Scaring policy makers or the public to motivate more than incremental change offers some appeal, given the ability of fear to focus attention. Movies like "The Day After Tomorrow" or "An Inconvenient Truth" have tried to do this in the context of global warming. However, as described above, fear appeals in this domain may not be especially effective, because Homo sapiens are not naturally scared of the risks posed by non-immediate resource scarcity and environmental degradation (Weber, 2006). Fear appeals of all kinds generally also have short shelf lives. Even when immediate personal safety is at stake, habituation or psychic numbing results in reduced effectiveness of fear appeals over time.

Encouragement of rule- and role-based decisions

This leaves society with recognition-and-rule based decision making, especially if high-level norms of conduct or lower-level rules of behavior can be established by trusted and respected sources. One of the most promising developments for the feasibility of sustainable development in the U.S. over the last few years has been the decision on the part of highly influential evangelical churches and other Christian denominations to reframe the debate about development vs. conservation from one about material costs and benefits to one of moral responsibilities and obligations (Robinson & Chatraw, 2006). When a message about the moral imperative to preserve our planet with its natural resources for future generations ("stewardship of the earth") comes from credible sources (e.g., religious leaders from a range of churches, that cover a large percentage of citizens, like the National Council of Churches in the U.S.), people are less likely to make decisions about consumption or conservation of resources based on personal and myopic cost-benefit calculations and more likely to use role- and rule-based decision processes that are less susceptible to impatience and excessive discounting of future consequences. The power of religious-rule-based decision making can perhaps most easily be seen in situations where such decisions have resulted in non-sustainable development. The prescriptions of the Catholic Church have played a very effective role in promoting non-sustainable population growth.

There probably is considerable cultural universality in the effectiveness of such reframing of consumption decisions from a calculation of costs and benefits to one of responsibilities and obligations, through the use of social or moral emotions such as guilt and shame when failing to follow the role-based obligation of acting like a good Christian ("What would Jesus drive?") or pride and self-affirmation when following the prescribed course of behavior, though the effectiveness might be somewhat larger in countries or cultures where collective identity plays a larger role than individualism (Weber, Ames, & Blais, 2005). What can be expected to differ across countries or cultures is the most effective entity to issue or endorse norms of responsible consumption and stewardship. While evangelical or Christian churches may be a natural source of such rules of behavior in the US, in more secular countries this role could fall to political organizations (e.g., Green parties in Europe). In general, institutions with a long time horizon and a non-geographic and non-nationalistic focus that possess the trust of the general population would be ideal issuers and disseminators of such a philosophy and ethic.

Motivating use of feedback

Another argument for the importance of easily assessed metrics that evaluate policy options on their ability to meet the full range of green growth goals is the fact that such metrics will allow policy makers to track their progress on their goals. Given that progress and perceived effectiveness is inherently rewarding, providing decision makers with feedback on their progress towards green growth goals will help keep these goals in their focus of attention. Examples of such immediate and prominent feedback at the consumer level include the fuel-efficiency display on the Toyota Prius hybrid car, displayed prominently on the dashboard. Such feedback can turn conservation into an enjoyable and self-rewarding activity, where players can constantly try to improve on their own previous record, with the same benevolently addictive results as successful video games. Competition against oneself can be supplemented with friendly competitions against other players (Cialdini, 2007; Abreu, Azevedo, & Pereira, 2011), as suggested by the existence of websites where people can post achievements of high fuel efficiency with their names. Carbon-use calculators available on the web are similarly helpful in providing information about most effective paths to the reduction of carbon footprints, and friendly competitions within families or within networks of friends might give motivation or reason to use these calculators. The emergence of smart-metering technology to provide electricity users in developing countries including the USA and Europe holds significant promise in this regard, especially if introduced in ways cognizant of people's resistance to change and other cognitive and motivational dangers (Azevedo, Morgan, & Lave, 2011).

Social influence

Another promising avenue towards responsible consumption behavior or economic development that will in the aggregate result in sustainable development is the use of social influence, observational learning, and imitation. Influences by the behavior of others are more widely present even in such seemingly rational settings as financial markets, and seem to be particularly prevalent in situations in situations with ambiguity about the best way to proceed (Schoenberg, 2007). The use of celebrities to model the type of responsible behavior that policy makers want to encourage seems to present no downsides. Their celebrity status ensures that their behavior is widely observed and amplified by the media. Another advantage of the use of imitation as a learning tool is the fact that it results in behavioral change without any need for the realization that change is in order. At levels beyond the individual, demonstration projects conducted by visible groups or companies can serve a similar function, not only by showing the feasibility of a particular new technology or institution, but also by triggering imitation on the part of other players.

Decision defaults

A final promising tool is the judicious use of decision defaults. Most decisions have explicit defaults (e.g., no response to a letter from an electricity provider means continued supply of electricity from nonrenewable sources) even when these are not clearly spelled out. Only very rarely do we encounter situations where a decision must be made (e.g., on a website that requires clicking one of two radio buttons to indicate acceptance or rejection of a privacy policy, before being allowed to proceed). Given that defaults are unavoidable and do not take away from people's ability to choose the option they truly prefer, if they are willing and able to process all available information to make an informed choice, behavioral economists argue that decision defaults should be set to the choice option that maximizes people's own long-term utility, rather than to an option that the decision maker will later regret taking (Benartzi & Thaler, 2004; Loewenstein & Haisley, 2008). Setting judicious decision defaults will ensure that people are not hurt by the decision avoidance that might be triggered by informational overload and lack of interest.

Ethical status of behavioral economics tools

Some of the tools or solutions described in this paper may be seen as instruments of paternalism, that is, as instruments that allow governmental officials or policy makers to manipulate the attitudes, preferences, and actions of the population, albeit for the greater good. This is indeed the case, though the methods being suggested here are certainly no more manipulative than what is currently being used by corporations and advertisers to promote consumption and by public

relations advisors to promote political candidates or government policies. While some of the tools described above are overtly paternalistic in the sense that they influence people's behavior without their conscious awareness (e.g., the use of goal priming or imitation), other tools fall into the category of libertarian paternalism, advocated by behavioral economists and decision researchers. Behavioral economists Thaler and Sunstein (2008) argue that, in light of human attentional and processing limitations, it is often possible to design policies, in both the public and private sector that make people better off -- as judged by themselves -- without coercion. Designing decision environments with sustainable-development friendly defaults, for example, does not reduce people's choices and is probably less paternalistic than other policies like the imposition of a carbon tax.

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