The Psychology of Environmental Decisions

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Abstract

Humanity faces an unprecedented set of global environmental problems. We argue that to promote pro-environmental decisions and to achieve public consensus on the need for action we must address individual and collective understanding (cognition) of environmental problems, as well as individual and collective commitments to take action to mitigate or prevent those problems. We review literature pertaining to psychological predispositions, mental models, framing, psychological distance, and the social context of decisions that help elucidate how these goals of cognition and commitment can be achieved. This article reveals the complex and multiply determined nature of environmental decisions. However, we argue that this complexity points to opportunities to reduce the inherent uncertainty surrounding global environmental challenges via appeals to the psychological mechanisms that underpin our decisions.

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1. INTRODUCTION

We are now in an epoch described by some as the Anthropocene—a geologic period in which human activities have had a dominant impact on Earth systems (1). The realization that we are having such a profound (negative) effect drives home the importance of understanding the factors that affect human interaction with the natural environment (2). There is a pressing need to understand why some people tend to behave in pro-environmental ways and support collective mitigation efforts, whereas others are seemingly insensitive to current global environmental problems that are "unprecedented in their complexity and their spatial and temporal reach" (3, p. 164). This understanding can come by examining in detail the decisions that people make.

Environmental decisions encompass an extremely broad range of phenomena, from complex, multifaceted, multistakeholder decisions about land use (4), to individual consumer choices about lightbulbs (5–7). Following precedent (2, 8) we adopt a definition in which a decision is defined as pro-environmental by the extent to which it positively impacts "the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere" (9, p. 408).

Despite the broad range of phenomena encompassed by environmental decision making, a common conceptualization can be brought to bear when approaching the analysis of such decisions. The decision-analytic framework divides the world into acts (options to choose between), states (possible ways the world might change), and outcomes (the consequences of each act given each state). Adoption of a decision-analytic framework requires a decision maker to assign first utilities to different outcomes and then probabilities to different possible states of the world. With these utilities and probabilities specified, the decision maker can then maximize his or her expected

Table 1 A framework for understanding the psychological underpinnings of environmental decisions yielding four questions addressed in the review

	Cognition	Commitment
Individual	What factors affect an individual's basic understanding of the environmental problem?	What factors affect an individual's willingness to commit to individual action?
Collective	What is the role of others' beliefs in understanding and acceptance of the environmental problem?	What factors affect an individual's willingness to commit to collective action?

utility by weighting the value of each possible outcome by the probability of it occurring (10). As such, the framework offers a method for assessing the risk inherent in many decisions.

However, although such a prescription might be optimal, it is often not practical—even in simple consumer choices, let alone the highly uncertain and complex environmental issues currently facing society (11). In many situations, we are unlikely to have knowledge of all possible future states of a situation or of the probabilities with which those states will occur. Thus, assessing risk becomes problematic. Moreover, such a purely analytic framework belies the complex psychological processes underpinning human decision making (12). These processes include the ways in which people mentally represent, integrate, and weigh different sources of information, but a complete psychological account must also consider the characteristics of human learning, memory, and attention that contribute to the boundedly rational nature of human decision making. Such an account also needs to acknowledge our tendency to be susceptible to cognitive biases and to rely on simplifying heuristics (13–15).

In this article we aim to provide some guidance through the burgeoning literature on the psychology of environmental decisions. The article is framed in terms of a two-by-two typology of attributes that yields the four questions presented in **Table 1**. We start with the idea that encouraging more pro-environmental decisions and behavior is desirable (9), as is achieving public consensus on the need for governments to take urgent action to address many pressing global environmental problems (3). We suggest that these goals can only be achieved by assessing the factors leading to individual and collective understanding (cognition) of environmental problems, as well as individual and collective commitment to take action to mitigate or prevent such problems. Each of the literatures that we address contributes to answering these four questions. The mapping of the literatures to questions is by no means one-to-one, however. Many of the areas we review overlap, and the reasons for avoiding pro-environmental decisions can be manifold. In the Summary and Conclusions section we provide summary answers to each of the questions and highlight those aspects in need of further research.

The four literatures we review highlight the importance of considering both individual and collective aspects of cognition and commitment, as well as the complex layering of the psychological determinants of environmental decision making (16). We begin by acknowledging that no one comes to environmental decisions as a tabula rasa: Many environmental situations are highly emotive, politically charged, and value laden. Given this, one might expect that a variety of psychological predispositions influence people's willingness to engage with environmental issues and behave in pro-environmental ways (17). We go on to consider how people build on these existing predispositions to develop mental models of environmental problems, especially those of a dynamic nature. We ask how the accuracy of such models can be improved and whether such improvement leads to pro-environmental behavior (18). Our discussion then moves beyond the mental model and turns to the importance of external information framing for cognition and

commitment. This discussion also entails consideration of the influence of psychological distance on people's construal of environmental problems—the degrees to which environmental issues are felt to be psychologically close on dimensions of (un)certainty and temporal, spatial, and social distance (19). The final literature we review addresses the social context: How does the behavior of those around us affect what we do? This section examines how injunctive and descriptive norms affect environmental behavior. It then moves on to studies at the interface between individual and collective decision making, exemplified by the social dilemmas that characterize many environmental issues. Our primary contribution is simply to make readers aware of, and to briefly introduce, the kinds of literatures that can provide insight into the complex psychological processes involved in decisions about our environment.

2. PSYCHOLOGICAL PREDISPOSITIONS

No one makes decisions in a vacuum. Each one of us brings a rich assortment of values, ideologies, worldviews, and general experience to each and every decision we make. These psychological predispositions have implications both for how we understand environmental issues and for the extent to which we are willing to make pro-environmental choices and cooperate in collective efforts to address environmental problems. Thus, an understanding of the influence of psychological predispositions helps illuminate answers to several of the questions we pose for this article (see **Table 1**). Environmental decisions are particularly susceptible to these psychological predispositions. Many environmental issues are highly emotive and potentially threatening (e.g., nuclear power, climate change); thus, they heighten the sense of personal involvement and impact (20). Moreover, deciding to act pro-environmentally can often involve personal sacrifice, such as the increased cost, effort, and inconvenience associated with buying organic food, driving less, and reducing thermostat settings, and thus needs to be buttressed by a sense that one is acting for a long-term collective good (2).

2.1. Environmental Values

Research has a long tradition of exploring the intersection of values and environmental behavior (21). A value can be defined as "a desirable trans-situational goal varying in importance, which serves as a guiding principle in the life of a person or other social entity" (22, p. 21). In the context of environmental behavior, Stern (9) has suggested that three types of values are important: egoistic (a focus on the self), altruistic (a focus on the welfare of others), and biospheric (a focus on the welfare of the environment). Thus, an individual might be motivated to buy a fuel-efficient car, for instance, because it is cheap (egoistic), because its emissions have a lower impact on the health of other people (altruistic), or because its emissions have a lower impact on the environment (biospheric) (2).

Several studies indicate that egoistic values tend to be negatively related to pro-environmental attitudes, intentions, and behaviors, whereas altruistic and particularly biospheric values are strongly positively related (2, 8, 21). An example comes from a study by De Groot & Steg (2) in which participants were asked to indicate their intentions to buy an environmentally friendly car and donate to environmental charities. Participants' environmental values were assessed along with measures of their self-determined motivations. The latter are an index of the extent to which a person feels that she initiates and has control over her actions. Self-determined motivational types perform pro-environmental acts more frequently and engage in activities perceived to be more difficult (23). De Groot & Steg found that values were more predictive of pro-environmental intentions than were self-determined motivational types, but that values and motivational types

were related in several ways. Specifically, participants who strongly endorsed statements such as "I enjoy contributing to the environment"—an example of intrinsic motivation—also scored high on measures of altruistic and particularly biospheric value orientations (i.e., including things like preventing pollution and respecting the Earth as highly important). These findings led De Groot & Steg to recommend that practitioners should attempt to promote pro-environmental decisions by strengthening people's biospheric values and intrinsic motivations, though the extent to which this is practical via large-scale interventions is questionable.

2.2. Environmental and Cultural Worldviews

A complementary way to assess the psychological predispositions underlying environmental decisions is to interrogate the worldview held by a person. Broadly speaking, an environmental worldview captures a person's general beliefs about the relationship between humans and the environment (17, 24). A measure commonly used to assess worldview is the new environmental paradigm (NEP) (25, 26). The NEP includes questions about the beliefs that humanity is able to upset the balance of nature, that humanity does not have the right to rule over nature, and that there are limits to the growth of human societies. The NEP has been used to predict pro-environmental behaviors, intentions, and policy acceptance, but it does not appear to be as powerful a predictor as values, especially biospheric values (24).

Recent developments in what has been termed the cultural cognition thesis (CCT) (27, 28) have seen a merging of traditional cultural theory regarding social relations (29) with theories of how people form risk perceptions (30). This merging has led to the development of a framework in which a person's worldview is placed as a point along two continuous attitudinal dimensions. The hierarchical-egalitarian dimension captures attitudes toward social orderings that are rigid, stratified, and conspicuous, e.g., gender, race, and class. It is measured using statements such as, "We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, men and women." The individualist-communitarian dimension measures alignment with a society in which people should determine their own well-being without governmental assistance, and includes items such as, "The government should do more to advance society's goals even if that means limiting the freedom and choices of individuals." People's responses on these two scales then define them as hierarchical individualists or egalitarian communitarians.

The classification of people's worldviews according to this dimensional structure is related to the acceptance of scientific consensus views on climate change and disposal of nuclear waste as well as nonenvironmental issues, including gun control and the human papillomavirus (HPV) vaccine (27, 28). One recent pertinent study pitted the CCT against the science comprehension thesis in an examination of attitudes toward climate change (28). According to the authors, the science comprehension thesis predicts that individuals who are more scientifically literate should be more concerned about the risk posed by climate change to human health, safety, and prosperity. No such direct relationship was found in a sample of over 1,500 US citizens. Instead, Kahan et al. (28) reported that cultural worldviews, not scientific literacy, explained more of the variance in climate-risk perception. In fact, for hierarchical individualists (those who are generally opposed to government intervention and restrictions on industry) there was a modest negative correlation between science literacy and perceived climate risk. Striking as this finding is, it would be premature to conclude that worldviews are the only factor that is important and that science communication is no longer helpful or relevant in promoting pro-environmental attitudes and decisions (31). Moreover, some questions have been raised about the orthogonal, two-dimension structure of the CCT (i.e., that it precludes the possibility that different cultural biases can coexist simultaneously in

degrees within individuals) (see Reference 17). Nonetheless, one needs to consider the worldviews of the message recipient when communicating environmental information.

2.3. Morality and Political Orientation

Just as measures of environmental values correlate with worldview (24), worldview, in turn, correlates with political orientation (28). Hierarchical individualists tend to be more aligned with conservative political agendas, whereas egalitarian communitarians are more likely to share the views of political liberals. Feinberg & Willer (32) discuss an interesting hypothesis: that the basis for this polarization of environmental views along political lines stems from differing perceptions of whether environmental concern is a moral issue. They suggest that liberals tend to resonate with harm- and care-based moral arguments, which appear to dominate environmental rhetoric in the media. In contrast, conservatives find appeals to purity and sanctity more in line with their moral values. In an experimental test of this hypothesis, Feinberg & Willer demonstrated that liberals exhibited more positive pro-environmental attitudes than did conservatives when an op-ed message was phrased in terms of the harm humans are causing the environment and the need for us to care and protect our world. However, when the message described the extent to which the environment had become polluted and emphasized the need to purify it, conservatives and liberals showed equally positive pro-environmental attitudes. These results suggest that political polarization of environmental views can be overcome, or at least reduced, by direct appeals to the moral compasses of the message recipients (see also Reference 33 for an extensive discussion of the links between moral judgment and climate change).

2.3.1. Climate skepticism and denial. In extreme cases, ideological predispositions can lead people to take what appear to be contrarian views on environmental issues. Such stances have been adopted in relation to issues that include acid rain, the ozone hole, the use of DDT, and more recently climate change (34). The past few years have seen an upsurge in skepticism about anthropogenic global warming, and many researchers have documented the psychological causes, characteristics, and motivations underlying this rejection of the consensus scientific view that humans are causing the global climate to change (35, 36). Bain et al. (37) provided an insightful addition to this literature by demonstrating that even those people who deny that climate change is occurring can be encouraged to act more pro-environmentally so long as the outcomes of mitigation efforts are described in ways that they find appealing. Specifically, descriptions of mitigation efforts that emphasized increases in interpersonal warmth in society (e.g., "Taking action to reduce energy pollution would help us become more aware of how we live and how we impact on each other") or the promotion of economic and scientific development led to stronger endorsement of environmental citizenship intentions than if a frame emphasizing reduction in environmental and health risks were used.

In sum, the literatures examining psychological precursors to pro-environmental beliefs and actions reveal that, despite divergences according to ideology and worldview, it is possible to present environmental issues and decisions in ways that will encourage pro-environmental choices among diverse groups. In addition to directly influencing environmental decision making, the psychological predispositions discussed above have implications for mental models of environmental systems and problems. In the following section we discuss the ways in which people understand environmental issues, and the consequences for environmental decision making, thereby focusing on the individual-cognition aspect of our typology (see **Table 1**).

3. MENTAL MODELS AND ENVIRONMENTAL DECISION MAKING

Environmental systems are typically complex. The mechanisms that govern domains such as forest ecology, water resource management, and global climate change are multifaceted, interactive, and change over time. From a psychological point of view these systems are generally understood by developing a mental model, a mental representation of the relations between causal factors (e.g., increased fossil fuel burning, deforestation) and their effects (e.g., accumulation of CO_2 in the atmosphere, increase in global temperature) (38, 39).[1] Mental models are derived from people's intuitive beliefs and knowledge stored in long-term memory. The mental models of nonexperts typically lack the detail and coherence of scientific models (41). They nevertheless have a profound influence on reasoning, prediction, and ultimately action.

Understanding people's mental models of environmental phenomena is crucial to understanding their environmental decision making. The accuracy of individuals' models of the causal mechanisms that drive environmental phenomena is a good predictor of their level of concern about environmental issues and willingness to take pro-environmental actions (42–44). Although developing a more accurate mental model may not always be sufficient to increase pro-environmental behaviors (see Section 2.2), it appears to be a necessary first step (45). Moreover, in democratic systems increasing public understanding of important environmental issues allows voters to make more informed judgments about the environmental policies of political parties.

3.1. Conceptions and Misconceptions in Mental Models of the Environment

One method commonly used for assessing people's mental models of the environment is to ask them to list the possible causes of a particular environmental phenomenon (46–48). An alternative approach involves asking individuals to identify the most important concepts in an environmental domain and to spatially organize the concepts in a way that reflects their causal relations (49).

Such approaches have revealed that some aspects of lay mental models of environmental phenomena are broadly consistent with current scientific evidence (e.g., the burning of fossil fuels is linked to increased greenhouse effects). People's mental models, however, also often exhibit systematic biases that lead them away from an accurate understanding of the environment. Many people, for example, exhibit attribute substitution, erroneously assuming that familiar concepts can be used as proxies for more abstract constructs. Hence, climate is erroneously equated to weather and CO_2 emissions are seen as a form of air pollution (12). Once in place, such erroneous beliefs show considerable stability. For example, two surveys conducted 17 years apart (in 1992 and 2009) found similar levels of endorsement of erroneous beliefs, including climate change is influenced by lunar cycles or global warming leads to increased skin cancer (47).

Although it is important to gauge people's understanding of the causes of major environmental events, recent research has examined mental models of environmental mitigation and their effects (e.g., how different policies for controlling CO_2 emissions may affect future incomes). Such research suggests that people often misunderstand the economic costs of mitigation; for example, some believe that policies that would cut greenhouse gas emissions would reduce incomes rather than just slow the future rate of income growth (50).

[1]Note that this definition of mental model should be distinguished from that proposed by Johnson-Laird (40), who uses the term to refer to the way people represent relations in logical syllogisms. This approach to understanding mental models has less direct relevance to environmental decision making.

3.1.1. The role of personal experience. Perhaps not surprisingly, mental models of environmental phenomena are affected by personal experience. For example, surveys in the United States, Europe, Britain, and Australia (44, 51–53) have reported a link between personal experience of extreme weather events and increased understanding of climate change and willingness to take pro-environmental actions. Reser et al. (54), however, have shown that these effects are conditional on people interpreting the extreme weather event as being caused by climate change.

Weber & Stern (55) suggest that experience with extreme but relatively infrequent environmental events may have less of an impact on mental models than less intense but more frequently observed changes in the local environment (e.g., changes in local rainfall or seasonal temperatures, decreased plant growth). Consistent with this view, people who believe that recent local temperatures show a warming trend have greater belief in and concern about climate change and are more likely to donate money to a global warming charity (56).

3.2. Mental Models of Dynamic Environmental Systems

Most environmental systems are dynamic; the relations between their components change over time. Unfortunately, a considerable body of evidence indicates that people often have difficulty in accurately representing and reasoning about such systems (57). One common type of dynamic system highly relevant to current environmental challenges is the stock-flow system. A stock (e.g., total amount of accumulated CO_2 in the atmosphere) is some entity amount that is accumulated over time by inflows (e.g., anthropogenic CO_2 emissions) and depleted by outflows (e.g., CO_2 uptake by plants). The amount of stock in a system is determined by the relationship between inflow and outflow: When inflow exceeds outflow, the stock will increase; when outflow exceeds inflow, the stock will decrease; and when inflow equals outflow, the stock will stabilize.

Such stock-flow problems are often represented graphically, with inflows, outflows, and stock accumulation plotted separately. For example, Sterman & Sweeney (58) showed participants a hypothetical plot in which the accumulated concentration of atmospheric CO_2 rises steadily until the year 2000 and then remains stable for the next century. The same participants were then shown an inflow function with CO_2 emissions increasing up to the year 2000, together with an estimate of current outflow. Notably, current outflow was shown to be substantially lower than inflow levels. Participants were asked to estimate the pattern of emission inflow that would be necessary to achieve stability in accumulated CO_2. Assuming a static level of outflow, the correct response is that emissions would have to be cut dramatically, to a level equal to the outflow, in order to achieve stability in the accumulated stock of CO_2.

A consistent finding is that such problems are difficult, even for highly educated people with backgrounds in science, engineering, or mathematics (58–60). In many cases people's responses suggest that they incorrectly assume that stock patterns (accumulated CO_2) should parallel the pattern of inputs. In the problem described above, people often infer that a stable pattern of inflows (i.e., CO_2 emissions remaining at current levels over the next century, together with a stable level of CO_2 output) will lead to a stable level of accumulated CO_2. This error has been termed the correlation heuristic (59) and has been found to persist across a range of stock-flow patterns, in different ways of displaying data (line graphs, bar graphs, spreadsheets, or text), and when additional time and incentives for performance are provided.

3.2.1. Improving the accuracy of dynamic mental models. What steps can be taken to improve the accuracy of people's mental models of dynamic systems? One approach is to promote better mental models of stock-flows through analogical training. Analogical reasoning involves identifying a common relation between two situations and generating inferences based on these

commonalities (61). For example, in attempting to explain CO_2 accumulation you might use the analogy of filling a bathtub with the plug removed. If the flow of water into the tub exceeds the outflow, the water level will rise. Comparing this more familiar example with the less familiar case of gas accumulation should highlight the common relations between stock and flow.

Training with such familiar analogies has benefited performance on the CO_2 stock-flow problem, particularly when the problem is presented in text rather than graphical format (18, 62). Related work shows that asking people to explicitly compare a number of different stock-flow patterns and highlighting the common relations involved can also boost performance on the CO_2 accumulation task (63). Although such analogical training has been shown to improve understanding of an important environmental issue, so far there is little evidence that this translates into an increase in a preference for immediate environmental action (18, 62).

Of course CO_2 accumulation is just one component of a much larger set of systems that impact global climate change. This multiplicity of connected causal systems is typical of many environmental domains. So if decision makers often struggle to form accurate mental models of phenomena like CO_2 accumulation, how can we expect them to understand systems that contain even more complex causal interactions? One possible answer is to represent such systems in dynamic computer simulations. Sterman et al. (64), for example, developed the Climate Rapid Overview and Decision Support simulator, which incorporates a range of factors linked to climate change (e.g., CO_2 stock-flows, forestation trends, methane emissions, ocean heat transfer). Users select different input variables (e.g., CO_2 emissions from fossil fuels) and observe the predicted impact on various environmental outputs (e.g., sea level rise, ocean pH) over time. Similar approaches have been developed that simulate other aspects of climate systems (65) and management of water resources (66). These interactive packages have the advantage of enabling participants to experiment with the environmental system, allowing them to observe the effects of taking different actions. The logic underlying this approach is consistent with basic research that shows that people learn more about causal systems when they interact with those systems than when they just observe them (38).

An alternative approach to improving mental models of the environment is to encourage individuals to compare and discuss their individual mental models of the problem. The aim is to identify key points of agreement and disagreement and ultimately develop a shared mental model. Although this process has been studied extensively in organizational decision making to date, few studies have examined in detail this process in an environmental context (67, 68). Some suggestive evidence comes from a study of the mental models held by board members responsible for water management in the Camargue region of France (69). The overlap between components of board members' individual mental models was positively correlated with their frequency of interaction; members who met together frequently tended to have more similar causal models than those who did not. Although this method may lead to increased agreement about the causes of environmental events, its effectiveness in improving the accuracy of mental models of the environment has yet to be established.

Examination of the literature on mental models in an environmental context reveals that there is considerable scope for improving our understanding of environmental problems. However, ways in which mental models can be improved, and the extent to which this will directly impact pro-environmental decision making, are not clear-cut. In the next section we focus on literature that examines ways to more directly influence pro-environmental decision making through the framing of environmental issues. Thus, we shift from the cognition to the commitment aspects of our framework in an effort to identify how to promote individual decision making and support for collective environmental endeavors (see **Table 1**).

4. FRAMES AND PSYCHOLOGICAL DISTANCE

One of the most enduring and important findings in the psychology of decision making is the dramatic influence of framing (70). Framing refers to the description of an issue or question to achieve a desired interpretation or response. Perhaps the most powerful example is the effect of framing outcomes as gains or losses relative to the status quo in risky decision making. The standard result is that people tend to feel the pain of losing $100 much more than the positive affect associated with gaining $100, and thus are often loss averse. This simple insight has major implications for many types of environmental decisions. For example, in decisions about residential energy use, the encouragement to use energy more efficiently is preferable to an energy curtailment frame because the latter invokes a direct loss, thereby potentially precipitating loss aversion (7).

4.1. Labels and Defaults

Framing need not pertain to direct comparisons between gains and losses; sometimes simply choosing the right kind of label for an environmental policy can influence choice. For example, Hardisty et al. (71) found that only 26% of participants self-identified as US Republicans were willing to pay a CO_2 emission reduction fee on airline tickets when it was labeled as a carbon tax, but this number rose to 58% when the fee was described as a carbon offset. Echoing the findings reviewed in Section 2, Democrats' choices were unaffected by the frame, with over 60% willing to pay the fee regardless of whether it was described as a tax or an offset. Note that both offsets and taxes can be considered losses relative to the status quo, but the former is more palatable to those whose worldviews encompass a general aversion to taxes (see Section 2.2).

Another powerful framing effect is that of defaults. The tendency to prefer the status quo (to choose not to choose) is widespread and often leads people to choose preselected default options (72). For example, consumers faced with a hypothetical choice between electricity provided by green or gray electricity companies were more likely to choose whichever company was the incumbent (already supplying electricity to the residence and thus the default), despite green being the overwhelming choice for a matched group of participants in which neither company was set as the default (73). Similar patterns of attraction to the default are seen in a study by Dinner et al. (6) in which participants were given a scenario about a newly built house in which either energy-efficient or standard lightbulbs had been installed. When offered the chance to change lightbulbs, only 20% of participants in the energy-efficient bulb default condition chose to switch to the standard type, whereas over 40% chose to remain with standard bulbs when they were the default option. These findings highlight the potential to dramatically influence pro-environmental decision making through simple changes to the ways in which options are presented to consumers.

Many of these insights from framing and other aspects of what has become known as behavioral economics are being applied to a broad range of policy settings, especially those of health and finance (74–76). There is considerable scope for applying these nudges to environmental issues, such as improving climate change communication (12, 77, 78) and reducing residential energy use (5, 7), especially when used in combination with normative messaging (79; see Section 5, below). The scope and momentum of current initiatives suggest that the use of these kinds of techniques will continue to increase in the coming years.

4.2. Personal Experience as a Frame of Reference

The framing effects reviewed thus far pertain to aspects of specific attributes, i.e., the way in which options are described as involving losses, gains, the presence of defaults, etc. However, framing

in a much broader sense can have implications for the way in which people view environmental issues and the extent to which they feel concerned and motivated to engage in pro-environmental behavior.

As foreshadowed in Section 3.1, personal experience of environmental phenomena in general and climate change in particular can have an impact on one's understanding and willingness to take pro-environmental actions. Recent research shows that people accurately perceive changes in climate (51, 80), and individuals' perceptions of relatively mild climate change, such as weather or temperature anomalies, correlate with increased perception that climate change is a risk (51), worry about climate change (81), and belief in anthropogenic climate change (56, 82–85).

In a similar vein, exposure to hurricanes was associated with a reversal in implicit attitudes toward a green politician (86), and those who report flood experience are more concerned about climate change and see it as less uncertain than those who do not (44). More broadly, perceptions of climate change experience are associated with increased belief in and distress about climate change (54). Two key theoretical concepts pertinent to exploring this link between personal experience and environmental understanding/behavior are psychological distance and construal, which are discussed in the next section.

4.3. Manipulating Psychological Distance

Our perception of events is necessarily subjective rather than objective. One person's subjective interpretation, or construal, of a given behavior can be very different from that of another person (87). Fujita et al. (88) give the example of one person perceiving the act of throwing a plastic bottle in the trash as preventing littering (and thereby viewing it positively), whereas another might construe it as failing to recycle (and thus make a negative assessment). A large body of research indicates that people can construe different objects and events at abstract or concrete levels (87, 89), and that psychological distance influences this process of construal (90). In this context, psychological distance refers to the extent to which an object is removed from the self, such as in likelihood of occurrence, in time, in geographical space, or in social distance (90). It has particular resonance for many environmental problems, especially global problems, e.g., climate change, because climate change still appears to be treated by many as a distant phenomenon—uncertain as well as temporally, socially, and geographically removed from our everyday experience. Thus, researchers have argued that construing climate change in this psychologically distant and abstract manner makes support for ameliorative action less likely (91–96). As noted in Sections 3.1 and 4.2, however, those who believe they have personally experienced climate change—those for whom climate change is psychologically close—often show increased concern about and belief in the impacts of global warming. This pattern of effects raises the intriguing possibility that attempts to induce psychological proximity experimentally might lead to similar changes in belief, concern, and perhaps willingness to behave in environmentally sustainable ways.

4.3.1. Temporal and hypothetical distance. By manipulating the perceived time until the onset of environmental impacts, researchers have examined the extent to which people value equivalent outcomes farther away in time (i.e., discounting) (97). In one relevant study, half of the participants reported lower willingness to change their behavior when the impacts were framed as being farther away in time, suggesting considerable individual differences in discount rates. Other research has also demonstrated the effects of manipulating temporal distance; just as smaller, more immediate financial gains are preferred to larger, future gains, people prefer a small environmental benefit now (e.g., 21 days of improved air quality) to a larger one in the future (35 days of improved air quality one year from now) (98).

Manipulating the perceived certainty (hypothetical distance) of environmental outcomes may also influence willingness to engage in pro-environmental behaviors. For example, when participants felt that there was widespread disagreement among climate scientists about the causes of global warming, they were less likely to engage in climate change mitigation actions (99) or to accept the existence of anthropogenic global warming (100). One challenge to reducing the hypothetical distance of environmental predictions is that people routinely misunderstand such predictions (101). This misunderstanding can be both genuine and due to general confusion about expressions of likelihood (101), but it may also derive from the adoption of a contrarian attitude as noted in Section 2.3.1. However, regardless of misinterpretations, increasing the certainty (where possible) of communications about environmental issues should help encourage pro-environmental decisions.

4.3.2. Social and spatial distance. Spence & Pidgeon (102) examined the effects of framing climate change impacts as occurring at local versus distant locations, in combination with framing climate change in terms of gains or losses. Their results indicated that, independent of gain or loss framing, these impacts are perceived as more severe when occurring in distant areas rather than local areas. However, people were significantly more positive in their attitudes toward climate change mitigation when the impacts of climate change were framed as occurring locally, as opposed to in distant locations. This finding suggests that framing environmental problems as spatially close may be an effective tactic to encourage people to make pro-environmental decisions, even though severe impacts are perceived as distant.

Hart & Nisbet (103) examined the effects of social distance of environmental issues by manipulating the social distance (from the participant) of potential victims of climate change impacts. Increasing social distance by discussing impacts on people living in the southern United States or abroad, versus in upstate New York (the participants' local area), was associated with polarization in support for climate change mitigation—Democrats expressed more support for climate action when exposed to victims perceived as socially distant, whereas Republicans expressed more support for action when exposed to victims perceived as socially close. These results highlight that the utility of decreasing the psychological distance of climate change on some dimensions depends on the nature of the audience.

4.4. Think Globally, Act Locally?

Researchers have examined the ways in which different types of frames interact to influence environmental decision making. When framed in a concrete mind-set—one that emphasizes the specifics of actions required to achieve a goal—messages of loss were more likely to promote recycling behavior in participants. In contrast, participants encouraged to adopt an abstract, distant mind-set responded more to messages framed around the positive gains associated with recycling (104). It is suggested that the increased processing fluency associated with the message that fits the mind-set increases receptivity (but see Reference 105 for an alternative suggestion about optimal framing).

Research that has directly manipulated construals shows that abstract construals associated with future decision making lead to greater attention to high-level concerns such as environmental sustainability than to lower-level concerns such as price or ease of use (106). Pro-environmental choices (e.g., installing solar panels, bicycling to work instead of driving) often involve trading off short-term feasibility concerns (price, convenience) for long-term desirability concerns (reducing one's carbon footprint, contributing to a sustainable society). Thus, abstract thinking in certain contexts might be a promising means of promoting pro-environmental behavior.

Framing and psychological distance manipulations appear to present simple and effective ways to encourage pro-environmental decision making and support for collective actions. Further research is needed, however, to identify how different dimensions of psychological distance interact and the ways in which different types of frames can be optimally combined to promote pro-environmental decision making. The final yet crucial dimension we discuss is how social context influences both our collective understanding and perhaps more importantly our willingness to commit to collective action, even when such action might entail individual sacrifices (see **Table 1**). Important research examining the role of the behavior of those around us is reviewed in the next section.

5. SOCIAL CONTEXT

5.1. Social Norms and Social Influence

Social norms are explicit or implied rules about how people should and do behave (107), and their power to influence environmental decision making and behavior has been widely demonstrated. Both injunctive norms (those about what other people approve or think should be done) and descriptive norms (those about what others actually do) influence decisions to engage in environmentally relevant actions, including littering (108), energy saving (79, 109, 110), recycling (111), and prosocial behavior in general (112). Research conducted across a number of cultures demonstrates that, when one is examining the predictive power of several potential predictors of pro-environmental behavior, social norms consistently have the strongest relationship with intentions of pro-environmental behavior (113).

The effects of social norms are pervasive across a range of domains, and recent research has demonstrated how people tend to be unaware of the influence social norms have on their decisions and behaviors. Nolan et al. (110) found that when people were given a door hanger containing an appeal to save energy, people saved the most energy if their door hanger contained a normative appeal to join your neighbors in saving energy (thereby implying a norm of energy saving among their neighbors), in contrast to other messages that appealed to people to save the environment or save money by saving energy. Interestingly, however, when people were asked about how much the messages had affected their decisions, those who received the normative message rated it as the least influential, despite it having the greatest impact on actual energy use. These findings underscore the importance of considering the effects of social norms, given their potential to have a large and often unappreciated influence on environmental decision making.

Recent research also highlights how perceptions of what others approve (injunctive norms) interact with perceptions of what others actually do (descriptive norms). Smith et al. (114) demonstrate that, although the perception that others approve of engaging in pro-environmental behavior encourages action, the perception that others are not acting (a descriptive norm of inaction) diminishes the motivating effects of positive injunctive norms. In similar research, Göckeritz et al. (115) showed that the association between descriptive normative beliefs and conservation behavior was strengthened by the perception that others approved of engaging in such behaviors (i.e., injunctive normative beliefs), and other recent work also has emphasized the interactive effects of these different aspects of social norms (116). Another line of inquiry has demonstrated the effects of descriptive norm conflict among various groups (e.g., family, friends, and peers/colleagues). For those with positive attitudes toward the environment, conflicting environmental behavior among different groups of people in one's life is associated with increased perceptions that environmental behavior is effective, and with increased pro-environmental intentions and behaviors ranging from saving water to dimming lights in order to protect nesting sea turtles (117–119). Yet for those with

negative attitudes toward the environment, conflicting environmental behavior among different groups of people in one's life is associated with decreased perceptions that environmental behavior is effective and decreased pro-environmental intentions and behaviors. Research on conflicts between descriptive and injunctive norms, and between the norms of various groups, emphasizes the need for communicators to be conscious of the potential consequences of making particular norms salient in environmental appeals, for example, by inadvertently highlighting discrepancies between what people approve and what they actually do.

In addition to perceptions of what others think and do, social goals may also influence pro-environmental decisions. Griskevicius et al. (120) demonstrated that when status motives were made active (e.g., by reading about a high-status competitive job scenario, versus a non-status-related scenario) people were more likely to make green choices but only if their actions were publicly observable and green options were more costly than nongreen options. Hence, people sometimes strategically make pro-environmental decisions to enhance their social status or to conform to perceived norms of high-status groups.

As well as the interplay between perceptions of what others do and approve, other variables moderate the effects of social norms on conservation behaviors. For example, people like pro-environmental products more and contribute more to an environmental social dilemma when pro-environmental (rather than anti-environmental) norms are made salient and threat is present (121). These findings suggest normative appeals may be even more effective in promoting pro-environmental behavior in the context of global environmental threats, such as climate change.

Along with the environmental decisions of individuals, the descriptive social norms of leaders also influence employees' pro-environmental behaviors in organizational contexts (122). Research on family norms also highlights that, independently of child or parent attitudes, energy-saving, recycling, and green-purchasing behaviors are predicted by parental behavior (i.e., descriptive household norms) (123). Thus, it is clear that norms, even if not made explicitly salient, have a powerful influence on many forms of pro-environmental decisions and behaviors. In addition to influencing the environmental decisions of individuals, understanding social norms and other group processes is also essential to predicting how people will behave in the context of cooperative, group-based approaches to environmental issues.

5.2. Social Dilemmas: The Interface of Individual and Collective Decision Making

Many environmental issues can be analyzed as examples of mixed-motive decisions known as social dilemmas. Broadly speaking, social dilemmas are a class of decision problems in which individuals acting in accord with their own immediate self-interest produce collective outcomes in which everyone is worse off in the long run. Social dilemmas occur in one of two forms: public goods (give-some) dilemmas and resource (take-some) dilemmas (also known as the commons dilemma) (124). In a public goods dilemma, individuals must decide whether to contribute personal resources to achieve or maintain a public good that benefits all members of the collective whether or not all members have contributed to that public good. The structure of this type of dilemma is one in which costs are borne by individuals and benefits are shared by the group. In the environmental domain, examples of public goods dilemmas would include (*a*) decisions to reduce carbon emissions and invest in (more costly) green energy in an industry where competitors may not invest and (*b*) decisions to contribute to funding alternative energy research in which the outcomes benefit everyone.

In resource dilemmas, the obverse of public goods dilemmas, a collective resource is available to everyone in the group and individuals must decide whether to restrain their usage of the resource

to avoid depleting the collective good. In this case, the benefit of harvesting the resource goes to the individual, but the cost (of depletion) is borne by the collective as a whole. Conservation of water, rainforests, fisheries, and oil supplies are examples of resource dilemmas in the environmental domain.

The dilemma of conflict between individual and collective interests is exacerbated when (*a*) collectives are large, so that the impact of any individual's decisions is miniscule; (*b*) individuals must decide whether to sacrifice self-interest without being able to control what other actors in the collective do; and (*c*) the negative consequences of self-interested decisions are long-term (temporally distant) rather than immediate. These properties are characteristic of most environmental dilemmas, so the need to understand why and under what conditions individuals will sacrifice immediate self-interest for the sake of collective welfare is particularly acute in this domain.

5.2.1. Social dilemmas in the laboratory. Real-world environmental decision making can be studied from the perspective of social dilemma models, but social psychologists and behavioral economists have devised laboratory paradigms to experimentally study such decisions. These laboratory analogues place individuals (in groups of varying size) in decision situations (give some or take some) that have the structural properties of a social dilemma. Recent reviews of the broad experimental literature on laboratory social dilemmas call attention to the implications of these studies for environmental issues (125, 126). The probability that individuals will cooperate for collective benefit is influenced by both situational and psychological factors. Psychological factors include individual differences in social value orientation (self- or other-regarding motives) (127–129) and dispositional trust (130), as well as temporary motivational states and construals of the decision situation (125). Situational influences include structural features of the dilemma itself (125), group size, opportunities to communicate with other group members prior to individual decision making (131), and the potential for sanctions in the form of rewards for cooperation or punishment for noncooperation (132).

Creating a sanctioning system alters the incentive structure of the dilemma by changing the relative cost of cooperation versus that of noncooperation. In general, conservation and contributions to public goods are increased when the potential for sanction (either rewards or punishments) is present (132). However, implementing sanctions requires the ability to monitor individual behavior, and delivering reward or punishment is itself costly, so creating and implementing sanctions require collective cooperation. Furthermore, the use of reward and punishment to incentivize cooperative behavior may undermine more intrinsic motivations to cooperate (133, 134), such that, if the incentives are removed, rates of cooperation decrease to levels below those found with no incentives (135). In addition, when individual group members are given the decision to deliver punishments, antisocial punishment has been observed; i.e., punishment is given to those who contribute more than other members of the group (136, 137). Overall, the results of research on the consequences of sanctioning suggest that sanctions must be "complemented by strong social norms of cooperation" in order to be effective (137, p. 1362).

The component features of laboratory paradigms for studying social dilemmas vary on a number of dimensions, including framing (give-some versus take-some decisions), incentive structure, and whether it is a single (one-shot) decision or repeated (iterated) over multiple decision trials. Iterated public goods and resource dilemmas come closest to simulating the nature of real-world environmental decision making, and these have sometimes been specifically adapted to resemble environmental problems, including conservation and climate change mitigation. The remainder of this section focuses specifically on recent research studies of this type.

5.2.2. Uncertainty effects. When the consequences of overuse (or undersupply) of a collective resource are clear and predictable, members of a group are often able to preserve the resource by various forms of tacit coordination, such as the use of an equal-share rule in contributing or harvesting decisions (138). However, anything that introduces noise or uncertainty into the outcome calculations undermines coordination and cooperative solutions to the dilemma. Uncertainty is created when information about others' behavior is highly variable (138) or when information about others' contributions or harvests is distorted by random noise in the system, which undermines conservation under resource depletion conditions and lowers individual motivation to preserve the collective resource (139). Similarly, when members of a group in a resource dilemma task are given strong warnings that the collective resource is being depleted, harvests initially drop significantly but then rebound to previous levels after three trials (140), presumably because uncertainty about the likelihood of catastrophe increases as a function of time elapsed from the warning.

An experiment by Milinski et al. (141) utilized an experimental game that was explicitly designed to model climate change as a kind of threshold public goods dilemma. In each of 10 trials, participants (in groups of six) decided whether to contribute 0, 2, or 4 euros (from a 40-euro endowment) to a climate change account. If the group cumulatively reached a total of 120 euros by the end of the tenth round, they could keep what remained in their private accounts at the end of the game, but if they failed to reach the target, they risked losing their entire personal fund. (Note that in this game structure tacit coordination with an equal-share rule would have each group member contribute 2 euros per trial, which would achieve the threshold amount and leave each player with a fair share of 20 euros.) When the probability of loss was high (90%), one-half of the groups in the experiment succeeded in reaching the target level of contributions (and the remaining half came close). But when the risk of loss was lowered to 50% or only 10%, all but one group failed to reach the target.

In a similar experiment designed to simulate nations' decisions to invest in climate change abatement, Barrett & Dannenberg (142) had 10-person groups play an iterated public goods dilemma game in which all players lost money if a threshold of contributions was not reached. When the threshold amount was fixed (at 150 chips) and certain, 90% of the groups avoided the catastrophic loss, but when the threshold amount was uncertain (varying with equal probability between 100 and 200 chips), only 20% succeeded in avoiding catastrophe. Without a clear contribution goal, tacit coordination is undermined, and average contributions drop significantly.

In addition to risk uncertainty, significant time delays in the final outcome of decisions in a social dilemma task also undermine collective success. Jacquet et al. (143) had six-member groups play a 10-trial public goods dilemma with a threshold target for avoiding a 90% risk of catastrophic loss. Once the game was over, final payoffs to the participants were delayed by either one day or seven weeks (temporal discounting) or were given to a future group rather than the original players themselves (simulating intergenerational discounting). With a short temporal delay, 70% of groups succeeded in reaching the target contribution level; with a long delay, only 40% of the groups succeeded; and none of the groups reached the target in the intergenerational condition.

5.2.3. Group norms and modeling effects. One significant factor in determining individuals' decisions to cooperate in a social dilemma is their knowledge (or expectations) about what other members of the collective are doing (contributing or harvesting). Normative influences on decisions (see Section 5.1) can come in the form of communication of cooperative values (prescriptive norms), such as moral appeals (135), or from information about the modal (or total) choices of group members (descriptive norms). Of particular interest is the effect that a single individual's cooperative choices may have on the behavior of other group members. Weber & Murnighan

(144) have demonstrated that across trials the presence of a single consistent cooperator (one who contributes at high levels on every occasion regardless of what others do) has a significant positive effect on contributions to public goods. They argue that a consistent cooperator serves as a catalyst to collective cooperation by signaling that contribution is an appropriate normative behavior.

At the other end of the spectrum, a single consistent noncontributor (the bad apple) can have a disproportionate negative effect on the willingness of others to continue contributing (even when the majority of the group had been contributors). Kerr et al. (145) demonstrated this effect in a five-person iterated public goods dilemma, but also found that when there was a possibility that individual members could be ejected from the group (exclusion threat) the influence of one noncontributor on the level of contribution by others was eliminated.

5.2.4. Group identity effects. Cooperation in social dilemmas increases significantly in collectives in which there is a strong sense of in-group identity, or we feeling (146–148). Identification with the group as a whole has a positive effect on levels of intragroup cooperation. However, strong attachment to one's own local group can be problematic when social dilemmas entail intergroup cooperation. Antagonism toward out-groups may make individuals reluctant to contribute to or preserve a collective good that benefits out-group members, even though in-group members would benefit as well (125). Intergroup interdependence may necessitate the cultivation of a sense of superordinate, common identity that encompasses in-groups and out-groups to reduce in-group parochialism and encourage cooperation at a global level (149).

Social contextual factors play an important role in the domain of environmental decision making, influencing the way we understand accepted behaviors in response to environmental threats and our willingness to both engage in individual environmental actions and make cooperative decisions in the context of collective actions. Although a plethora of research indicates the importance of social influence, further research is required to identify ways to overcome barriers to making pro-environmental and cooperative choices in the context of uncertain environmental threats.

6. SUMMARY AND CONCLUSIONS

The impact of human activities on Earth systems is unprecedented and has led to environmental problems of a kind never before experienced by human society. This situation makes imperative our understanding of the factors underlying human interactions with the natural environment. To shed light on these factors, one needs to assess the individual and collective aspects of cognition (the understanding of environmental problems) and commitment (the willingness to engage in actions that will ameliorate such problems). Our article encompasses several distinct areas of research, each of which contributes to understanding these individual and collective aspects of cognition and commitment. In this final section, we offer a brief summary of some of the key findings and provide provisional answers to the four questions posed in **Table 1**.

6.1. Individual and Collective Cognition

Basic understanding of environmental problems is affected by the mental model that an individual develops. The mental model, or mental representation of the relations between causal factors involved in a problem, often provides the basis for subsequent reasoning, prediction, and decision making. Our article shows that, although people often have serious misconceptions about the mechanisms involved in environmental phenomena, some approaches (e.g., analogies with familiar events, interactive simulations) can improve understanding. That said, there is much more to be learned about the role of mental models in fostering pro-environmental decision making. Future

work needs to focus on refining methods for assessing lay models of environmental systems and understanding the relationship between changes in knowledge and changes in commitment to pro-environmental action. Mental models are also likely to be influenced by the worldview and or values espoused by an individual. Given that mental models are derived from intuitive beliefs and knowledge stored in long-term memory, they comprise information viewed through the particular lens adopted by an individual. For example, a conservative's mental model of a multifaceted environmental problem, e.g., climate change, might be very different from that held by a liberal. These differences in mental models have important implications for attempts to improve the basic understanding of environmental problems via the provision of scientific, factual information.

Turning to the role of collective cognition, research indicates that emphasizing consensus beliefs about the reality of an environmental problem such as climate change (e.g., by stating that 97% of climate scientists support the anthropogenic global warming hypothesis) appears to exert a strong influence on acceptance of the problem (100). This perceived scientific consensus also seems to neutralize the effect of worldviews, making consensus information a potentially powerful tool to increase acceptance across a wide range of environmental phenomena. This is a clear indication that views held by other individuals—especially those perceived to be in positions of authority—can play a key role in understanding and acceptance of a problem. However, a shared understanding of an environmental problem can also arise by observing the behavior of those close to an individual (e.g., family members and peers) and by exposure to different norms in the media. Although their role in commitment to pro-environmental action may be more direct, these normative influences may also affect an individual's understanding of environmental problems (e.g., the extent to which one understands that his or her individual contributions to carbon emissions are associated with global warming is likely to be associated with the degree to which others deemed as important hold this mental model).

6.2. Individual and Collective Commitment

Individual commitment is affected by a wide range of factors, encompassing nearly all the areas we have reviewed. The likelihood that individuals will commit to pro-environmental action may be affected by the accuracy of their mental model of the problem, the degree to which they espouse environmental values, their alignment with an egalitarian-communitarian worldview, the availability of appropriate default options, their perceived psychological distance from the environmental issue, and their perceived social norms. One issue that becomes apparent in reviewing this literature is the difficulty in pinpointing or isolating which of these factors (or combinations thereof) has the greatest impact on willingness to commit to action. Perhaps this is not a sensible question to ask: The differences in the complexity and temporal and spatial nature of the environmental problems we face, and the differences in the level of commitment people can endorse, may make it impossible to develop a single silver bullet solution. Moreover, the political and economic constraints on the decisions that people (and governments) can make place boundaries on the success of any communication strategy. What is clear, however, is that careful experimentation and testing of various combinations of these factors are crucial for improving our understanding of what works and why.

The extent to which individuals will choose to sacrifice immediate self-interest for the sake of collective welfare is affected by several factors that have been explored in experimental analogues of real-world environmental dilemmas. These include the opportunity to communicate with other group members, the potential for sanctioning (rewards/punishment) other players, and the overall size of groups. One key finding emphasized by our review is that the introduction of uncertainty into dilemmas has significant and often highly detrimental effects on the development

of cooperative behavior. This is a sobering finding given that the major environmental problems faced by society are inherently uncertain. We rarely have noise-free information about the consequences of resource use or the intentions of other players (e.g., nations). This central role for uncertainty/risk points to the need for more research into how cooperation can be achieved when the opportunity to reduce uncertainty in a system is unavailable.

In summary, the complexity and multifaceted nature of the psychology underpinning environmental decisions present a challenge but also an opportunity for addressing the complex and multifaceted environmental problems confronting humanity. The range of factors, dimensions, and drivers of behavior that one can appeal to in promoting individual and collective pro-environmental cognition and commitment raises optimism that the Anthropocene will not be the last epoch we enjoy on this planet.

SUMMARY POINTS

1. The psychology underlying environmental decision making can be understood by addressing individual and collective cognition of an environmental problem and individual and collective commitment to support actions to ameliorate that problem.
2. Investigation of these factors leads to the consideration of literature relating to psychological predispositions, mental models, framing, psychological distance, and the social context in which decisions are made.
3. Mapping this literature onto the individual/collective–cognition/commitment framework reveals complex interactions that present opportunities to appeal to different drivers of decisions when promoting pro-environmental behavior.

FUTURE ISSUES

1. What is the best way to assess people's knowledge and mental models of the natural environment?
2. To what extent do worldviews or values trump education and scientific knowledge when attempting to engage people with environmental issues?
3. Can we bring the shadow of the future closer? Will attempts to induce the psychological proximity of environmental problems lead to greater understanding, acceptance, and cooperative behavior?
4. How can cooperation be encouraged in inherently uncertain environmental dilemmas?

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