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*Education for people and planet: Creating sustainable futures for all*

# **Effective education and communication strategies to promote environmental engagement: The role of social-psychological mechanisms**

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## **Abstract**

Communicators of climate change seek ways to better educate and motivate individuals to personally commit to sustainable, energy-saving activities. However, critical psychological and social barriers to conservation make this task challenging. Behavioral scientists are well aware of the difficulties that individuals and groups have in responding effectively to information surrounding climate change, and have used these insights to develop a number of techniques to aid in persuading people of the importance of the climate change issue, and motivating adaptive behavioral responses. This report consolidates research findings from behavioral economics, decision science, and social psychology to explore key insights and evidence around effective climate change education strategies and interventions aimed at enhancing conservation behaviors. We explore key findings from the behavioral and decision sciences, including analyses of cognitive bias, choice architecture, social influences, values, and communication strategies. In addition, we discuss a set of international, academic-private partnerships that used interventions suggested by behavioral science and psychological theory to dramatic effects. These in-depth case studies demonstrate how practitioners and researchers have put research insights and principles into practice. We conclude by addressing implications for policymakers.

## Introduction

The evidence of climate change is largely undisputed, but how to moderate the impacts of climate change remains a complex, multifaceted, and global problem. Compounding the challenge is the topic itself: an area that is scientifically complex, confusing to many, laden with popular misinformation and misdirection, and often emotionally and politically charged. Within this environment, communicators of climate change and policy leaders constantly seek out ways to better educate and motivate people to personally commit to sustainable, energy-saving activities. Critical psychological and social barriers to conservation make this task more challenging.

Behavioral scientists are well aware of the difficulties that individuals and groups have in processing and responding effectively to the information surrounding complex societal challenges, and this is no less true for the issue of climate change. Indeed, the majority of people around the world perceive climate change as abstract, remote, and distant. As a result, this critical issue is not perceived as meriting their concern nor does it induce them to take any immediate, significant, and potentially costly action in response to it (ecoAmerica, 2014). Moreover, it is often very difficult to effectively disseminate critically useful information about climate change (Center for Research on Environmental Decisions, 2009). To promote energy-efficient consumption, production, and investment, meaningful and sustainable solutions will need to involve education and behavior change interventions at all levels -- the individual, household, and business.

Recent conservation efforts have drawn upon lessons from the behavioral sciences to gain a deeper understanding of the psychology behind environmental decision-making, particularly regarding why individuals often fail to understand the risks associated with the issue, and fail to make energy-saving decisions. In addition to studying such behavior, researchers have developed a number of techniques to aid in persuading people of the importance of the climate change issue, and in motivating adaptive behavioral responses. To inform strategies about effective education and behavior change, this paper explores key insights from the behavioral and decision sciences, including analyses of cognitive bias, choice architecture, social influences, values, and communication strategies.

In order to widen the impact of this report, we have defined the term "education" broadly. By "education" we do not merely mean the idea of a specific classroom setting focused on providing information to students from teachers (although this may be included in our definition of education). Our definition also includes any interaction by which those with information work to communicate that information to those who need it or would most benefit from it. This broader definition is necessary for several reasons. First, research in this field has demonstrated that although education plays an important role in shaping individual level perceptions of climate change, informed attitudes do not necessarily translate into effective action. Thus, although the classroom can be used to improve public understanding of issues relating to sustainability, traditional forms of instruction may not be the most appropriate avenues by which to drive sustainable behavior change. Second, beyond the strategies of improving climate literacy and basic education, research has shown that many other significant factors shape adaptation responses, including local temperature, social and cultural norms, and cognitive biases. Thus, for our purposes, "education" can include the actual communication of knowledge in a classroom, but also includes the dissemination of information and promotion of sustainable behaviors (including interventions) in a wide range of settings.

The behavioral science literature that we review in this report can be used in a number of contexts to enhance this broadly defined educational process so that those who are on the receiving end of important information are most likely to internalize it and adopt attitudes and behaviors consistent with it.

### **Background**

Without global policy and behavior changes, anthropogenic climate change is likely to intensify. Further, despite widespread scientific evidence documenting that the climate is changing and that these changes are in large part caused by human activities, public understanding of these facts and support for public policies is equivocal worldwide (Brechin & Bhandari, 2011). Not only does the general awareness of climate change vary from country to country, but even among those populations with a more sophisticated understanding of the issue, the perceived risks associated with climate change vary widely.

Using data gathered from the largest cross-sectional global surveys of climate change perceptions conducted to date, involving 199 countries, Lee and colleagues provided a global assessment of factors underlying climate change awareness and response to climate change (T. M. Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015). Figure 1 provides a summary of these findings, and shows international patterns of perceptions of global climate change relating to awareness and risk perception. The highest levels of awareness (over 90%) were reported among countries in the developed world, including North America, Europe, and Japan. In stark contrast, the majority of respondents in developing countries reported that they had never heard of climate change, including more than 65% of individuals in Egypt, Bangladesh, Nigeria, and India.

Figure 1.

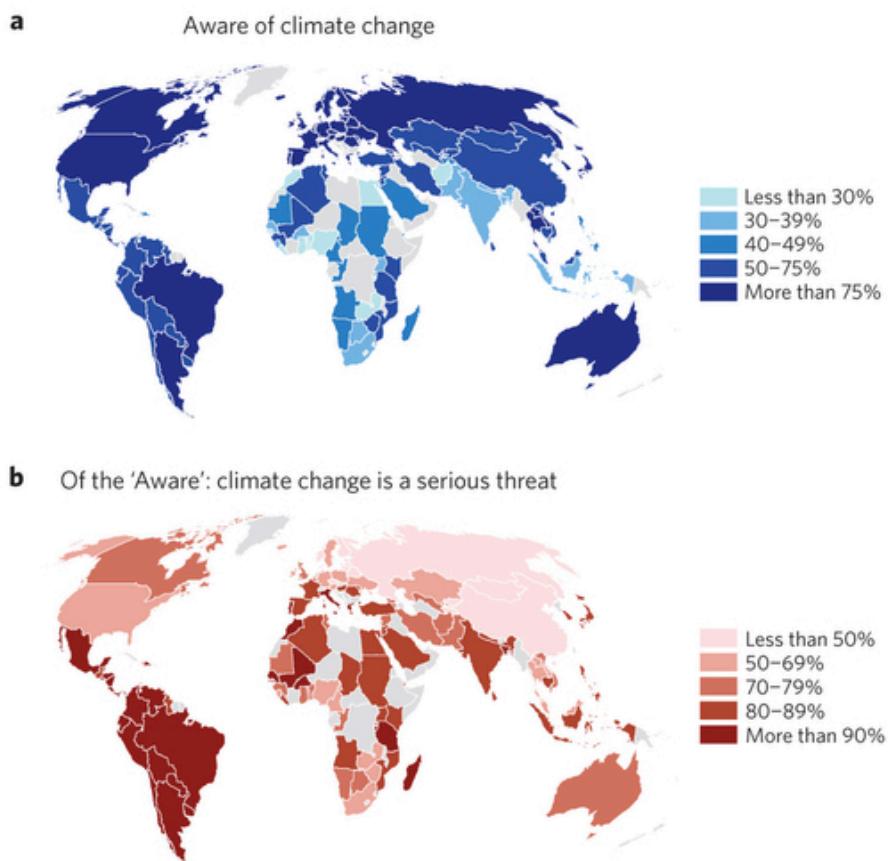
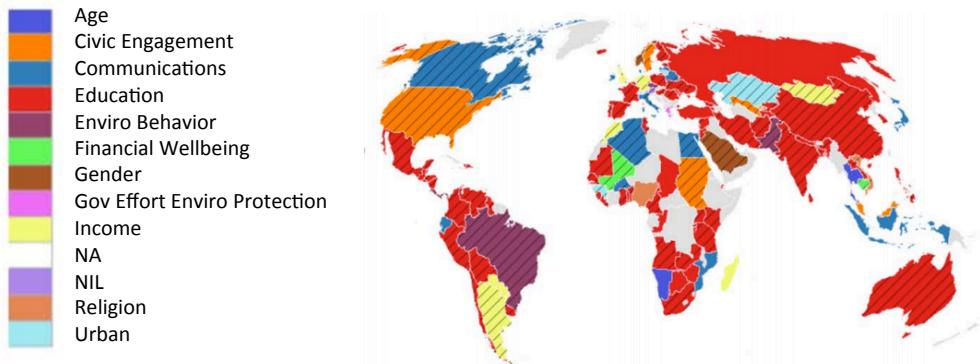


Figure 1 (Lee et al., 2015). International patterns of climate change perceptions across 119 countries. Data was compiled using results from a Gallup Poll conducted in 2007-2008. Data is weighted and collected by Gallup on the basis of two questions: How much do you know about global warming or climate change? And for those who are aware, they were further asked: How serious of a threat is global warming to you and your family? Original responses were re-categorized into binary level and as a percentage for each nation. For clarity, the level of awareness and seriousness are shown in five color classes. Areas in light grey represent countries with no data.

Using additional variables collected by the Gallup World Poll, the researchers also explored the relative influence of socio-demographic characteristics in influencing climate change awareness and risk perception. These characteristics included demographic variables (e.g., gender, age, education), physical and financial well-being, beliefs related to climate change, media access, and pro-environmental and civic engagement. Figure 2 shows the top ranked predictors of climate change awareness and risk perception by country. Most germane to this report, findings revealed that education level is the best global predictor for awareness of climate change. For 70 countries, education level and beliefs about the cause of climate change were frequently the top-ranked predictors of climate change awareness and risk perceptions. This makes the role of education and communication critical. However, beyond climate literacy, the results indicate that other factors shape public responses, and each country has its own relatively unique set of correlates. Notably, in the report by Lee and colleagues, the best predictor for viewing climate change as a substantial risk to society was not a person's general awareness of the existence of climate change, but awareness of *the causes of climate change* (the exception being in African nations where perceived temperature changes appears to be the best predictor of beliefs about the risks of climate change).

Figure 2.

a. Awareness (Top Predictor)



b. Risk Perception (Top Predictor)

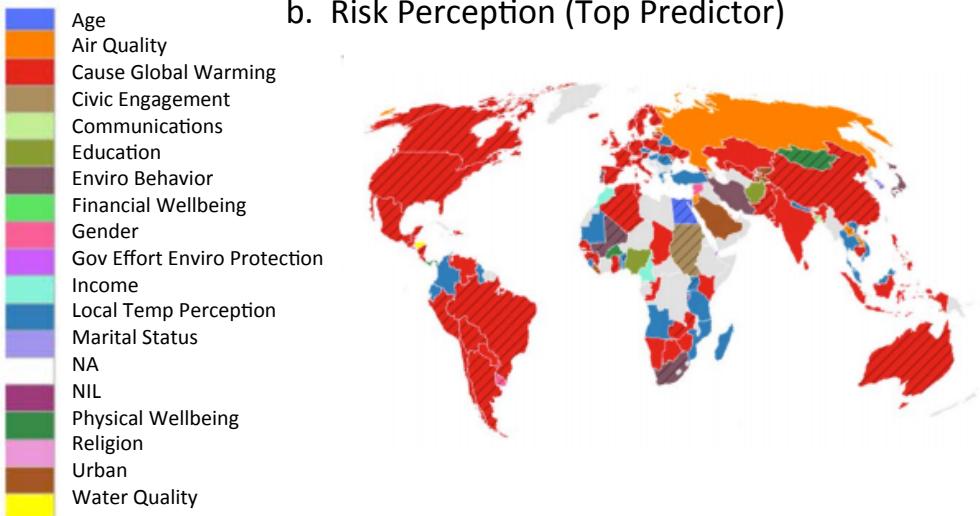


Figure 2. (Lee et al., 2015). Top ranked predictors of climate change awareness (a) and risk perception (b) across the world. The 'NIL' category is assigned when no important predictors are found during the analyses. Refer to the legend for the color-coded predictors. Areas in white represent countries with no data. See full results in Supplementary Dataset in Lee and colleagues (2015).

However, merely being *aware* of climate change risks does not in and of itself predict that actions will be taken to reduce greenhouse gas emissions or support policies aimed at achieving sustainable energy. Globally, the willingness of individuals to respond to climate change differs across countries. And, unfortunately, such willingness does not always translate into concrete actions. For example, a Fondazione Eni Enrico Mattei (FEEM) survey indicated that although 70% of Italians surveyed were willing to increase energy savings, only 2% were currently reducing their use (Pongiglione, 2011).

A number of psychological barriers and biases may prevent those who are aware of climate change from taking action to mitigate or reduce its impact, and can further inhibit effective conservation efforts from being taken. For example, people tend to use mental heuristics ('rules of thumb') to understand how their actions impact the climate, rather than reviewing the evidence in detail. Studies have shown that people's

beliefs about climate change are quite malleable, and can be influenced by something as trivial as the day's local temperature (Zaval, Keenan, Johnson, & Weber, 2014). Another common bias relates to people's general tendency to seek out information that confirms their already-held notions about how the world works and how their actions influence it (Nickerson, 1998). It is difficult to get people to seek out information that is not consistent with their worldview. This is a challenge both for raising awareness of the risks of climate change generally, and for communicators who might fail to appreciate the impact of diverse cultural backgrounds (and worldviews) of individuals that they are trying to influence. Finally, a lack of knowledge regarding energy efficiency can inhibit effective behavior change. For example, people are generally unaware of how much electricity their different appliances and products use (Attari, DeKay, Davidson, & De Bruin, 2010). Not only does this present a more general problem, but it can inadvertently cause individuals to believe that they have already worked to mitigate their impact on the climate after taking a single action, like turning off the lights, when, in fact, there are far more effective ways to mitigate climate change (Weber, 1997). Each challenge described above represents an opportunity in which improved education can have a large impact.

In addition to the benefits of concerted public education, there are many other strategies that can induce changes in consumption patterns and promote desirable mitigation behaviors. One such strategy, emphasized in recent policy initiatives, concerns the use of behavioral science interventions known as "nudges" to overcome various cognitive biases. This strategy aims to lead the individual to take a specific course of action in the direction of interest, without being prescriptive. For example, research has shown that changing a single word in a proposed public policy, such as referring to a carbon "tax" as a carbon "offset," can influence the degree to which it receives support among certain groups (Hardisty, Johnson, & Weber, 2010). Indeed, much of how information is received and used is dependent upon how it is conveyed or framed. For example, rating fuel economy in miles per gallon (MPG) can mislead consumers, as most people approach MPG as a linear indicator of the cost of fueling a vehicle, whereas, in reality, annual fuel costs scale nonlinearly in MPG (Larrick & Soll, 2008). This work suggests that we must take care when educating in the domain of climate science, and not simply assume that this process is merely a matter of providing more information.

This report will explore how particular kinds of communications and behavioral prompts can impact the way that individuals view and respond to the subject of climate change – and how we can better educate individuals on the risks associated with climate change while also inducing meaningful energy-saving decisions. Although there are many factors that influence people's engagement with climate change, we will focus upon those that we feel are the most important for educators and communicators.

### ***Methodological Approach***

This report consolidates research findings from behavioral economics, decision science, and social psychology to explore key insights and evidence around effective climate change education strategies and interventions aimed at enhancing conservation behaviors. The research cited has been conducted globally, across numerous academic and private institutions, but specifically highlights findings from the Center for Research on Environmental Decisions (CRED) at Columbia University. CRED is an interdisciplinary, international center that studies individual and group decision making under climate uncertainty and decision making in the face of environmental risk. In addition, we discuss a set of international, academic-private partnerships that used interventions suggested by behavioral science and psychological theory to

dramatic effects. These in-depth case studies demonstrate how practitioners and researchers have put research insights and principles into practice, and are integrated throughout the paper.

One important caveat that the reader should bear in mind is that most of the studies described in our review of the research have taken place in developed nations, particularly the United States, Australia, Canada, and those in Europe. In contrast, the challenges presented by global climate change and other environmental issues have a wide impact, particularly within developing nations. We recognize that national programs aimed to increase citizen engagement with climate change must be tailored to the unique context of each country, and this is especially true in the developing world. Accordingly, an effort will be made to highlight research that has been conducted in less developed nations. When possible, we will also conceptually extend the findings from research conducted in developed countries to other contexts. However, such efforts cannot be a substitute for widespread scientific data collection across the globe. As such, a secondary purpose of this report is to highlight research gaps that could potentially be filled in the future to improve our understanding of how individuals worldwide respond to the kinds of interventions we highlight.

We have divided the analysis of this report into four sections. First, we discuss how the use of green defaults, an important intervention tool from the decision sciences, promises to open up new possibilities for pro-environmental action – possibilities that may be more effective than traditional economic incentives or mandates. Second, we discuss behavioral interventions related to social influences of behavior, including identity, norms, and social incentives. We examine how one successful, scientifically-motivated energy efficiency program incorporates the practical benefits of this research. Third, we discuss how personal values relate to environmental behavior cross-culturally, and the importance of values consistency in persuading individuals to change their behavior. We address how proposing values-consistent solutions to problems can overcome unwillingness to consider scientific facts surrounding climate change, and how working with community and religious leaders to disseminate information about sustainable practices can influence behavior change. Finally, we explore a variety of tools that educators may use to make climate change more meaningful to their audience, including modifying their communication strategies, adopting participatory mechanisms, and utilizing climate change simulation games. We conclude by discussing the implications of these recent initiatives to the design and measurement of energy efficiency programs, and we address implications for policymakers.

## Analysis

### I. Behavioral Nudging and Green Defaults

Globally, individuals' understanding of climate change and willingness to respond does not always translate into concrete action. This section addresses how business leaders, policy-makers and educators can more easily turn intentions into actual behavior change by taking advantage of tools from "choice architecture" (Thaler, Sunstein, & Balz, 2014), an approach in which policy makers allow people the freedom to take a specific course of action, but encourage or "nudge" them in the socially preferable direction. Effective nudging can be used to overcome various cognitive biases, including the status quo bias (the preference for the current state of affairs, where any change from baseline is perceived as a loss). A body of behavioral science research in the environmental domain suggests that one type of choice architecture tool – *defaults* – may be particularly effective in driving pro-environmental action.

Default effects refer to the tendency of a person to stay with an option (or choice, or behavior) that has been selected automatically (or pre-selected) for that person instead of choosing an alternative. Findings from the decision sciences have shown that because sticking with a default option requires no additional action, people will tend to accept it even though they would not have chosen it if it had been presented as an elective. In many parts of the world, daily life is already accompanied by "green choice" defaults. For example, an office building may set a default temperature on its thermostats in order to save on heating costs, or a printer may be defaulted to print double-sided pages to save on paper. Providing a default not only saves people time (by relieving them of the task of making an active choice), but it may also be viewed as being the best option, since it is often assumed as being 'recommended' by the provider.

Considerable research confirms that setting green choices as defaults can influence people to behave more pro-environmentally (Sunstein & Reisch, 2014). Consider a simple example. Suppose a private or public institution wants to save money and protect the environment by reducing its use of copy paper. The institution might simply make double-sided printing the default option on all of its printers, instead of single-page printing. Recently, Rutgers University in New Jersey adopted this type of default mechanism. Students, who generally have no preference on this matter, were required to manually select the option to print on only one side of the page. After three years, the university found that it had reduced paper consumption by more than 55 million sheets, the equivalent of 4,650 trees (Rutgers University, 2009). The goal of conservation had been made that much easier by becoming the default option.

In a recent study, Dinner and colleagues found that green defaults can be used to influence consumers' choice to purchase more energy-efficient products (Dinner, Johnson, Goldstein, & Liu, 2011). The context in this study involved two alternatives: choosing to use cheap, inefficient incandescent lightbulbs, or selecting expensive, but efficient, compact fluorescent bulbs (CFLs). The choice between these two options has enormous consequences: according to the EnergyStar program of the U.S. Environmental Protection Agency and the Department of Energy, if every home in the United States switched just one incandescent bulb to a CFL, the result would be to save more than \$600 million in annual energy costs, and to prevent

greenhouse gases equivalent to the emissions of more than 800,000 cars (EnergyStar Program, 2010). Participants in the experiments were presented with a hypothetical scenario in which they were asked to choose between CFL or incandescent light bulbs. The scenario described renovations to be performed at the participant's home, where one of the bulb types had already been installed, and thus became the default option. Participants were told that at no cost, they could choose to switch bulbs to the other type. They were also given extensive information regarding the two types of bulb, including cost per bulb and cost in electricity per 10,000 hours. Results from this research showed that the default setting was highly influential. When the incandescent bulbs were the default, energy-efficient CFLs were chosen only 55% of the time. In contrast, when energy efficient CFL bulbs were the default option, they were chosen nearly 80% of the time. These findings suggest that if energy-efficient products are established as dominant, consumers are not likely to switch to energy inefficient products.

Large-scale, striking examples of the influence of green choice defaults can be found in Germany, where electric power customers in two German populations are automatically enrolled in their utility's "green energy" program. In those communities, more than 90 percent of people are enrolled in clean energy programs because a green energy provider is set as the default, and not as an "opt in" choice (Pichert & Katsikopoulos, 2008). The first example involves the town of Schönau in the Black Forrest where, in the aftermath of the Chernobyl nuclear power disaster, a citizen referendum established an environmentally friendly energy supply (the Schönau Power Company, which places a great deal of reliance on renewables and promotes solar energy). Customers are allowed to opt out and to use other energy sources, but almost no one does so; in recent years, only slightly above 0% have chosen to opt out. This is in dramatic contrast to the relatively low level of participation in clean energy programs in other German cities and towns: at the time of the study (2008), less than 1% of total customers actively chose to participate.

The second example involves the energy company Energiedienst GmbH in Southern Germany. In 1999, the company established certain tariffs, reflecting different consumer options with corresponding prices, while setting the default tariff to a green energy program. About 94% of customers stayed with this option, with only 4.3% switching to the less green, cheaper (by approximately 8%) tariff. In a follow-up research study that also took place in Germany, participants displayed an attachment to their default, asking for more money to give up green electricity than the amount they would have elected to pay for it.

Based on these and related results, it is fair to conclude that the use of a default setting can greatly affect the kind of energy that people use. Since the start of the liberalization of European energy markets several years ago, most European consumers of electricity now have the option of choosing products that best match their preferences. Many countries in Europe, North America, and the Asia-Pacific region now permit consumers to purchase so-called 'green' electricity by choosing a green tariff, by participating in green electricity programs, or by contracting with a utility company specialized in trading green electricity (Bird, Wüstenhagen, & Aabakken, 2002; Kaenzig, Heinze, & Wüstenhagen, 2013). Research conducted in the United States, the United Kingdom, and other European countries shows strong public support for renewable energy and suggests that people are even willing to pay a small premium to have it (Pichert & Katsikopoulos, 2008). However, despite such widespread availability and preference for green energy, only a small segment of the consumer population in these liberalized electricity markets choose to buy it since the default option is almost always 'grey' electricity (i.e. electricity produced from non-renewable sources). The vast majority of consumers stay with their power provider and the product they are used to (the

default), and thereby avoid transaction costs. The power of defaults provides an explanation as to why individuals stick with products they are used to, even though there may be other options on the market that they would prefer.

Business leaders, politicians, and environmental educators can be more successful in causing pro-environmental behavior changes if they make environmentally responsible behaviors the default option as often as possible. Unfortunately, in many domains, the default option is not the environmentally-friendly one. The Energy Star conservation mode is not the factory setting on many electronic devices, double-sided printing is not the default option in most corporate offices, and providing re-usable shopping bags is not the default option for most retail establishments. In domains such as these, green defaults have the potential to save money, increase energy independence, and reduce waste. In addition, when compared with mandates, green defaults have the important advantage of maintaining freedom of choice. For a business or government agency, the benefit of carefully selecting green default options is that individuals are simply nudged, and not forced, to behave in a pro-environmental manner. This is often referred to as “libertarian paternalism,” since individuals who decide that they do not prefer the default setting may simply change it.

It is important to note that the manipulation of defaults does have its limits. For example, although we have seen that the influence of default effects is strong, if the differential in price becomes too great, customers might opt out of the default option. Residential energy customers are not likely to buy green energy if it costs \$500 more each month, regardless of whether it is the default option or not. Also, individuals may react negatively if they suspect that the company (or the policy maker) is trying to force an option on them or to unreasonably influence their behavior. Evidence suggests that the decision-maker will be far more likely to opt out of the default option if they do not feel trust towards the provider (Tannenbaum & Ditto, 2011).

Attitudes towards behavioral nudges are also likely to differ cross-culturally. To date, research exploring the power of choice architecture interventions has been largely limited to the U.S and Europe. However, some initial work has already demonstrated that certain types of choice architecture interventions can work successfully in sub-Saharan Africa: enabling farmers to prepay for fertilizer when they had cash on hand was effective in promoting fertilizer adoption (Duflo, Kremer, & Robinson, 2009). Cultural and political context will certainly influence how users respond to and interpret nudges, and further studies are needed to investigate how individuals react to nudges in countries where resources are greatly limited. Work is also needed to explore how more collectivist cultures (such as those in China, Korea, and Japan) respond to choice architecture interventions, such as default effects. It seems likely that individuals in collectivist cultures (which value group goals over individual needs) would be more likely to conform to a specific course of action that seems to be encouraged by policy makers.

Overall, choice architecture interventions, including default effects, deserve greater public awareness. Educators, policy and civic leaders, and the public at large should be taught about the enormous power that nudges can have over individual choices, and discussion is needed to determine how that power can best be applied in the environmental domain. Importantly, the academic research community has already begun to educate and engage the policy community in a conversation about behavioral approaches. The Behavioural Insights Team (BIT; known unofficially as the "Nudge Unit"), headed by psychologist David Halpern, is an organization created in 2010 to apply theories from behavioral economics and psychology to improve

UK government policy and services. As an example of their work, BIT increased tax collection rates by changing the default web-link to direct letter recipients straight to the form they were required to complete, instead of the website containing the form. This minor “nudge” increased tax collection rates by 19-23% (The Behavioral Insights Team, April 2014). Alongside the policy work and trials conducted by BIT over the last several years, BIT has conducted educational seminars, workshops and talks with policy makers, academics, and practitioners. The model has been followed in the United States and Australian governments, but could be expanded internationally, to local government, private, and non-profit organizations. “Nudge Units” like BIT should also consider focusing future efforts on issues relating to promoting environmental sustainability.

## II. Social Influences: Identity, Norms, and Incentives

Influence on decision making is not only associated with the construction of the choices themselves, but also the social context in which these choices are made. Recent research in the behavioral sciences suggests that socially oriented motives can have a strong influence on people’s tendencies to conserve, and that appealing to social norms can serve as a powerful behavioral lever. In this section, we examine two streams of research. First, we address recent academic-private partnerships, which have explored how *social norms* can be used promote a range of conservation behaviors. Second, we discuss research demonstrating that *social incentives* can have significant impacts on decisions to reduce energy consumption, even beyond monetary incentives.

### *The Use of Social Norms*

As used in the field of social psychology, social norms are shared expectations about what is appropriate behavior within and for a specific context. According to norm theory, one’s actions are far more likely to be scrutinized when they deviate from what is expected, with expectations arising either as the result of direct, socially communicated information or by the simple observation of typical behaviors (Kahneman & Miller, 1986).

The communication of social norms can be accomplished in either an injunctive way (e.g. by providing direct imperatives to constrain behavior) or in a descriptive way (e.g. by describing what people generally do in a given circumstance). A body of research has now confirmed that the use of social norms has a role to play in inducing pro-environmental behaviors, in that people appear to be particularly sensitive to the social and reputational aspects of such behavior.

Recent academic-private partnerships have explored how social norms can be leveraged to guide and promote a range of sustainable consumer behaviors. For example, Goldstein, Cialdini, and Griskevicius partnered with an upscale hotel in Phoenix, Arizona to determine whether targeted social norm messaging could influence their patrons’ decisions to reuse their hotel towels (Goldstein, Cialdini, & Griskevicius, 2008). The researchers experimented with several different messages on the hotel doors to encourage the reuse of towels. For example, one message was designed to signal an environmental, injunctive norm and stated, “Help save the environment.” This was followed by information about how energy and water used to wash hotel towels would negatively impact the environment. The researchers discovered, however, that the most effective messaging strategy was to signal that towel reuse was the social norm. This particular message stated, “join your fellow guests in helping to save the environment,” and included information

noting that almost 75% of guests reuse their towels. By signaling social norms in this way, the researchers were able to increase hotel towel reuse by 34%.

The influence of social norms has been successfully applied to other areas of sustainability. For example, researchers at a Dutch public university conducted an online survey experiment with the aim of testing strategies to reduce bottled water consumption (Van Der Linden, 2015). Students in the study were randomly assigned to one of three conditions: (1) persuasive information (students read a persuasive, informational article about bottled water consumption), (2) activating social norms (students were told that 65% of the university's student body was trying to reduce bottled water consumption), or a combination of both. Results revealed that the combination of social norms and persuasive information was the most effective, and elicited the greatest reduction in intentions to buy bottled water. These results suggest that combining educational, persuasive information with social norm messaging is likely to offer a high likelihood of successful behavior change.

Research has also shown that social norms in isolation are not necessarily the sole predictors of behavior—the *salience* of those norms is important as well. That is to say, if an individual's attention is not focused on the norm itself, it will have less of an influence on his or her actual behavior. Cialdini, Reno, and Kallgren conducted a series of studies on the importance of norms and norm salience on the problem of littering in the United States (Cialdini, Reno, & Kallgren, 1990). Across multiple situational contexts (e.g. a parking garage, a hospital, a library parking lot, an amusement park), the researchers investigated the degree to which social norms influenced people's choice to litter or not. The researchers found that norms had a significant impact on littering behavior. For example, a person was much less likely to litter in a clean environment, since this type of environment creates a descriptive social norm against littering. The salience of the norm was also highly influential. For example, seeing another individual litter in the environment drew the attention of the participants to the norms in question: participants were more likely to litter in a littered environment and less likely to litter in a clean environment when they observed someone else littering in that environment.

Research has also shown that the interplay between injunctive and descriptive norms is important for environmental behavioral intentions, particularly when it comes to the communication of information. A study conducted by Smith and colleagues examined the effect of perceived injunctive and descriptive norms on environmental behavioral intentions among students in universities from three different countries: Australia, the United Kingdom, and China (Smith et al., 2012). Participants read a report on energy conservation at their university. The report suggested either a strong or weak descriptive or injunctive norm with respect to energy conservation. For a weak descriptive norm, participants read that only 22% of students engaged in energy conservation; for a strong descriptive norm, the figure was changed to 82%. For a weak injunctive norm, participants read that 23% of students reported approval of other students who engaged in energy conservation; for a strong injunctive norm, the figure was changed to 85%. Following the reading of this report, participating students reported their own intentions to engage in energy conserving behavior. The researchers found that, across all three cultural contexts, participants reported the highest level of intentions when they read about both the descriptive and the injunctive norms supporting energy conservation. These results are important to consider when assembling information for education and communication purposes, since information can communicate what is socially expected, and, in turn, influence intentions to engage in a range of environmentally responsible behaviors.

Social norms also have the potential to be relevant in traditional classroom educational settings. Educators have an important role in correcting misperceptions about the degree to which individuals are perceived as caring about sustainability practices (i.e. injunctive norms) and engaging in those practices themselves (i.e. descriptive norms). Research has shown that having educational authority figures correct misperceptions about college binge drinking by noting that it is less prevalent than typically thought, for example, can help reduce its incidence. (Perkins, 2002). Presumably, once the norm to engage in sustainable environmental practices is established beyond a certain threshold, educators can have a major influence on the next generation by making those injunctive and descriptive norms salient to their students. In addition to correcting misperceptions, educators with the esteem of their students could potentially have a role in modeling positive behaviors, though more research is needed to determine the effectiveness of this type of role modeling among instructors.

Beyond the classroom, recent work by a company called O'POWER has demonstrated that social norm messaging can be “scaled” to influence energy conservation at the level of an entire community. During the past several years, O'POWER has partnered with utilities in California, Minnesota, Colorado, and other states in the United States to send energy use reports to residential electricity and natural gas consumers. These reports are designed to produce social comparisons relative to social norms. As such, the reports contain detailed information about a household's energy usage, the average energy usage of the household's neighbors, and the energy usage of particularly energy-efficient neighboring households. Distributing this type of information about peer energy usage resulted in a significant reduction in individual household energy use (Ayres, Raseman, & Shih, 2013). The O'POWER reports also include feedback, which rates the household as either “Great,” “Good,” or “Below Average.” These feedback mechanisms have been found to reduce energy usage by 1.2% in the Puget Sound Energy utility district and 2.1% in the Sacramento Municipal Utility District (in Washington and California, respectively). These results are striking and suggest the powerful impact of social norm information in influencing energy conservation, in this case by covering both information about specific energy usage as well as how that energy usage stacks up relative to a descriptive norm.

It should also be noted that although the body of research discussed above was conducted in Western cultural contexts (with the exception of the study that included a Chinese sample), cross-cultural research suggests that social norms may hold promise for a variety of developing nations. Developed nations, particularly in the West, tend to be “individualistic” in nature, emphasizing individual responsibility and expression. In contrast, many developing nations, particularly those in East and Southeast Asia that have received the most attention from this kind of research, tend to emphasize the importance of the group over the individual (Markus & Kitayama, 1991). In such contexts, social norms may have more of an impact, because individuals may be more likely to follow the rules established by the group in an interdependent as opposed to independent context. However, this claim is hypothetical in nature, and would need to be tested empirically, leaving the door open for future research.

### ***The Use of Social Incentives***

Typically, those working to influence behavioral change on an individual level attempt to do so through the use of monetary incentives or disincentives conducted on a national scale. Cap-and-trade schemes and carbon taxes fall into this category, since they have the effect of making energy produced by the burning of

fossil fuels more expensive relative to energy produced through renewable means. Some argue that cap-and-trade plans are a better response to the environmental challenges we face (Avi-Yonah & Uhlmann, 2009), while others argue that the carbon tax approach is superior (Keohane, 2009).

One major obstacle to each of these approaches is that they can make energy more expensive for the average consumer, and thus risk losing popular support. In addition, policies based on economic incentives may inadvertently cause consumers who already favor the reduced use of energy made from fossil fuels to become less psychologically motivated to conserve. Recent research on the use of monetary incentives has sometimes shown that they can “crowd out” an existing willingness to incur costs for the sake of environmental goals. For example, Frey and Oberholzer-Gee (1997) conducted a survey in Swiss towns which had been designated by the government as potential sites for the disposal of low- and mid-level radioactive wastes. The survey asked respondents one week prior to a referendum whether they planned to favor or oppose the building of those facilities. When the proposal was presented without compensation, 50.8% of the respondents said that they would support the building of the facilities, while 44.9% were opposed. However, when the identical question was posed, but included financial compensation from the government, support for the building of the facilities dropped 24.6%. The authors concluded that the offer of financial incentives undermined the original civic-mindedness of the respondents, who, under normal circumstances, would have been willing to support nuclear energy for their country while incurring the cost of having disposal facilities nearby. These “crowding out” effects could potentially extend to attempts to incentivize behavior change on an individual level with policies aimed at shifting financial costs.

The existence of such “crowding out” effects and of political barriers to passing on increased energy costs to individuals and families have led researchers to explore other potential motivations for reducing individual energy use, such as the use of *social goals and incentives*. Human beings have an inherent need to create and sustain social ties that frequently outweighs their motivations for financial gain. Handgraaf, de Jeude, and Appelt (2013) examined the importance of these social goals in a 13-week study of behavior in a Dutch environmental consultancy firm. The study made use of “smart plug” technology, which measures individual energy use. At the end of each week of the study, participants were given feedback about their energy use relative to their baseline measure. The feedback was divided into five categories: public social, public monetary, private social, private monetary, and a control condition which received no feedback. The monetary rewards ranged from €0 to €5, depending on the energy savings the individual managed to attain. Social rewards involved a number grade from 5.0 to 10.0 accompanied by positive and negative written feedback such as “unfortunate...” for a 5.0 and “great!” for a 10.0. Those participants who were assigned to the private conditions received only their own social (or financial) feedback. Participants assigned to the public conditions received their own social (or financial) feedback, the feedback of the other individuals in the public conditions, and their relative ranking among those individuals. The researchers found that, across the 13 weeks of the study, those who were in public conditions achieved significantly greater energy savings than those in private conditions, and those in the social feedback conditions achieved significantly greater energy savings than those in the monetary feedback conditions. The results were most pronounced between the social and monetary forms of feedback. Both conditions (both private and public) involving social feedback achieved significant savings relative to the savings of those in the control condition. In contrast, those in the monetary incentive conditions achieved no significant gains relative to the control condition.

The primary take-away from this study is that monetary incentives have a limited impact on decisions to reduce energy consumption, whereas social incentives can provide more significant change. This finding is particularly important considering that social incentives have no financial cost on the part of policy makers (and, in cases involving commercial entities, incentivizing energy savings in this way can actually lead to corporate-level savings). It should be noted that one possible limitation of this case study is that it took place in a consultancy firm that was symbolically committed to environmental values such as sustainability. Thus, the social norms created by the firm among its members supported sustainability goals, and social rewards for achieving these goals on an individual basis might have been particularly motivating. It is uncertain whether these sorts of approaches involving social rewards will be as effective in contexts in which pro-environmental behaviors are not seen as achieving the particular values or goals of one's group. This tie between pro-environmental behaviors and shared group values and norms is addressed in the following section.

### III. Values consistency in promoting behavior change

Personal values have been shown to have a powerful impact on one's willingness to engage in pro-environmental activities, including actions that may involve financial and other costs. In this section, we examine two sets of studies. First, we examine the kinds of personal values that are generally associated with pro-environmental attitudes, and when and how these values relate to actual pro-environmental behavior cross-culturally. Second, we note recent U.S. research demonstrating how values-consistent solutions to problems can overcome an unwillingness to consider scientific facts surrounding climate change. This research also demonstrates that working with community and religious leaders in communities not normally considered "pro-environmental" can influence individuals toward behavior change.

In cross-cultural psychological research on personal values, four broad categories have been identified in multiple contexts around the world: "self-enhancement" values, pertaining to goals such as personal achievement and success; "self-transcendent" values, pertaining to goals such as benevolence and community; "conservation" values, pertaining to goals such as tradition and security; and "openness" values, pertaining to goals such as stimulation and self-direction. These goals appear to be present, albeit with different relative emphases, across a wide range of countries and cultural contexts (Schwartz, 1992), and have important implications for questions surrounding environmental attitudes and behavior.

Schultz and Zelezny (1999) conducted surveys of both developed and developing nations to determine whether and to what degree different values were predictive of pro-environmental attitudes across different countries. Samples were drawn from Argentina, Canada, Colombia, Costa Rica, the Dominican Republic, El Salvador, Ecuador, Mexico, Panama, Peru, Paraguay, Spain, the United States, and Venezuela. Values from the Schwartz Value Inventory were correlated with the degree to which people endorsed the New Environmental Paradigm scale items—which measure a number of beliefs and attitudes related to areas of environmental concern—and anthropocentrism and ecocentrism—which measure the degree to which individuals endorse a human-centric view of life on earth or a broader environment-centric view. Researchers found that, across cultural contexts, universalism values (a component of self-transcendence) were positively correlated with ecocentrism and the NEP items. In contrast, the self-enhancement value of power was positively related to anthropocentrism, and negatively related to both ecocentrism and the NEP

items. This research shows the importance of value differences, and is remarkable insofar as it explored these relationships across a variety of cultural contexts and degrees of economic development. What is striking is the consistency of the relationships in spite of the great differences in overall endorsement of the various environmental attitudes (e.g. all of the aforementioned countries scored significantly higher on the NEP scale compared to the United States except for the Dominican Republic, Ecuador, and Peru).

Cross-cultural research on values and the environment is not limited to environmental attitudes, however. Schultz and colleagues (2005) later conducted another global survey on values and self-reported environmental behaviors, using individuals in Brazil, the Czech Republic, Germany, India, New Zealand, and Russia. Participants completed the Schwartz Value Inventory, and also measured self-reports of pro-environmental behaviors such as recycling behaviors and bicycling in place of gasoline-powered forms of transportation. And they measured the degree of responsibility individuals felt towards both local and global environmental problems. A moderated analysis found that, across cultural contexts, self-transcendent values predicted a higher degree of belief that human beings are integrated parts of nature (consistent with the correlations with ecocentrism found above), with self-enhancement values showing the opposite pattern towards this belief (again consistent with the results from the study discussed above). Furthermore, with respect to environmental behavior, researchers found that when global concern over environmental problems and a sense of personal responsibility for local problems were high, the presence of self-transcendent values predicted higher rates of pro-environmental behaviors. Consistently across contexts, self-enhancement values predicted lower rates of pro-environmental behaviors. This research suggests that, provided one's self-transcendent values are high, the promotion of global concerns over environmental problems and encouraging a sense of personal responsibility for local environmental problems can potentially encourage more pro-environmental behaviors across cultural contexts. Consistent with other research on the relationship between attitudes and behavior, pro-environmental attitudes alone are insufficient in promoting pro-environmental behaviors: one must experience a subjective norm in favor of that behavior (i.e. global concern) and believe that one's actions will have an appreciable effect (i.e. local responsibility).

Attitudes and values do play an important role in communication and climate-change education. For example, research in the United States has found that objective environmental information will not be well received if it is tied to a plan of action that contradicts the values of those in the audience. A U.S. study conducted by Kahan and colleagues (2007) found that "individualistic" individuals (those who believe that individuals should secure the conditions of their own well-being without collective interference, regulation, or outside assistance) were not receptive to scientific facts about climate change when those facts were used to promote increased antipollution regulation as a solution. However, when those very same facts were used to promote the revitalization of the nuclear power industry, the receptivity among "individualists" to those facts was significantly increased. Accordingly, the effectiveness of communication and climate-change education may be enhanced if it is tied to goals that are consistent with the values of the audience. Conversely, if scientific facts are either implicitly or explicitly tied to policies/approaches that are inconsistent with audience values, then the facts presented alongside those policies may be rejected out of hand. When communicating on the risks of climate change, a person can have a much greater chance of success if those facts are tied to behaviors that have a direct connection to the values of his or her audience.

The theory behind this research was explored in a field study conducted by the Climate Energy Project in the form of the Take Charge Energy Challenge (Fuller, 2011). This challenge was a contest among different communities within a Kansas region in order to determine who could produce the most energy savings. It involved the recruitment of local community leaders, particularly moral and religious leaders, to encourage residents of several Kansas towns to engage in a wide range of pro-environmental behaviors through a series of over 1,000 events and programs aimed at bringing the community together around the challenge. The leaders provided concrete steps that could be taken to reduce energy consumption (e.g. weatherizing homes; changing light bulbs). However, unlike the typical conservation rationales communicated on the national level (e.g., help the environment, save money, etc.), the rationale of these local leaders was tied to traditional virtues of thrift, patriotism, and spiritual conviction. This was largely due to the fact that, although the program goals were set at a higher level, the actual means of achieving those goals was determined collaboratively at a local level, promoting values-consistent messaging and behaviors. The program was successful and achieved energy use reduction across the active regions. Specifically, the communities saved 110.2 billion BTUs of gas and electricity, which translates to \$2.3 million in energy savings. This case study demonstrates that programs aimed to encourage pro-environmental behaviors at a more localized level of values can achieve success even in locations where more typical methods of climate education or regulations fail to garner public support. Taken together, these studies highlight the worldwide importance of taking the personal values of the audience into account when choosing how to approach communication and education strategies.

The two above examples highlight an important point: for any attempt to effectively educate the public about the importance of attitudinal and behavioral change with respect to the environment, the source of the message and the way the message is presented can be almost as important (and in some cases more important) than the message itself. While those working at the most abstract and distant levels of policy may have the broadest understanding of the goals that particular localities and communities set out to achieve, those at the local level may be better equipped to determine the best tools by which to achieve them. Suggesting means inconsistent with community values can create pushback and even inhibit the achievement of successful education. Further, another important aspect of educating communities should involve enlisting the help of community leaders. Not only do local leaders have more perceived legitimacy than distant policy makers, but they also have more knowledge about the particular state of affairs within the local community, and will be best suited to crafting effective messaging and motivating support.

There are, however, potential pitfalls surrounding behavioral change relying entirely on a sense of moral or ethical identification. One such issue arises in the area known as moral licensing—the tendency of some people to use a moral behavior as justification for subsequent immoral behavior. Mazar and Zhong (2010), in a study conducted at a university in Canada, examined how the purchase of “green” (i.e. environmentally friendly) products can influence subsequent behavioral choices. As expected, the researchers found that students in the study believed that the users of green products are more cooperative, altruistic, and ethical than those persons who do not use green products. The researchers posited therefore that the purchase of green products should be relevant to moral identity and self-regulation. Students were exposed to the products of either a green or a conventional online store. Half of the participants were simply asked to examine and rate the products on the store for their aesthetic value and design, while the other students were told they could fill their baskets with up to \$25 worth of products from the store (and that they might be randomly chosen to receive the products they selected). Following this exercise,

participants were told that they would interact with another individual in a following group task. In this next task (a variation on the “ultimatum game”), participants were given \$6, which they were free to distribute between themselves and their partner however they pleased. Researchers found that those who were exposed to green products were likely to share more money than those who were exposed to conventional products. However, those who purchased green products shared significantly less money than those who purchased conventional products. In a follow-up study, the researchers found that those who purchased green products in their online store were more likely to engage in deception on a subsequent task in order to increase their payout. This research suggests that, while buying green products is often viewed as an ethical choice, and may be viewed as consistent with desirable personal values, the ethical nature of such behavior may be used by some to justify subsequent immoral actions or choices.

We should note that moral licensing does not occur whenever an individual recalls a past moral behavior: if the moral behavior is recalled in abstract, rather than concrete, terms, it can result in moral consistency rather than moral licensing (Conway & Peetz, 2012). Moral licensing occurs because a past moral action is used as a justification for future immoral action by “balancing the scales,” as it were. Instead, if individuals view their past moral actions as essential components of their own personal identities—e.g., “I buy green products because I am an altruistic, cooperative person”—then their past behavior can be used to motivate morally consistent behavior. And so, while personal moral values are an important factor in influencing pro-environmental behavior, care must still be taken through the use of appropriate education to avoid moral licensing and encourage future morally consistent behavior.

Education can play a major role in avoiding moral licensing, since many individuals in school settings receive moral feedback from their teachers throughout their formative years. Educators could promote sustainable practices by linking those practices to desirable character traits in their students, rather than simply rewarding good behavior with praise for the action itself. There is research supporting this approach showing that children will respond to character-based/identity-based feedback at an earlier age than they will to action-based feedback. Researchers in Canada tested identity- versus action-based feedback in children aged 5 through 10 at two different Roman Catholic schools. Results revealed that when altruistic action on the part of the children was attributed to internal stable traits (e.g., “You know, you certainly are a nice person. I bet you’re someone who is helpful whenever possible.”) rather than rewarding the action itself (“You know, that certainly was a nice thing to do. It was good that you helped me with my work here today.”), they were more likely to engage in future altruistic behavior at an earlier age (Grusec & Redler, 1980). Early classroom educators therefore have a critical role to play in forming the characters of their students, and it will therefore be especially important for them to be aware of the values to which they can link sustainable practices.

#### **IV. Making climate change meaningful: Participatory mechanisms in communication and education**

It has been shown that traditional statistical and descriptive presentations of global climate change provide relatively poor motivation for people to take action, even when those presentations are fully understood. The reason for this seeming disconnect may be explained from research in the decision sciences, which has shown that the motivation to take action on abstract, complex, and risky issues is influenced more by personal experience and emotion-based processes than by analytic descriptions alone (Weber, 2006). This

section explores a variety of tools that educators may use to make climate change more meaningful to their audience, including adapting their communication strategies, adopting participatory approaches, and making use of simulations.

### ***Translate scientific data into concrete experience***

It is well known that educators can make their lessons more powerful and relevant by appealing to personal experiences and by evoking an emotional response from their audience. In the area of climate change, such techniques can also encourage activism. Knowing this, communicators who create presentations on climate change may rely on several simple experiential tools, in addition to their standard analytic techniques. First, messaging should be tailored to create, recall, and highlight concrete experiences so as to better appeal to the personal relevance of climate change and elicit an emotional response. To do this, educators can make use of their own personal or anecdotal accounts of negative climate change experiences, and they may invite audience members to offer their own. Second, communicators should utilize carefully researched metaphors, allusions, and real-world analogies, as these can help relate an abstract, unfamiliar topic to people's everyday interactions and experiences (Nisbet, 2009). For example, by using a metaphor equating the greenhouse gas effect to piling on a thick layer of blankets, an audience can better understand how the greenhouse gas effect increases temperatures (Frameworks Institute, 2013). Visualization of large numbers (such as referring to "tons" of C0<sub>2</sub>) can also be helpful. And research has shown that the use of vivid imagery, whether expressed verbally through imaginative examples, or through the use of visual aids such as film, can be an effective way to improve an audience's understanding and appreciation of the significance of climate change.

An additional barrier to effective communication and education with respect to climate science is the specific technical knowledge that such science assumes. Research suggests that when speaking to the general public, communicators should try to avoid using scientific jargon, complicated scientific terms, and acronyms. Studies show that science-based messaging can actually increase public polarization on climate change, due to cognitive biases and social identity (Hart & Nisbet, 2011). This is potentially an issue for lay audiences everywhere, but it is particularly problematic for individuals living in rural communities in developing countries, which likely do not have equal access to the technical expertise to interpret the jargon of climate science and participate on equal footing. This problem is compounded by the fact that in certain contexts, centralized approaches to environmental issues are treated as expressions of modernization, and often include the use of technical jargon in inter- and intra-group communication.

Renzo Taddei (2011) investigated the impact of these forces on the participation of communities in water allocation committees in Northeast Brazil. Analysis of the modern development of such water allocation systems showed the trend described above. During the 1990s and 2000s, water committees, which purport to represent the local communities to the central government, began to increasingly approach water allocation questions using particular technical jargon and language. This had the tendency to alienate and exclude individuals not fluent in technical communication, leading many individuals representing different community interests (such as representatives of local religious groups or leaders of irrigation projects) to resign from the committees in frustration. The end result was to have committees who did not necessarily represent the interests of the communities making decisions on their behalf, particularly on issues like water tariffs. This is very much the opposite of the approach described in our previous section concerning "values"-based methodologies: rather than attempting to engage leaders of local communities by

connecting climate science with proper behavioral approaches consistent with cultural and localized values, these representatives, through their reliance on technical knowledge and heavy scientific jargon, caused a gradual withdrawal and estrangement of large parts of the population (and its community leadership) from a critical environmental initiative.

### ***Participatory Strategies***

It should be noted that in most cases where participatory strategies have been adopted the effects have been generally positive (Peterson et al., 2010). In the region discussed above, Northeast Brazil, efforts have been made to introduce Water Allocation Seminars, in which representatives of stakeholders from connected reservoirs can negotiate water allocation. Participation in these seminars has been found to increase compliance by the population with the resulting allocation decisions, reduce local conflicts, and prevent instances of infrastructure sabotage. Similar processes inviting local participation in water allocation decisions in Uganda has led farmers to understand and be more willing to adopt modern forecasting data in their planning decisions.

Participatory mechanisms may represent an important tool for educators in traditional schooling contexts when it comes to encouraging pro-environmental attitudes and behaviors in their students. Researchers in the American South enrolled 16 classrooms in the Caretaker Classroom Program, which was designed to foster pro-environmental attitudes and behaviors among American youth. Students in these programs participated actively in a number of environment-related activities including: recycling aluminum cans and paper, planting trees and flowers, maintaining school grounds, adopting animals on the endangered species list, writing letters to government officials, and participating in environmental organizations. Researchers found that compared to a control group of their peers at the same schools, students enrolled in the Caretaker Classroom Program reported a more positive change in pro-environmental attitudes at the end of the school year. Further, their parents reported a greater interest among their children in talking about the environment and reported greater changes in concern for the environment themselves compared to parents of children in the control group (Leeming, Porter, Dwyer, Coborn, & Oliver, 1997). This research demonstrates an important role for participatory mechanisms in the classroom that can have ripple effects that extend to other contexts. Relatedly, a meta-analysis of intervention activities aimed at improving students' environmental behaviors showed that those that took place within a traditional classroom setting were more effective at achieving behavior change compared to those taking place outside of the traditional classroom. Furthermore, classroom interventions that actively involved participation among students showed larger effects compared to those that did not, once again highlighting the importance of the role of participation in environmental education (Zelezny, 1999).

These results are not limited to the traditional classroom, however. Other research has shown that by participating in community "Citizen's Round Tables," many subjective assessments of knowledge concerning climate change can be addressed, and the motivation of residents to address local environmental issues can be increased. In an Australian study, Pisarski and Ashworth (2013) utilized the principles of communication accommodation theory, in which communicators adopt the same standards of speech, dress, and presentation style as the participating group. Efforts were made to organize the groups as homogenously as possible, in order to create a sense of camaraderie and facilitate open and frank discussions. These discussions included a more formal presentation by a climate expert as well as informal within-group discussions. Researchers found that participation in these discussions led to a significant

long-term (i.e. 1 month) increase in concern about global warming, a significant long-term increase in beliefs that the government should do more to facilitate research to address and mitigate the challenges associated with climate change, and a significant long-term decrease in the need for additional information about global warming.

The learning of new knowledge and skills to alleviate risks associated with climate change has the added benefit of helping to achieve global sustainable development goals. For example, the use of participatory processes often leads to an improved understanding of probabilistic climate change forecasts, which, in turn, can result in more adaptive agricultural decisions. Over the last decade, a team of researchers at CRED has been exploring how resource-limited African farmers from a diversity of agricultural backgrounds can work together to understand and use scientific climate forecasts. This work is critical, as the Intergovernmental Panel on Climate Change (IPCC) report has called for more research to enhance the adaptive capacities of vulnerable communities in Africa, including the need to understand early warning systems and seasonal forecasts (Boko et al., 2007).

In one field study focusing on three agro-ecological zones of Burkina Faso, researchers assessed the comprehension of seasonal climate forecasts by local farmers who had attended educational climate group workshops as well as those who did not attend (Roncoli et al., 2009). These seminars included both the dissemination of climate forecast information and education regarding how to comprehend that information in terms that the farmers could understand. For example, in order to help the farmers understand differences in a probability distribution, an exercise was used with different colored chips representing a "chicken" that the farmer could capture to sell at market. Farmers were asked to blindly take chips from a basket, containing different colored chips. The chips were represented proportionally in a manner reflecting different probability distributions in order to give the concrete experience of different likelihoods, which could then be used to make more accurate predictions. Following this exercise, in a second session, farmers were given the opportunity to discuss how the forecast information could be used to make crop and livestock decisions and select methods by which they would disseminate this information to the wider community. The results showed that farmers who participated in the group workshops were more likely to understand the probabilistic aspect of the forecasts as well as its practical limitations, and to employ greater use of forecasts in agricultural management decisions. The researchers suggest that by participating in group discussions, individual farmers were able to pool their ideas and to collectively plan appropriate responses. Such group discussions may have encouraged the farmers to integrate newly-learned scientific information with their own knowledge relating to local agriculture and climate. Taken together, these findings support the notion that people may understand probabilistic information better when it is presented to a group, where it may be collectively discussed and evaluated, and take that knowledge actively into practice.

Participatory research with farmers from two agro-ecological zones of Senegal, West Africa further demonstrates that the introduction of predictive climate forecast information can induce changes in farmers' practices (Roudier et al., 2014). The workshop protocol in this research employed two rounds of simulation exercises during which participants simulated a series of crop management decisions. These exercises provided examples of how farmers could use climate forecast information at different timescales (seasonal and decadal rainfall forecasts). Results demonstrated that after the group workshop, in 75% of the cases, farmers were able to identify at least one adaptive strategy that they could use in response to climate

forecast information. At the end of the workshop, participants engaged in a general discussion regarding traditional forecasting knowledge and also provided feedback on the scientific forecasts and workshop process. This participatory research further demonstrates that investing in the development of climate educational services to improve farmers' adaptive strategies may help manage some of the vulnerability of African rural households to climate variability.

It's important to note that participation is a complex group process deeply embedded in the social and cultural context, involving a variety of ideas, motivations, goals and social norms. A cross-cultural analysis of activities surrounding participatory processes suggests that the western-dominated notion of participation overlooks the cultural richness of what it means to participate for many people cross-culturally, including norms of exclusion, alliances, and non-linguistic activities (Peterson et al., 2010). Educators and discussion leaders must understand the social norms relating to participation of their audience, as these norms determine how environmental information should be presented and discussed. For example, cultural norms involving debate and group consensus: in Uganda, reaching a group consensus is regarded as a goal in itself for any group interaction, and may be more important than letting all participants convey their opinion or express disagreement (Peterson et al., 2010). There are also norms concerning language usage. For example, using highly technical climate-related language may seem insulting when it makes knowledge inaccessible to less educated participants, essentially limiting their involvement in the discussion. This can be detrimental, since eliciting participation from all group members is extremely important when trying to broker successful environmental decisions (e.g., plans for response strategies to seasonal climate forecasts). Further, individual participation can greatly enhance the learning process.

Understanding each audience member's particular form of participation can help educators better determine if all stakeholder are taking part (in some form) in the discussion (Center for Research on Environmental Decisions, 2009). For example, gender and social position are important for understanding how a member participates and how others regard that member's contributions. CRED research on Ugandan farmer's decisions in the face of climate uncertainty highlights that non-linguistic behaviors are also forms of participation during discussion. For example, spatial arrangements reflect differences in social roles or power, which in turn affect how people participate (Peterson et al., 2010). While Ugandan men often sit close to the speakers, the women sit on the margins of the group. Although some women may address the group directly (particularly if asked to contribute), they more often talk among themselves or participate through non-verbal means, such as glances, clapping, or laughter.

Though the evidence for the benefits of participatory mechanisms on a local or community level is extensive, and the data shows that community leaders are typically more adept at achieving concrete goals relating to more sustainable environmental practices, this research should not be overstated. Too much devolution of authority to community leaders away from a centralized focus of goals can lead to a host of problems. Looking at the case of Madagascar, researchers have noted that though the devolution of centralized decision making to local actors can also lead to unintended consequences (Froger, Meral, & Herimandimby, 2004). Some of the examples they cite include possible "capture" by local leaders who direct resources towards self-interested ends rather than the goals of the nation as a whole, and also of the very real conflicts of interest that may exist between localities. Some localities may have certain resources that they are motivated to preserve while others have no such motivation, and thus practices set entirely at

a local level without state or judicial oversight could potentially lead to goal conflict and a degradation of sustainability practices. Participatory mechanisms are powerful tools for increasing the legitimacy of particular public policies, finding the most effective means of achieving the ends of those policies, and disseminating information related to those policy goals. However, they also typically presume strong support from more centralized actors and a judicial-legal system that can enforce negotiated agreements and direct local actors towards common ends. This may be a particularly important caveat for nations with unstable governments or extensive political corruption.

Even given these limitations, the studies described above underscore the importance of participatory processes for effective communication and climate-change education. They highlight both the dangers of too much jargon and technical language in potentially alienating important stakeholders that come from different backgrounds, and the benefits that come with facilitating a common space in which ordinary citizens can join in discussions surrounding environmental issues. We cannot underestimate the importance of local community leaders and residents taking part in the actual decision making and local planning processes associated with shared resource allocation. Participatory processes allow individuals to express their needs as stakeholders to a larger audience, pool their diverse knowledge and personal experiences for a better understanding of a communal problem, and work together towards an optimized solution. Once introduced, group learning should be sustained by promoting frequent opportunities for interaction and commitment among stakeholders. As climate change creates changes to weather patterns and threatens resource stability, these kinds of participatory discussions are going to be increasingly important for effective decision making, both as to resource allocation, damage prevention, and motivating the necessary levels of commitment within local populations.

### ***Climate Change Games***

When participatory strategies are not possible, other education techniques can be employed to simulate interactive decision making and heighten engagement. Games on the topic of climate change have emerged as uniquely effective tools in teaching diverse audiences to understand and take action on climate-related issues. “Climate change games” are defined as games (including simulations) that involve climate change as their central theme, and focus on its scientific processes, social and physical impacts, and the potential role of human behavior (Wu & Lee, 2015). These games allow players to experience some of the complexities of climate systems, while targeting a variety of different learning domains and formats. Games can be played by children in school, as well as by adult learners. Adult learners, be they community leaders, the general public, or college students, are today’s decision makers and are more likely to make informed choices if they understand the social, economic, and environmental consequences of climate change. Perhaps most importantly, when designed well, games are fun, educational, intrinsically engaging, and motivational in the subject area.

A game can captivate people in ways that more traditional educational methods cannot. This is especially true in the area of climate change, as most people do not personally experience local effects that are drastic enough on a regular basis to motivate them to take action. By positioning the player in various climate-centered scenarios, a game can provide ‘designed experiences’ where players can learn through doing and being, rather than simply absorbing information from descriptive presentations or textbooks alone. This, of course, can be extremely effective, as social science has consistently shown that first-hand experience is a much stronger motivator for action compared with analytically focused, descriptive information

(Loewenstein, Weber, Hsee, & Welch, 2001). Furthermore, games are able to simulate complex scientific models while providing a level of personal control that is simply not possible in the real world. This may be particularly helpful when the topic involves global climatic systems that would otherwise be impossible to experience concretely in real life.

For example, in the computer game *Polar Explorer*, players participate in interactive decisions affecting glacial retreat. A group of scientists at the Lamont-Doherty Earth Observatory and Columbia University designed an interactive game simulation to help students better understand the influence of glacial melting on the rise in sea level. Simulated experiences such as these are not only highly engaging, but they also target affective outcomes such as players' motivations, attitudes, and values (Salen & Zimmerman, 2004). Using a group of middle and high school-aged students, a small test study was designed to determine if this interactive simulation would enhance learning and motivation. Students were instructed to play *Polar Explorer*, a glacial simulation game that allows the player to visualize the complex processes involved in glacial retreat by linking glacial contour maps to visualizations of glacial melting (Singh Virk, Turrin, & Compres, 2014). This visualization was linked to an interactive animation showing sea levels along a local NYC waterfront familiar to the students (South Seaport in Manhattan). As part of the glacial simulation activity, students clicked on an interactive ice contour map of Greenland. Each click on an ice contour caused it to melt, triggering a linked rise in sea level shown against the waterfront at South Seaport. In this way, students were able to observe a direct, causal connection between distant glacial retreat and sea level rise in their local city. This is important, as the majority of US residents think of climate change in geographically and temporally remote terms. To assess learning, students were asked to complete a brief comprehension survey after playing the glacial simulation game, including the question, "How do glaciers cause sea levels to rise?" The assessment revealed that students were highly engaged by the simulation, and scored fairly well in their understanding of the topic. These initial findings from this study suggest that games, with their use of interaction, intense visualization, and symbolic representation of concrete events (such as using contour maps to show coastline impact) may be highly valuable in promoting climate change learning and engagement.

Climate change games now vary greatly in both format and learning objectives. This, in turn, allows for flexibility when selecting targeted tools for education and assessment. The diverse format of climate change games currently available include mobile games, computer games, card/board games, online facilitated experiences, and pervasive games. They may be comprised of a combination of offline and online activities. For example, in the pervasive game *EcoKoin*, players respond to and generate ideas for sustainable living challenges, and can share them within a social network to earn points in the game (J. J. Lee, Ceyhan, Jordan-Cooley, & Sung, 2013). Socially connected mobile games such as *EcoKoin* may provide powerful opportunities to educate large populations and promote environmental engagement on a large scale.

Portable, simple card games have also been developed. For example, *EcoChains* is a 2-4 player game of strategy that gives players the opportunity to learn about the components of an Arctic marine food web and the potential impact of future changes on the ecosystem. Card games such as these could potentially be used among individuals in developing countries without easy access to computers, and will be more appropriate in school contexts where there are problems due to a shortage of resources. However, research

is greatly needed to explore how game play should be applied in contexts where there is a lack of basic infrastructure and poor levels of teacher training.

Additional research is also needed to confirm whether game play can result in long-term changes in attitudes or in tangible behavior among those being educated. To explore this important question, The National Science Foundation has funded several projects with the mission to create novel educational approaches geared toward adults to transform public understanding of climate change. The Polar Learning and Responding Climate Change Education Partnership (PoLAR Partnership) is developing a suite of novel interactive and game-like tools based on shifting polar environments in order to inform public understanding of and response to climate change. The PoLAR Partnership is a project of the Columbia Climate Center at Columbia University, and is supported by grants from the National Science Foundation for a term of seven years. If grant projects such as these can empirically demonstrate that game play translates to real behavior change, then governments and private sector companies (through their social responsibility networks) could consider investing in this area.

## Conclusions

Gaining public support for climate change policies depends on a clear understanding of how people process information and what psychological factors motivate environmentally responsible behavior. There are many challenges to successfully driving pro-environmental action, but each one presents a new opportunity to improve the way we educate the public about climate change and the behaviors required to mitigate its accelerating and damaging effects. Indeed, the potential to motivate individuals to reduce energy consumption is critical: if the demand for energy efficiency were stimulated comprehensively to encourage households and businesses to invest in energy efficient appliances and buildings, potential energy savings could amount to 9.1 quadrillion BTUs by 2020 (Jimoh, 2011).

It is important to note that the work cited in this report reflects the current scope of global research in this field, which has been dominated to date by studies in the United States and Europe (Lee et al., 2015). Although these findings have greatly advanced our understanding of the complexity of climate change education strategies and behavioral interventions, they are no doubt country and culture-specific, and thus difficult to generalize across an economically and culturally diverse planet. Further, the United States in particular is a nation with strongly divergent political attitudes towards the issue of climate change. As discussed in the section on values consistency, messages that appeal to one group may alienate others. To effectively communicate on climate change, we need to understand our diverse audiences, respect their concerns, and educate and engage by localized example. We support the growing call for cross-cultural research in education, anthropology, psychology, sociology, geography, and other fields on the issue of climate change and sustainability to understand the underlying contextual and cultural factors that influence individual and group attitudinal and behavioral outcomes. Additional international research similar to that conducted by Lee and colleagues (2015) is needed, as national and regional educational programs must be tailored to the unique context of each country, especially in the developing world.

As we have noted throughout this report, understanding how to motivate behavioral change in individuals, households, and larger groups requires an understanding of how people respond to non-price factors. A growing body of research in psychology and behavioral economics suggests that non-monetary interventions can be just as powerful as monetary incentives in driving pro-environmental behaviors and influencing green consumer choices. These behavioral approaches, which include default options, appeals to social norms, and promoting values consistency, are quite inexpensive and yet can be extremely powerful. Default options can be structured so as yield energy-saving decisions by consumers. Similarly, recent research on the influence of social norms confirms that descriptive norms have the potential to significantly reduce household energy consumption (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). Scientifically-motivated energy efficiency programs that rely on appeals to social norms, such as O-POWER, could generate 12.7 million tons of CO<sub>2</sub> (MtC) of annual carbon abatement (Baddeley, 2011). At the same time, caution and careful judgment must be applied in any structured program, most particularly when the proposed behavioral nudges would cost consumers a nontrivial monetary amount, notwithstanding potentially significant environmental benefits.

We also believe that behavioral nudges should complement, and not be used as a substitute for, other types of economic incentives or mandates. For example, relying on green defaults will have a relatively small impact in comparison with a carbon tax or other major policy change. Indeed, Stern and colleagues (2010) argue that significant opportunities to reduce energy consumption will result when the insights from the behavioral sciences are utilized in combination with key initiatives in public policy. The two go hand in hand. It is easier to gain acceptance of the direction and scope of new public policies by conditioning consumers in advance (including by behavioral changes) to recognize the merit of those policies. Similarly, promoting behavioral change can be more effective when it is consistent with and supported by clear government policies. The latter is particularly true in countries with underdeveloped energy infrastructure. A concerted and integrated effort should be made by researchers, policy-makers, and businesses to translate insights from the behavioral sciences into scaled interventions, moving from the laboratory to field research to practice. Such an effort would yield high returns, for although developing basic theory and understanding underlying psychological mechanisms are critical to advancing knowledge, such knowledge must be applied and scaled to large consumer populations to bring the desired results. Note that although the experimental results highlighted in this report often fall within the domain of climate change attitudes and behaviors (e.g., energy savings and other mitigation behaviors), we believe that the theoretical basis of these results will extend to other large-scale areas of sustainable development, including transportation, environmentally-friendly methods of farming, and corporate sustainability. Governments should continue to provide support to potentially high impact behavioral programs, and incorporate them as a part of their broader support for energy conservation, communication, and climate-change education.

Finally, we believe that the humanitarian and environmental community could benefit from incorporating behavioral science approaches and findings into their own work. Learning about the principles of decision science could also improve the effectiveness of environmental organizations and strategies such as building awareness, providing information, and reinforcing positive behaviors. An effective way for organizations to incorporate insights from the decision sciences is to engage staff in learning activities in which they experience cognitive biases that affect decision-making and behavior, and these activities should be carefully tailored to participants and their work (Moore et al., 2015). Materials for designing experiential learning activities about decision science are available via a variety of sources, including peer-reviewed

literature, and popular science articles. Humanitarian and environmental organizations that wish to apply decision science findings to their own work should partner with academic researchers to design and empirically test interventions. Such research partnerships can also serve as critical platforms for advancing scientific understanding of human behavior related to sustainable decision-making.

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