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## Climate Change and Individual Decision Making: An Examination of Knowledge, Risk Perception, Self-interest and Their Interplay

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## Summary

In this essay, three separate yet interconnected components of pro-environmental decision making are considered: (a) knowledge, in the form of basic scientific understanding and procedural knowledge, (b) risk perception, as it relates to an individual's direct experience of climate change and (c) self-interest, either monetary or status-driven. Drawing on a variety of sources in public policy, psychology, and economics, I examine the role of these concepts in inducing or discouraging pro-environmental behavior. Past researches have often overemphasized the weight of just one of those variables in the decision making. I argue, instead, that none of them alone is capable of bringing about the behavioral change required by the environmental crisis. Evidence shows that increasing the public's scientific knowledge of climate change cannot unilaterally bring about a strong behavioral change. The same can be noticed even when knowledge is joined by risk-perception: deep psychological mechanisms may steer people towards inaction and apathy, despite their direct experience of the detrimental effects of climate change on their lives. Focusing on self-interest alone is similarly unable to induce pro-environmental behavior, due to a host of psychological factors. Instead, in all of the above cases an important missing ingredient may be found in providing the public with locally contextualized procedural knowledge in order to translate its knowledge and concern into action. The importance of this kind of practical knowledge has solid empirical and theoretical underpinnings, and is often overlooked in the climate-change debate that tends to focus on more high-level issues. Yet, for all its essential simplicity, it may carry important public-policy implications.

**Keywords**: Individual Behavior, Climate-Change, Psychology, Uncertainty

**JEL Classification**: D03, D80, Q00

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## Abstract

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## 1. Introduction

### *Motivation: The Political Intractability of Climate Change*

There is little doubt today that anthropogenic greenhouse gas emissions are responsible for steady mean increases in temperature and that, if left unabated, will likely have grave environmental and social consequences. Indeed, the world community recognizes that strong collective action is needed to stabilize greenhouse gas concentrations to levels far below those projected in the absence of policy (IPCC, 2007). Yet, addressing climate change on a political level has proven intractable. The global political process has so far been completely ineffective, unable to overcome the twin challenges of collective action and intergenerational equity, so that a strong and purposeful climate-change agreement remains elusive.

Collective action or commons problems arise when a set of individual economic agents jointly exploit a common resource. In such environments pure self-optimizing behavior often leads to disastrously inefficient outcomes: air quality gets seriously compromised, fisheries collapse, groundwater basins dry up. In order to avert such undesirable effects, some degree of coordination is necessary among the agents that utilize the resource. Indeed, it is often the case that, were agents able to come together and negotiate a mutually beneficial and binding agreement, everyone could be made better off. Yet, even in such relatively clear-cut instances, achieving the necessary degree of coordination can prove elusive. The main problem arises when selfish strategic considerations are brought to bear: if other agents decide to curb their self-interested behavior, then it often becomes advantageous for an individual agent to free-ride off his peers' restraint (Hardin, 1968). Individuals often find this temptation too hard to resist, so that in the end everyone acts selfishly and a suboptimal equilibrium is reached. In the case of climate change, such free-riding problems can be particularly acute (Barrett, 2003) since any global agreement will need to accommodate an extremely wide spectrum of economic interests. The situation is made worse by the fact that, while the costs of curbing emissions are distinctly local, its benefits are geographically spread-out across the whole atmosphere. And while it should be noted that collective-action problems can occasionally be resolved in all manner of ways, ranging from pure command-and-control measures to pure laisser-faire to considerably more subtle schemes (Ostrom, 1990; Barrett, 2003), it is fair to say that global climate change poses an unprecedented challenge.

Intergenerational calculations and tradeoffs constitute an inextricable part of climate-change policy. They arise because, while the costs of climate-change mitigation are primarily borne by the present generation, its benefits are likely to be felt only far into the future. The public sector's standard approach in assessing the desirability of such long-term policies and projects is to carry out

a cost-benefit analysis based on a social discount rate that is calibrated on market data. Yet, for a number of reasons this approach does not seem suitable to addressing global climate change. The essential problem lies in the very long time horizon over which uncertain benefits and costs must be discounted. In contrast to the relative clarity of a cost-benefit analysis regarding, for example, the construction of a dam or tunnel, how should one discount an environmental catastrophe that may or may not occur 100, 200, or 300 years from now? While the basic facts regarding global warming are clear, climate science is still very much in flux, too much so to be able to discern precise quantitative relationships between emissions and concentrations of greenhouse gases and temperature increases and thus provide clear scientific guidance on the above question (Weitzman, 2009).[1] To make matters even worse, assessing these sorts of intertemporal tradeoffs is an ethically fraught issue, as it directly affects the welfare of unborn generations. The search for a fair, efficient, and consistent framework to perform such intergenerational calculations is an issue that has challenged philosophers and economists for a long time (Rawls, 1971; Ramsey, 1928). It is fair to say that the jury is very much still out and not likely to be reaching a verdict anytime soon, if at all.

***Emphasis on individual behavior***

While the world community should remain steadfast in its commitment to an eventual international agreement, the political stalemate creates a clear need for complementary approaches. In this sense, there is a growing body of research that points to individual behavior as an important driver of change in climate-change policy. The following World Bank quote suggests why:

> "First, […] roughly 40% of OECD emissions result from decisions by individuals – travels, heating, and food purchase. […] Second, individuals are the drivers of larger processes of change involving organizations and political systems. Particularly in democratic countries, government action is the result of public pressures to act by citizens and voters. Third, policy decisions are taken by individuals subject to standard mental processes"(Liverani, 2010).

Thus, independently of the ongoing political process, directly modifying individual behavior may hold the key to immediate, and relatively significant, emissions reductions. And, what is perhaps even more important, if somehow individuals could be induced to adopt pro-environmental

[1] Climate science is one of these few disciplines where, depressingly, the more research is done, the less useful, policy-relevant information tends to be produced: "Studying the climate system reveals new, little understood mechanisms and feedback effects that may increase or decrease warming. So, as understanding grows, predictions become less, rather than more certain. [For example], the IPCC's range of predictions of the rise of temperature by 2100 has increased from 1.4-5.8% in the 2001 report to 1.1.-6.4% in the latest report." (Funke and Paetz 2011).

behavior (PEB) and habits, then perhaps their political leaders would feel pressured to follow suit in order to respond to the demands of their constituencies.

Given the above, how does the current picture look when it comes to individuals' PEB? Unfortunately, not so great, as recent research indicates that climate change has low priority in an individual's hierarchy of needs (Lorenzoni et al., 2007; Bord et al., 1998). Data gathered by European and American surveys on (Eurobarometer 322, 2009a; Leiserowitz et al., 2010b) suggest that a meaningful change in individual behavior as it relates to the environment has yet to be realized.[2] Indeed, while in both Europe and the US awareness of climate change is high and most people claim to be willing to reduce their energy use (Eurobarometer 322, 2009a; Leiserowitz and Smith, 2010a; Leiserowitz et al., 2010b), OECD residential per capita CO2 emissions have been steadily increasing (IEA 2010)[3].

An important part of the problem lies in the failure to accurately assess the environmental impact of modern life. For example, activities such as air travel are becoming increasingly cheaper, while their impact to the environment remains as detrimental as ever. The kinds of PEB that require less sacrifice (e.g. switching off lights, separating waste items for recycling) tend to be the most adopted, but are unfortunately also the least effective, while those that have a higher impact on the environment, such as transport, are by far the most difficult to change (Leiserowitz et al., 2010b; Eurobarometer 322, 2009a; Eurobarometer 300, 2008; FEEM survey 2007).

Modern societies have, obviously, designed an enormous amount of economic policy in an attempt to address environmental degradation and induce socially beneficial pro-environmental behavior (PEB) in their citizenry. Yet, economic instruments alone have at times been unable to produce a proper behavioral change of the kind this essay is concerned with (Special Eurobarometer 75.1, 2011; McNamara and Grubb, 2011). This suggests that another kind of inquiry is needed to join the economic analysis, an inquiry that devotes primary attention to individuals' inner motivations. Indeed, recent research in the social sciences suggests that obstacles to the successful implementation of economic policies may be found in the cognitive and emotional sphere of the individual (McNamara and Grubb, 2011; Norgaard, 2009; Bazerman, 2006), which occasionally run counter to the rational optimization of self-interest.

[2] A wide range of behavior bears environmental consequences so some specificity is perhaps in order. In this article I focus on actions relevant to climate-change mitigation and more specifically on individual choices related to energy consumption, transport, food, and recycling. A proper behavioral change pertaining to the above would include significant reductions in consumption of electricity and heating/air conditioning, the use of public transport or car pooling rather than driving one's own car, a reduction in air travel – especially when other means of transport are available-, the consumption of local and seasonal food, and diligent recycling.

[3] Data range from 1971 to 2008. The increase of OECD CO2 per capita emission follows a steady trend; just in 2008 a slight decline can be observed, probably due to the economic crisis.

In this article, I analyze the main obstacles to pro-environmental behaviors within the individual decision-process. Specifically, I focus on individual attitudes toward climate change: from the very perception of the issue, to the way of "interacting" with it, to the possible response and actions the individual chooses (or not) to undertake. I consider three separate yet interconnected factors that according to recent studies (Lorenzoni et al. 2007; Norgaard 2009; Bazerman 2006; O'Connor et al. 2002) seem to play a major role in influencing pro-environmental decision-making namely, (a) knowledge, primarily in the form of scientific understanding, (b) perception, as it relates to individual's direct experience of climate change and (c) self-interest.[4]

In what follows I draw on a variety of sources in public policy, psychology, and economics and examine the role of these concepts in inducing or discouraging PEB. I argue that increasing the public's scientific knowledge of climate change cannot unilaterally bring about the kind of behavioral change I am considering, not even when it is coupled with economic incentives. The same I find to be true even when knowledge is joined by risk-perception: deep psychological mechanisms may steer people towards inaction and apathy, despite their direct experience of the detrimental effects of climate change on their lives. The essay's examination of self-interest yields similar results due to a host of psychological factors that are often discussed in the behavioral economics literature.

Instead, I argue that in all of the above cases an important missing ingredient may be found in providing the public with locally contextualized procedural knowledge in order to translate its knowledge and concern into action. The importance of this kind of practical knowledge has solid empirical and theoretical underpinnings, and is often overlooked in the climate-change debate that tends to focus on more high-level issues. Yet, for all its essential simplicity, it may carry important public-policy implications.

## 2. Knowledge

The extent to which pro-environmental behavior (PEB) is dependent upon knowledge of climatic issues is vigorously debated in the academic community (Reynolds et al., 2010; Norgaard, 2009; Krosnick et al., 2006; Read et al., 1994). Within this debate, different concepts of knowledge are

[4] This study intentionally does not comment on the role that culture plays in the decision-making process relating to climate change – a role which is absolutely undeniable. This is primarily because culture is deeply bound to a specific context, and cannot be considered independently from a particular geographic area. Its discussion would inevitably link the present essay to a specific local context, which would not be appropriate given its focus on decision-making processes that go beyond specific cultural environments.

often introduced and discussed so that properly distinguishing between them is necessary in order to gauge their effect on PEB. In what follows, I focus on three prominent forms of knowledge that affect PEB: awareness, understanding, and procedural knowledge.

First, there exists a simple awareness of climate change as a rise in worldwide average temperature that is attributable to human actions, which, studies suggest, is relatively present in the western world. Unfortunately, however, this awareness is also often accompanied by a complete lack of understanding of how climate change is generated. People who are solely aware of climate change in broad terms often fail to understand causal relationships within the climate-change issue – and consequently also their role as actors who could contribute in tackling the problem. Why grasping causal relations is so important, especially if the aim is to realize a behavioral change, is effectively captured by Ludwig von Mises (1963, pp. 22-23): «Man is in a position to act because he has the ability to discover causal relations which determine change […]. Acting requires and presupposes the category of causality. […] In order to act, man must know the causal relationship between events, processes, or states of affairs. And only as far as he knows this relationship, can his action attain the end sought».

Read et al. (1994), and later Reynolds et al. (2010) identified two causal passages at the core of the understanding of climate dynamics that represent the minimum degree of knowledge that allows people to understand the essence of the climate change phenomenon:

1. Global warming is mainly caused by excessive accumulation of $CO_2$ in the atmosphere
2. The most important source of $CO_2$ is the combustion of fossil fuels (carbon and oil primarily)

I refer to such kinds of substantive knowledge surrounding the science of climate change as *understanding*. There are many different degrees of understanding, ranging from the absorption of a few basic facts such as the above to sophisticated scientific training in climate science. It is clear that understanding of climate change implies awareness, though not vice versa.

Finally, I draw attention to a third kind of knowledge, which I call *procedural knowledge*, that is directly relevant to an individual's actions. Procedural knowledge provides the individual with locally contextualized practical information on how to translate her environmental concern, probably motivated by a mix of awareness and understanding and perhaps even direct experience (more on this later), into concrete action. Examples of this sort of procedural knowledge include practical guidelines on the optimization of energy consumption, green shopping habits, and recycling best practices, among many others.

***General Awareness***

Surveys conducted in the recent years in both Europe and United States report a substantial level of awareness about climate change, probably due to increasing media attention to the issue. When asked, respondents tend to describe themselves as generally informed about climate change: 63% of Americans believe that climate change is happening, and 51% claim to be either fairly well and 11% very well informed about it (Leiserowitz and Smith, 2010a). In Europe these percentages are lower but still quite high: 47% and 9%, respectively (Eurobarometer 2008).

Yet, despite this general awareness of climate change, the percentage of the public with a fair understanding of basic climate-change facts is rather poor: 31% of Europeans think that $CO_2$ emissions and other greenhouse gases have only a marginal impact on climate change, with 12% of "don't know" responses (Eurobarometer 322, 2009a). In the US, 42% of respondents do not know which gases are responsible for increasing the Earth's surface temperature (Leiserowitz and Smith, 2010a). Occasionally, there is outright ignorance of the most basic facts regarding global warming: 21% of Americans think that the greenhouse effect refers to the ozone layer (Leiserowitz and Smith, 2010a), and a similar finding was reported in the UK (Lorenzoni et al., 2007).

***Understanding***

That mere awareness, if not supported by additional knowledge, is unable to generate PEB is quite obvious - if one does not realize that greenhouse gases are responsible for global warming, they will not even think about reducing $CO_2$ emissions. The question is, therefore, whether what I refer to as "understanding" is able to induce the kind of behavioral change we are interested in.

Determining the effects of knowledge on PEB is an issue of ongoing and vigorous academic debate. Scholars who adhere to the *knowledge deficit model* (Reynolds et al., 2010; Read et al., 1994) tend to be sanguine about the potential of understanding to engender changes in behavior. According to their framework, individual inaction is precisely attributable to a pre-existing lack of knowledge –in this case understood as scientific understanding (Reynolds et al. 2010; Bostrom et al., 1994; Read et al., 1994). Supporters of this decision-theoretic model essentially embrace von Mises' (1963) argument claiming that, since possession of basic information about causal relations between act and outcome is a necessary condition for action, then providing people with this kind of knowledge should probably be sufficient to enact their behavioral response.

In contrast to the views of these scholars, a considerable amount of research suggests that increasing the amount of relevant information surrounding an action does not imply that this action will be automatically performed. In fact, many scholars seem to agree that, despite being a necessary element for taking action, understanding of an issue is not a strong predictor of human

behavior. In the specific case of climate change, the connection between knowledge and action seems to be particularly weak. Recent data gathered by the Yale Project on Climate Change Communication (Leiserowitz et al., 2010b) seem to confirm the tenuous connection between knowledge and action, suggesting that the fact that people know and believe that a certain action is environmentally relevant does not necessarily imply that they will engage in it (see Figure 1).

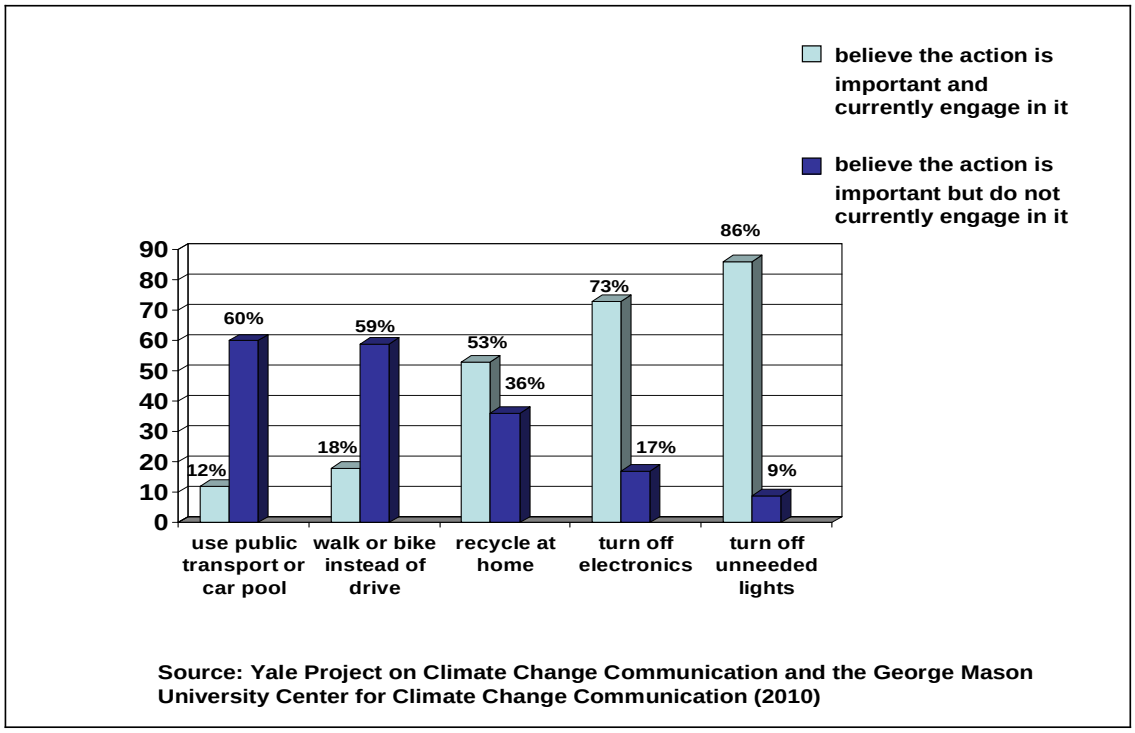


*Figure 1 - Gap between belief and action*

A number of factors may be responsible for individuals' inaction when presented with more information about climate change. Recent research (Norgaard, 2009; Strauss, 2008; Krosnick, 2006; Immerwahr, 1999) has argued that knowledge, per se, cannot produce a behavioral change, especially in the field of climate change, since too many other countervailing factors are in play. Echoing some of the themes of the current study, these factors include: emotional processes, that may lead to a denial of problems that are disturbing but not easy to solve; cognitive responses, since a complex and uncertain issue that is not yet visible on a daily basis is hard to come to grips with; personal interest, which makes people unwilling to alter their lifestyle; individual beliefs and values about the environment; the social dimension, since a positive reaction to climate change often depends on the reaction of the local social structure.

Driven by some of the above points, Krosnick et al. (2006) argued that knowledge about an issue generates a practical reaction only if people believe to have a specific responsibility and

display a particular attitude towards an environmental crisis. In earlier work, Stern (2000) developed a theoretical framework - the value-belief-norm (VBN) theory – according to which knowledge of climate change and of its harmful consequences is just a component, a necessary condition for enacting personal norms that can in turn create a "general predisposition" to act in an environmentally-friendly way. This predisposition is transformed action only under favorable social-contextual variables.

***Procedural Knowledge***

While knowledge is often portrayed as an ineffective driver of human action, seldom is it asked to which kind of knowledge one is referring to (Kaiser and Fuhrer, 2003). So the question could be reformulated in this way: which kind of knowledge constitutes the "the first step" toward a behavioral reaction? As our previous analysis suggests, while a minimum of scientific understanding is indeed fundamental, it does not seem to be a sufficient driver in generating PEB. Still, most surveys do not go beyond the inquiry on people's understanding. In doing so they fail to study the importance of *procedural* knowledge, i.e., practical information that helps individual translate personal beliefs regarding climate change into concrete action (Kaiser and Fuhrer, 2003).

Recent research lends support to the claim that procedural knowledge is an important component of inducing PEB. Nye and Hargreaves (2009) reported two interesting experiments conducted in the UK by the Global Action Plan, an international environmental NGO. The experiments aimed at producing a behavioral change in two different contexts (work environment and households).

Both programs attempted to provide people with procedural knowledge on how to adopt environmentally-friendly behaviors in their everyday life. The first experiment, referred to as "The Environment Champions Program", was run in an office of about 280 people. A 16-member team comprised of staff of various levels of seniority, was drawn from different departments. The group conducted a three-month communication campaign on energy, resources, and recycling, with the objective of reducing the environmental impact of the office. The "Champions" tried to introduce informal rules for everyday office behavior focusing especially on energy use and waste production. Importantly, they did not want to act on people's environmental knowledge or values; instead, they just gave practical information about environmentally friendly behaviors and how to undertake them. The results of the experiment were quite good: there was 38% reduction in waste production, and 12% in energy consumption.

The second experiment, referred to as the "Eco-Teams Program", aimed to produce a behavioral change in domestic habits. EcoTeams (see also Nye and Burgess, 2008) brought together

groups of people ideally living in the same neighborhood. Meetings were held once a month and covered different themes, such as energy and water use, waste production, transport, heat/air conditioning, choice of products. Upon its completion, the program asserted a number of notable results. Among its participants 16% joined a green energy tariff, 37% installed energy efficient light bulbs, 17% reduced domestic heating to just the most-used rooms of their home, 21% increased their use of public transport for regular journeys and 44% started buying local produce as much as possible. Tellingly, most participants reported already having an environmentally friendly attitude but claimed that joining an EcoTeam had provided them crucial information on how to translate their concern into action within their local context. They seemed to have particularly enjoyed the exchange of tailored knowledge about, for instance, switching to alternative energy systems, recycling, and buying local food. Practical and locally contextualized knowledge appeared to be the missing ingredient in turning participants' already existing environmental values into a meaningful behavioral change.

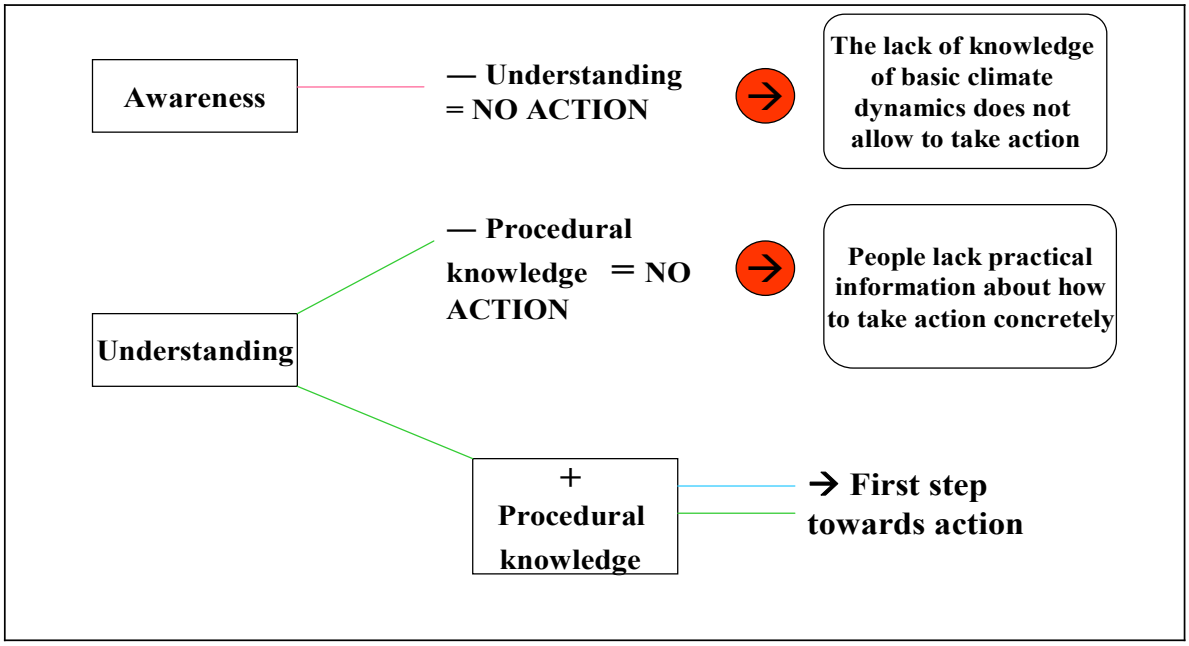


*Figure 2 – Different kinds of knowledge and their influence on actions*

On a final note, I stress the point that procedural knowledge would seem to be most effective when coupled with an understanding of climate change. If the latter were not present, procedural knowledge would simply aim to introduce new habits without acting on pre-existing beliefs, just like the (only moderately successful) Environment Champions Program did. But, in order for motivation to be kept steady, procedural knowledge would always require a minimum of

understanding of what climate change is, otherwise the meaning and the importance of changing environmentally harmful habits would not be understood, and public motivation would eventually fade.

## 3. Risk perception

An important source of motivation for adopting PEB can be found in individuals' direct experience. The explanation is obvious enough. When people are alarmed about an issue and perceive urgent risks connected to it, they are far more likely to change their behavior.

That said, in most parts of the western world climate change remains a rarely perceived risk. While extreme climatic events such as unseasonably hot summers and unnaturally strong storm seasons have occasionally occurred, they have failed to sustain the public's attention. Which, indeed, may not be altogether unreasonable. The connection of such isolated events to the wider climate change issue is broadly perceived as uncertain, including by scientists who caution against confusing short-term weather variations with statistically significant long-term climate change. The increase of the Earth's average temperature is by definition a global trend and does not imply that temperature increases steadily in every season and everywhere. Indeed, it is very hard to attribute any single event to climate-change, however dramatic that event may be – available science just cannot deliver that kind of certainty.

Some scholars insist on the importance of perceiving a risk for generating a reaction, and argue that the reason why a behavioral change has not occurred is that climate change is not seen as directly damaging (Spence et al., 2011; Weber, 2011; Krosnick et al., 2006). Thus, since the potential damages involved could be huge and irreversible, some researchers contend that the risk should, to some extent, "be made vivid" through an accurate information campaign. Yet, despite risk perception being an important emotional factor, it cannot always generate an appropriate behavioral response. Indeed, as I will discuss shortly, risk perception can also provoke the opposite reaction – apathy.

### *Is climate change a vivid risk?*

People react in accordance with the vividness of a threat (Bazerman, 2006), and the threat is vivid when it can happen within a short time. The potential consequences of failing to address climate change are temporally distant so that they become easy to ignore.

The above fact may help explain the conflicting findings of recent empirical research.. A US survey (Leiserowitz, 2006) reported that 76% of people claim to be highly concerned about global warming, but then rank climate change 12th out of 13 environmental issues (p. 46). 68% of respondents said that they think the threat represented by climate change is global, affecting people all over the world, but only 13% considered themselves and their community to be at risk: as such, they do not include themselves in that global dimension (p. 53). In Europe, Eurobarometer (2009b) reports that climate change is seen as the second most serious problem that the world is facing today; but if the question narrows down to one's own country's problems, concern drops to a meager 4% (Eurobarometer 72, 2009c). And if the question is posed on a personal level, only 5% mentions the environment within the two most serious problems (Eurobarometer 72, 2009b).

It thus seems like people report themselves as concerned about climate change, but what they are concerned about is perceived as very distant and not representing a direct threat. When people were asked which image they connected mostly with climate change (Leiserowitz, 2006), «62% of Americans provided associations to impacts geographically and psychologically distant, generic increases in temperature, or to a different environmental problem. Critically, this study found that most Americans lacked vivid, concrete, and personally-relevant affective images of climate change, which helps explain why climate change remains a relatively low priority national or environmental issue» (p. 55). Crucially, climate change is not only seen as distant, but also as not representing a threat for the *individual*. Before climate change will put human life severely at risk, still many years have to pass; furthermore, the extent of the risk and its concrete impact, are still largely unforeseeable.

***From a concrete risk to a proper reaction?***

If a risk is not perceived as urgent, vivid and concrete, it is very likely that people will not act promptly to prevent it (Oppenheimer and Todorov, 2006; Krosnick et al., 2006). Recent publications in *Nature Climate Change* support this view: Spence et al. (2011) and Weber (2011) connect peoples' reaction to climate change not so much to their beliefs about the certainty or uncertainty of it, but rather to their direct experience. They examine UK citizens' reaction to flooding occurred in the past years, and report that people who experienced flooding had a higher level of concern, more willingness to take preventive measures, and the feeling that their actions could be effective. Spence and his co-authors claim that «if people are better able to relate to the potential consequences of climate change impacts, they may also be more likely to feel that their behavior can lead to changes in these impacts» (Spence et al., 2011). Intuitively, when people have

direct experience of an abstract problem, they also feel like they can do something to oppose it (Spence et al., 2011).

Yet, despite the previous results regarding people's stated levels of concern, the survey's findings did not indicate such an obvious connection between first-hand experience and *actual mitigation efforts*. One first potential explanation behind this discrepancy could be that the practical actions flood-victims declared to be more willing to undertake were quite general (i.e., preparedness to reduce energy use). In addition, the questions concerned their "willingness" to change future behavior, and not the effect of their experiences on current behavior. Finally, and most importantly, the data themselves did not seem to suggest that first-hand experience is a key driver of future behavioral change. On a five-point scale (1 strongly disagree – 5 strongly agree), in response to the statement "I can personally help to reduce climate change by changing my behavior", flood victims reported an average score of 3.49 compared to 3.34 for people not affected by flooding; to the statement "I am prepared to greatly reduce my energy use to help tackle climate change" the numbers were 3.65 vs. 3.57.

In a separate study, Whitmarsh (2008) also compared the behavior of UK citizens who experienced flooding versus those who did not, and reported qualitatively similar findings. When asked "Do you think anything can be done to tackle climate change?", 65% of those without flooding experience answered "yes", compared to 62.4% of those with. To the statement "We can all do our bit to reduce the effects of climate change", we actually have higher percentage of people without flooding experience in agreement: 84.1% versus 80.9%. Since in both articles the differences in attitude are relatively small, one might infer that the salience of the risk is not enough to predict people's behavior.

***Side effects of risk perception***

Echoing and accentuating the findings of these flood-related studies, psychological research finds that direct experience may sometimes even *restrain* people from taking action (even when information about the issue is readily available) and so does not necessarily imply a behavioral change. It is argued that perceiving a risk in a direct and personal way may lead individuals to "cognitively suppress" a reality they are well aware of (McNamara and Grubb, 2011; Sandvik, 2008).

Recent field research lends support to this view. Two studies, conducted in a village of the Swiss Alps (Strauss, 2008) and in a Norwegian rural community (Norgaard, 2006), described instances in which local people had a high level of awareness that climate change was directly

happening, as well as a high level of concern, and yet this concern did not translate into preventive actions.

In the Swiss Alps village, 95 residents were interviewed (about 75 out of 400 households). Nearly all of them were convinced that climate change was taking place and 75% said that the weather had become warmer and wetter, but the widespread feeling was that nothing could be done to prevent the danger. People were discouraged by their apparent helplessness and said they prefer to work on what they feel they can somehow "control" (Strauss, 2008). In the case of the Norwegian community, Norgaard added an analysis of the local media to the interviews and participant observations. The interviewees were aged 19 to 70 years old, and ranged from students to businessmen, from shopkeepers to local politicians. People reported to have noticed a temperature rise in recent years, and remembered well the consequences of the extremely warm winter they had experienced in 2000: the scarce snowfalls caused a delay in the opening of the ski area; the local lake had failed to freeze, thus preventing ice fishing. The degree of knowledge people displayed about climate change was very high, as reflected by the attention that the local newspaper devoted to climatic issues and to international environmental policy. In fact, Norgaard herself mentions that she was "continually impressed with the level of up-to-date information that people had regarding global warming"(p. 378). Nevertheless, despite all these positive factors, people made almost no mitigation efforts. Through individual interviews and focus groups, Norgaard observed that people associated climate change to fear and helplessness: they felt that their actions would have been ineffective and that there was not much they could do at the local level. Respondents simply wanted to avoid thinking what their life would be like without snow in winter, or what would happen to their farms and community, if global warming keeps getting worse. Despite being well informed on the phenomenon, they tried to keep it outside their everyday life, as if it were not there.

Prompted by her empirical findings, Norgaard discussed the concept of a "social organization of denial", claiming that the social structure itself can constitute a big obstacle to environmentally responsible behavior, even in countries where understanding and perception of the problem are very high. Motivation to take action is harder to come by when people feel like they are acting alone, and not as members of an organized social group that facilitates the mutual exchange of information, coordinates its actions, and offers support and companionship. It is «not a negation of information about global warming per se; rather […] a failure to incorporate this knowledge into everyday life or to transform it into social action» (P. 374). Perceiving the risks connected to climate change and feeling that it is an insurmountable problem against which there is no solution stops every reaction, leading people to simply give up. Norgaard stresses that people act when they

know they can make a difference, and highlights the counterproductive effects that risk perception itself can occasionally have on people's attitude toward a problem, if it comes without a hint on how to solve it.

Finally, it is worth noting that a number of other studies concur with Norgaard's field research, arguing that unless people are told that they can do something about a problem, risk perception by itself may just increase feelings of helplessness/hopelessness and ultimately have a paralyzing effect on those affected (Norgaard, 2009; Lorenzoni et al., 2007; Immerwahr, 1999). Lorenzoni et al. (2007) noticed that in order to be motivated to act, people need *to be able to take action* (p. 446). According to a 2004 BBC poll that they analyze, just a half of British citizens think that a behavioral change would have an impact on climate change, which, in their view, is among the main reasons of the British public's widespread inaction. Again, the key to changing behavior may lie in individuals' need to feel they have the ability to actually solve the problem they are faced with.

***Psychological theories supporting Norgaard's view:* goal setting *and* perceived behavioral control theory**

It is natural to assume that people tend to lose motivation when they feel they are facing a problem that they are completely unable to solve. This fact is reminiscent of Locke and Latham's (2002) *goal-setting* theory, which explores human behavior and motivation in relation to the conscious and intentional goals that people set. The idea is that the goals themselves modify individual behavior: high goals lead to greater and prolonged effort (pp. 706-707), while low goals decrease commitment and motivation. Importantly, goals have to be achievable: attainment is a key factor, it is what keeps motivation steady. If an objective appears unreachable, people will dismiss it and lose interest. And tackling climate change, from the perspective of the single agent, may well seem like an unreachable goal that makes people feel completely powerless.

The idea that human action is dependent on its perceived self-efficacy is also discussed by Ajzen (1991) as a part of his theory of planned behavior (TPB). According to this theory, human behavior can be predicted on the basis of two main factors: behavioral intention (that comprises knowledge, attitude and norms), and perceived behavioral control. Leaving aside a discussion on TPB itself, what is relevant here is the emphasis on the importance of perceived behavioral control, that is, the perception of one's self-efficacy, of one's confidence in and ability of reaching an objective. Self-efficacy beliefs influence the whole decision process, from motivation to the instrumental reasoning on how to attain an end.

Echoing my earlier point, what is required for giving people the idea that their actions can be effective are feasible objectives and *procedural knowledge* on how to fulfill them. In order to give rise to a reaction, the perception of the risk has to be followed by a good information campaign and a clear and effective set of measures that even single individuals in their daily life can undertake. Otherwise, simple risk perception with no guidance on how to react may in fact generate the opposite result: paralysis and apathy.

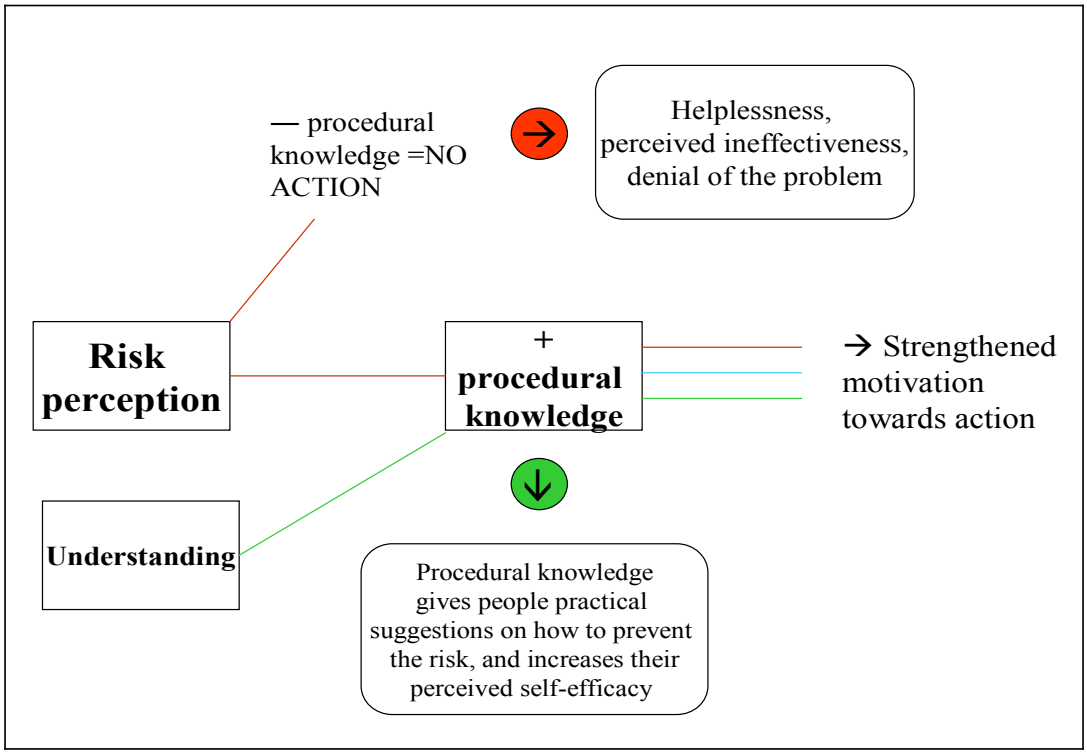


*Figure 3- How risk perception can be translated into action*

**4. Self-interest**

Even granting a best-case scenario in terms of knowledge and risk perception, there is another fundamental factor that influences almost every human decision: self-interest. Self-interest takes different forms in the climate change issue. First, it is what makes people unlikely to support environmental policies that concretely and immediately affect their budget: when climate policies are perceived as costly, they are less likely to be supported. But climate-change policy also involves costs in terms of lifestyle, and often people are also unwilling to give up their habits and comforts in order to benefit the environment.

The social dilemma of Garrett Hardin's famous "tragedy of the commons" (1967) encapsulates part of the story regarding the effects of self-interest. As mentioned in the paper's

introduction, the essence of the problem lies in the strategic conflict between self-interest and collective well-being. That is, individuals' self-interested behavior leads to environmental damage and an inefficient use of natural resources, even though mutual restraint would, in the end, make everyone better off. Therefore, it is of primary importance to narrow the gap between self-interested behavior and effective climate-change policy, and to make certain kinds of pro-environment behaviors economically expedient.

All that said, while such an adjustment of economic incentives is important, it may not always be sufficient in generating a behavioral response. In what follows, I briefly describe a number of psychological barriers that occasionally obstruct behavioral change, even when it is economically convenient (Special Eurobarometer 75.1 2011; McNamara and Grubb, 2011). But first, let us take a look at some data.

***Willingness to pay for climate-change mitigation***

Many international surveys have investigated people's willingness to pay (WTP) for mitigating climate change. According to recent data (Eurobarometer 322, 2009a) , 49% of Europeans declare they are willing to pay a premium for greener forms of energy: of this percentage, 25% would pay 1% to 5% more, 20% would pay 5% to 20% more, and 4% would pay over 20% more. 27% of people are not willing to pay anything extra, and 24% do not know.

In America, although people claim to be in favor of complying with the Kyoto protocol and reducing emissions, they do not seem to be willing to accept a measure that has a tangible economic effect on their lives. For instance, a great majority of Americans opposes a gasoline tax (78%) or a business energy tax (60%) (Leiserowitz 2006). Similar data are reported by Sunstein (2006): even though 59% of Americans claimed to support the Kyoto Treaty with only 21% claiming to oppose it, 52% reported that they would not accept it if it meant paying an extra $50 per month. And just 11% declared they would have supported the Kyoto Protocol if it involved incurring an expense of $100 per month. It is only fair to conclude that commitment to the Kyoto Protocol does not run particularly deep.

The above surveys suggest that when environmental measures are discussed in broad terms, as part of a national policy, individuals generally agree to take action against climate change (Sunstein, 2006). However, as soon as the necessary policy costs are shown to affect them directly, even if very modestly, their attitudes change. What factors could help explain this discrepancy? Well, when confronted with a tangible cost that affects their bottom line, it is reasonable for people to ask what exactly they are being asked to pay for, i.e., what benefits they will obtain in exchange for their economic sacrifice. And herein lies the problem: while the costs of proposed policies are

concrete and immediate, the benefits are not. People are being asked to incur immediate costs without knowing exactly what they are paying for, or even if they will *ever* get any benefit in exchange for the payment. The costs of curbing emissions are high and at the actor's expense, while benefits will be shared by all: this means that an economically rational actor may well choose to let the others pay, while he "plays it safe" and waits until more information is available.

Viewed from a more general perspective, the cause-effect relation offers once again insight into where the complication lies: cause and effect, action and outcome, occur at two different levels - personal and global: the individual incurs private costs, while the community reaps public benefits. The outcomes of the personal behavior of the agent, whether correct or incorrect, will not be felt at the individual level, but at the global one. This discrepancy *de facto* encourages self-interested behavior. Given the high costs of pro-environment measures, polluting becomes economically convenient for the single agent who opts to let the others pay while enjoying the fruit of his peers' sacrifice. This is the "free-rider" problem, well described by Ostrom (1990): «Whenever one person cannot be excluded from the benefits that others provide, each person is motivated not to contribute to the joint effort, but to free-ride on the efforts of others. If all participants choose to free-ride, the collective benefit will not be produced» (p.6). And what is even worse is that the selfish behavior of everyone gives rise to the overexploitation of a common good.

WTP does not only concern money. It further involves comforts and habits people are reluctant to give up, even when they conflict with a cause they profess to believe in. Such comforts and habits include traveling by car rather than taking public transport, flying short distances, overusing air conditioning and heating, and buying imported food or other goods that need to be shipped great distances. Even beyond the comfort and pleasure they afford, such habits occasionally carry a strong social connotation, since they are to some extent expression of wealth, which makes the required behavioral change even more complicated.

Indeed, recent survey findings in the UK (Lorenzoni et al., 2007) show that people perceive with great discomfort the idea of taking action on climate change through a change of lifestyle and habits: 48% of people are reluctant to alter their lifestyle, even though doing so would reduce their personal contribution to climate change (p. 450). What is clear throughout is that individuals generally support policies that involve only minor changes to their lives (Bord et al., 1998). For instance, a FEEM 2007 report showed that while Italians declare their general willingness to increase their energy savings (70% of respondents), just 2% of them are currently reducing their use of cars, and the same tiny percentage declares they are using air-conditioning only if necessary.

A few years ago, O'Connor et al. (2002) conducted a survey in Pennsylvania in order to investigate the relationship between personal wealth and willingness to commit to environmental

protection. The hypothesis was that people with an unstable economic situation, with anxiety about their financial future, would be much less likely to support and adopt green behaviors – first because people give priority to closer matters of concern, and second because, in most cases, "green" behaviors are perceived as implying a price rise. Fuel-efficient appliances are expensive, green electricity providers that sell energy through renewable energy sources may have higher costs than providers that burn coal, and governmental policies that aim to reduce greenhouse gas emissions generally raise the price of energy. The results of O'Connor et al's (2002) survey showed, first, that there is no relation between personal economic conditions and environmental concern: the poor are just as concerned as the wealthy. Instead, the difference lies in the kind of measures the two groups do actually support. On the one hand, people with lower incomes are less willing to incur added monetary expenses[5] but, at the same time, are favorable to making lifestyle changes such as using mass transit, driving less, saving energy, and reducing the use of heating or air conditioning. On the other hand, people with higher incomes are more willing to pay an extra amount of money for environmental policies and to buy low energy consumption electrical appliances. But the data show that these wealthier respondents are neither willing to cut back on their driving, nor to reduce heating and cooling. In short, they are used to living "comfortably", and do not like the idea of constraining their personal freedom through environmental regulation. This kind of behavior appears difficult to change, since it concerns people's habits and lifestyle, has strong social-status implications, and affects people's private lives.

***Psychological obstacles to a rational management of self-interest***

Despite the previous discussion's relative pessimism, the same principle of self-interest can be used to stimulate pro-environmental behaviors. Indeed, economic instruments of all kinds, whether they be taxes or quotas or anything else, appeal to people's self-interest in order to change their behavior. Clearly, if climate change mitigation were made to be economically convenient, the behavioral change would surely be easier. But, I argue, it would still not be guaranteed. A consistent body of literature has focused on the psychological underpinning of economic decisions, starting from the observation that the theory of rational choice often fails to predict human behavior – i.e., humans are not always rational optimizers of interests (Sunstein and Thaler, 2006; Tversky and Kahneman, 1986). In some cases, even when people are presented with a convenient option that would be in their best economic interest to adopt (e.g., a generous energy tariff, or strong incentives for home

[5] Losing one's job is, naturally, not favorable to supporting the proposed policy. The potential closing of coal mines (O'Connor et al, 2002, p. 15) would be a prime example.

insulation or installing solar panels), a number of psychological factors come into play that may obstruct what represents a rational optimization of interest. In what follows, I briefly discuss a few.

First, individuals by their nature discount future benefits and costs. This attitude is not in itself irrational or unwelcome, especially when it involves an individual's immediate need for survival versus more long-term concerns. Future discounting is an innate instinct in human beings, since every future consideration brings along a certain degree of uncertainty, and therefore what is immediate and visible is naturally valued more than what is temporally distant and not well defined. It is thus perfectly normal for people to display a preference for present, as opposed to future well-being. The problem arises when, for some reason, people act myopically and display discount rates that are very high. This generates a scarce willingness to undertake beneficial actions that imply an immediate expense and a medium/long term payoff, such as building solar panels or insulating houses. In such situations, the present cost far outweighs future gains and, as a result, people's forward-looking attitude loses its potency. Consequently, most people do not opt for medium/long-term savings; rather they prefer to spend less in the present even though in a few years time they would have likely recouped today's costs[6]. A similar logic applies when it comes to adopting environmentally friendly habits that may be perceived as "costs" (since they require the immediate change of behavior), and whose payoff is vague, not quantifiable and therefore unappealing.

Similar arguments can be found in Sunstein and Thaler (2006), who describe the individual as having two semiautonomous selves: a far-sighted "Planner" who tries to consider the long term issues, and a myopic "Doer" who is exposed to temptations and preoccupied with short-term concerns. When making decisions, the latter often prevails over the former – people's predominant reasoning seems to be defined by a "benefits now, costs later" attitude. That is why «climate policy should also heed individuals' tendency to favor local, visible and privately securable outcomes» (Liverani, 2010, p. 8).

Beyond time discounting, the economics of climate change mitigation are complicated by the so-called "status quo bias": individuals have a natural tendency to preserve their *status quo*, as they overestimate the degree of uncertainty, and potential downside, that is involved in altering their present arrangement (Bazerman, 2006). For instance, it is observed that even switching energy provider to a more efficient one (or substituting old household appliances with energy efficient ones, which often results in significant savings) is not the easy and linear decision that one could expect (McNamara and Grubb, 2011). Instead, people seem to disregard the potential benefits of

[6] Data gathered by Special Eurobarometer 75.1 on energy-saving behaviors confirm this attitude: despite good economic incentives and high payoffs, only 19% of Europeans have opted for home insulation, and only 6% have purchased a more "eco-friendly" car.

such a change, and prefer to keep their old habits in order to avoid transaction costs, extra bureaucracy, or even the mere idea of changing, that involves the necessity to get used to new habits (McNamara and Grubb, 2011).

Along these lines, a final point which bears mentioning is that individuals often make economically disadvantageous decisions because of a need to imitate what other people do (McNamara and Grubb, 2011; Fransson and Gärling, 1999). There are various reasons behind this phenomenon, which I briefly mention without going into. First, there is the natural human tendency to conform (Sunstein and Thaler, 2006), which, no doubt, is representative of the deep human need to socialize and belong. Second, when making decisions, hardly ever does one possess complete information on their long-term costs and benefits or, sometimes, even their pros and cons. This lack of information leads individuals to look at and imitate the behavior of people around them, which is inarguably a whole lot simpler than carefully evaluating the consequences of their actions (McNamara and Grubb, 2011; Sunstein and Thaler, 2006).

## 5. Conclusion

The current paper has focused on knowledge, risk perception, and self-interest as motivating drivers of pro-environmental behavior. Drawing on a variety of sources, I have argued that a combination of different factors is needed to induce a change in people's behavior. Figure 4 summarizes how various combinations of the above may not necessarily lead to the desired behavioral response.

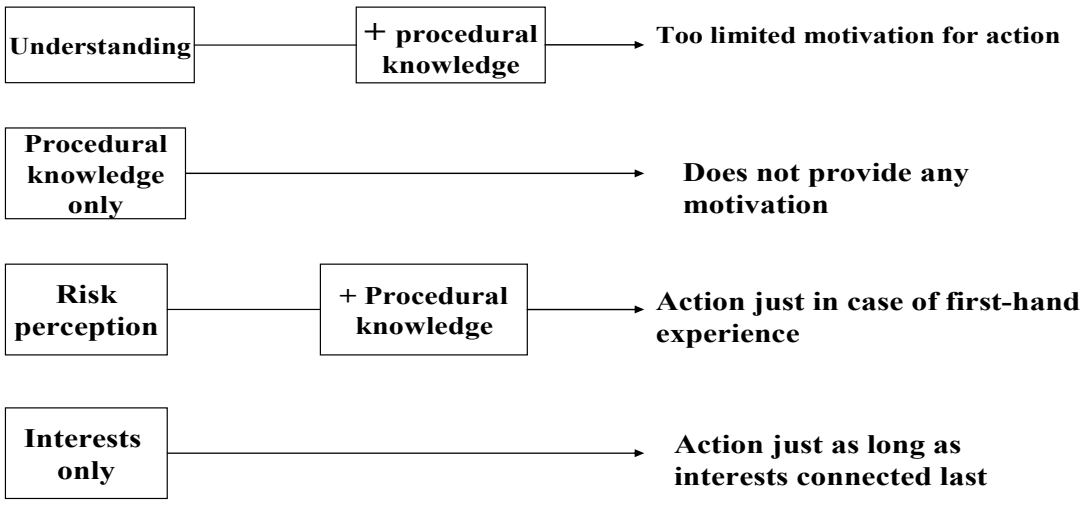


*Figure 4. Ineffectiveness of single variables in inducing PEB*

Improving the public's understanding of climate change would certainly provide an important cognitive basis that gives the subject the intellectual tools to comprehend both what is actually happening and how to intervene. Yet, as most scientists acknowledge, knowledge and action are not consequential, since many other factors influence human behavior: to understand an issue does not give automatically a motivation for taking action on it, especially if the latter bears short-term economic losses for the individual.

Accordingly, it would not be effective to focus on procedural knowledge only: providing behavioral indications without further support (ideological or emotional), fails by default to motivate action, since it does not communicate to individuals *why* their behavioral change is important. The Environment Champions Program analyzed above is a clear example of this: providing purely information and not knowledge was able to introduce new habits that are not judged as a great sacrifice, such as saving energy or separating waste for recycling, but could not contribute to a deeper behavioral change such as, for instance, a significant reduction of the use of car, since it did not provide much motivation for it.

Psychologists who work on risk perception stress the importance of the emotional component of motivation. The fear of future events, that to some extent are seen as tangible risks, certainly constitutes a strong predictor of human behavior. Yet, the evidence presented in this essay suggests that such an emotional component may be a strong motivator only when an individuals' direct experience is coupled with a good information campaign on how to deal with the risks. Otherwise, a lack of procedural knowledge on how to tackle a problem may provoke the exact opposite response, leading to feelings of hopelessness and apathy despite the risk's relevance and vividness.

Acting exclusively on the sphere of economic interests implies another order of problems. It is true that economic interest is often the unique motivation for many human actions, so that providing people with strong economic incentives can be sufficient to spur PEB. Nevertheless, focusing purely on self-interest can give rise to a number of problems such as the following: (a) motivation may arise solely from economic factors so that if the economic benefit fades, the individual has no other reasons for taking pro-environment actions; (2) incentives for adopting environmentally friendly behaviors may be highly dependent on the government and on its specific policy, and not every political party is concerned about climate change and considers it a priority; (3) many behaviors that help in tackling climate change may not involve specific expenses (e.g., recycling); (4) monetary interests are often a weaker motivating driver than comforts and lifestyle: traveling in one's own car or flying are generally more costly, but also more comfortable, and an

expression of wealth, and such factors may be more important than rational cost-benefit calculations.

In Figure 5 below we see how the variables analyzed may work better, in predicting behavior, when interconnected. It suggests the need of a joint effort of scientists, psychologists and economists, each acting on their sphere of competence, but in a constant dialogue with the other disciplines, in order to spur the required behavioral change. Moreover, procedural knowledge, a topic that is often overlooked in policy spheres, should be given particular attention possibly through the use of astute information campaigns and community-building activities.

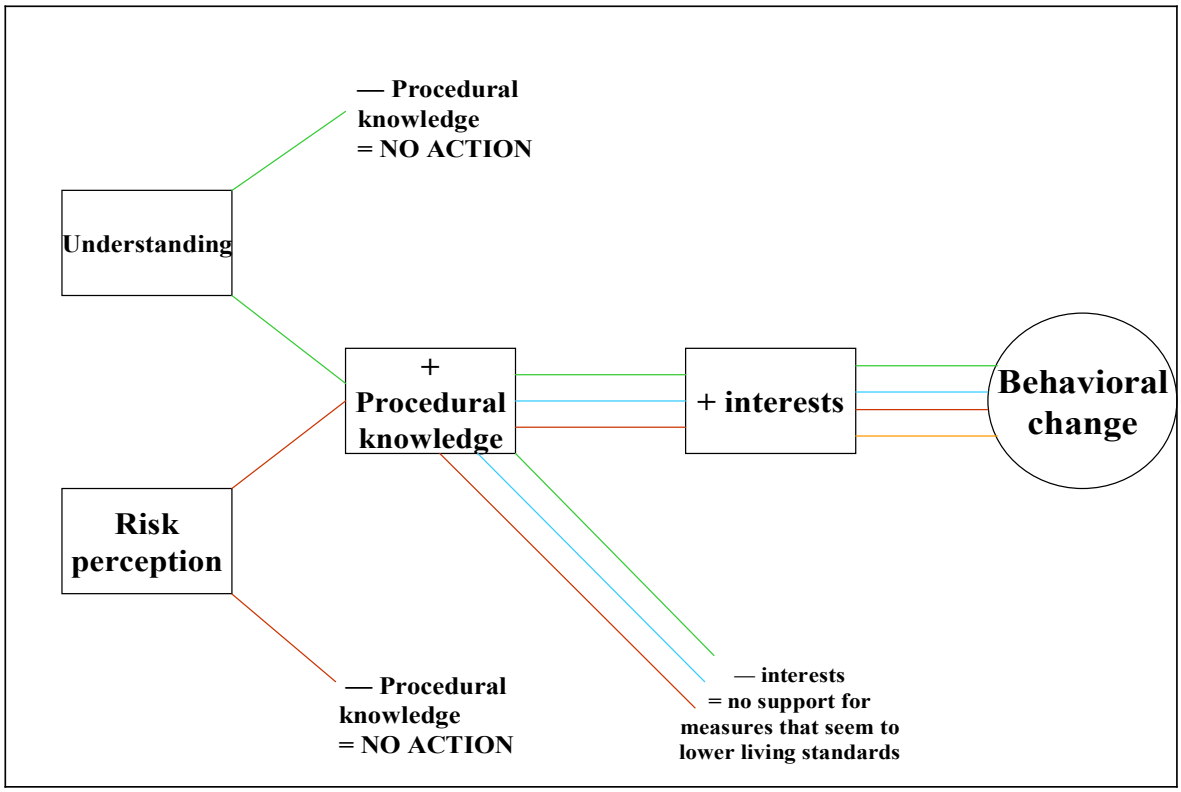


*Figure 5- Cognitive and emotional variables that influence motivation to adopt pro-environment behaviors*

I end by noting that individual pro-environmental decision making depends on several factors. There are macroscopic ones, such as those analyzed in this essay, but there are also many others of a more subjective nature which are subtle and ephemeral but can drive individual behavior with just as much strength. It is therefore very difficult to foresee how individuals will behave, and a healthy degree of humility among researchers who study these issues is absolutely imperative. Yet, in the field of climate change, carefully taking macroscopic variables into account may provide substantial insight into effective ways of inducing pro-enviromental behavior. It is my hope that the present essay has suggested fruitful avenues for future research along these lines.

## References


Ajzen, I., *The theory of planned behavior*, Organizational behavior and human decision processes, 1991, 50; 179-211;

Barrett, S., *Environment and Statecraft: The Strategy of Environmental Treaty-Making*, Oxford: Oxford University Press 2003;

Bazerman, M.H., *Climate Change as a predictable surprise*, Climatic Change, 2006, 77; 197-193;

Bord, R., Fisher, A., O'Connor, R., *Public perception of Global Warming*, Climate Research, 1998, Vol. 11, No. 1; 75-84;

Bostrom, A., Granger Morgan, M., Fischhof, B., Read, D., *What Do People Know About Global Climate Change? - 1. Mental Models*, Risk Analysis, 1994, Vol. 14, No. 6; 959-970;

Eurobarometer:

Special Eurobarometer 75.1, Europeans and Energy (Part II), April 2011; http://www.europarl.europa.eu/pdf/eurobarometre/2011/2011_04_21/SA_EN_Final.pdf ;

Special Eurobarometer 322, *Europeans' attitude towards climate change*, November 2009; http://ec.europa.eu/public_opinion/archives/ebs/ebs_322_en.pdf (2009a);

Standard Eurobarometer 72, *Public Opinion in the European Union*, Report. Fieldwork October-November 2009; http://ec.europa.eu/public_opinion/archives/eb/eb72/eb72_vol1_en.pdf (2009b);

Standard Eurobarometer 72, *Public Opinion in the European Union*, First results, December 2009; http://ec.europa.eu/public_opinion/archives/eb/eb72/eb72_first_en.pdf (2009c);

Special Eurobarometer 300, *Europeans' attitude towards climate change*, Report. September 2008; http://ec.europa.eu/public_opinion/archives/ebs/ebs_300_full_en.pdf ;

FEEM, Report of the *Osservatorio sulla Percezione delle Questioni Energetiche*, 2007;

Fransson, N., Gärling, T., *Environmental concern: conceptual definitions, measurement methods, and research findings*, Journal of Environmental Psychology, 1999, 19; 369-382;

M. Funke and M. Paetz, *Environmental policy under model uncertainty: a robust optimal control approach*, Climatic Change, 2011, 107; 225-239;

Gardiner, S., *A perfect moral storm: Climate Change, Intergenerational Ethics and the Problem of Moral Corruption*, Environmental Values, 2006,15; 397-413;

Hardin, G., *The tragedy of the commons*, Science, Vol. 162; Dec. 1968;

Immerwahr, J., *Waiting for a Signal: Public Attitudes toward Global Warming, the Environment and Geophysical Research*, A Report from Public Agenda; April 15, 1999;

International Energy Agency, *$CO_2$ Emissions from Fossil Fuel Combustion*, 2010 Edition, www.iea.org;

International Energy Agency, *Key World Energy Statistics 2010*, www.iea.org;

IPCC 2007: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

Kaiser, F.G., Fuhrer, U., *Ecological Behavior's Dependency on Different Forms of Knowledge*, Applied Psychology: An International Review, 2003, Vol. 52, No. 4; 598-613;

Kempton, W., Boster, J., Hartley, J., *Environmental Values in American Culture*, Cambridge: MIT Press 1995;

Krosnick, J.A., Holbrook, A.L., Lowe, L., Visser, P.S., *The origins and consequences of democratic citizens' policy agendas: a study of popular concern about global warming*, Climatic Change, 2006, 77; 7–43;

Leiserowitz, A., *Climate Change Risk Perception and Policy Preferences: the role of Affect, Imagery, and Values*, Climatic Change, 2006, 77; 45-72;

Leiserowitz, A., Smith N., *Knowledge of Climate Change Across Global Warming's Six Americas*, Yale University. New Haven, CT: Yale Project on Climate Change Communication (2010 a);

Leiserowitz, A., Maibach, E., Roser-Renouf, C. & Smith, N., *Americans' Actions to Conserve Energy, Reduce Waste, and Limit Global Warming: June 2010.* Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change Communication (2010 b);

Liverani, A., *Climate Change and Individual Behavior. Considerations for Policy*, Policy Research Working Paper 5058, The World Bank, Background Paper to the 2010 World Development Report, Sept. 2009;

Locke, E.A., Latham, G.P., *Building a Practically Useful Theory of Goal Setting and Task Motivation*, American Psychologist, September 2002, Vol. 57, No. 9; 705–717;

Lorenzoni, I., Nicholson-Cole, S., Whitmarsh, L., *Barriers perceived to engaging with climate change among the UK public and their policy implications*, Global Environmental Change, 2007, 17; 445–459;

McCombs, M., Shaws, D., *The Evolution of Agenda-Setting Research: Twenty-Five Years in the Marketplace of Ideas*, Journal of Communication, 1993, 43; 58–67;

McNamara, S., Grubb, M., *The Psychological Underpinning of the Consumer Role in energy Demand and Carbon Abatement*, Electricity policy Research Group Working paper 1110, Cambridge Working Papers in Economics 1126, March 2011;

Mises, L. von, *Human Action. A Treatise on Economics*, San Francisco: Fox & Wilkes, 1963 (1st ed. 1949, ed. by Yale University);

Norgaard, K.M., *Cognitive and Behavioral Challenges in Responding to Climate Change*, Policy Research Working Paper 4940, The World Bank, Development Economics, World Development Report Team, May 2009;

Norgaard, K.M., *'People Want to Protect Themselves a Little Bit': Emotions, Denial, and Social Movement Non participation*, Sociological Inquiry, 2006, Vol. 76; 372-396;

Nye, M., Burgess, J., *Promoting durable change in household waste and energy use behavior*, A technical research report completed for the Department for Environment, Food and Rural Affairs (DEFRA), University of East Anglia, 2008;

Nye, M., Hargreaves, T., *Exploring the Social Dynamics of Proenvironmental Behavior Change. A Comparative Study of Intervention Processes at Home and Work*, Journal of Industrial Ecology, 2009, Vol. 14, No. 1; 137-149;

O'Connor, R., Bord, R.J., Yarnal, B., Wiefek, N., *Who Wants to Reduce Greenhouse Gas Emissions?*, Social Science Quarterly, March 2002, Vol. 83, No. 1; 1-17;

Oppenheimer, M., Todorov, A., *Global Warming: The Psychology of Long-Term Risk*, Guest Editorial, Climatic Change, 2006, 77; 1-6;

Ostrom, E., *Governing the Commons. The Evolution of Institutions for Collective Action*, Cambridge (UK): Cambridge University Press 1990;

Ramsey, F.P., *A mathematical theory of saving*, Economic Journal, 1928, 38; 543-559;

Rawls, J., *A Theory of Justice*, Cambridge, MA: Harvard University Press 1971;

Read, D., Bostrom, A., Granger Morgan, M., Fischhof, B., Smuts, T., *What Do People Know About Global Climate Change? - 2. Survey Studies of Educated Laypeople*, Risk Analysis, Vol. 14, No. 6, 1994; 971-982;

Reynolds, T.W., Bostrom, A., Read, D., Granger Morgan, M., *Now What Do People Know About Global Climate Change? Survey Studies of Educated Laypeople*, Risk Analysis, Vol. 30, No. 10, 2010; 1520-1538;

Roemer, J., *The ethics of distribution in a warming planet*. Environmental and Resource Economics 2010, *in press*;

Sandvik, H., *Public concern over global warming correlates negatively with national wealth*, Climatic Change, 2008, 90; 333-341;

Smith, A., *An Inquiry into the Nature and Causes of the Wealth of Nations*, ed. by E. Cannan, New York: The Modern Library, 1994;

Spence, A., Poortinga, W., Butler, C., Pidgeon, N. F., *Perceptions of climate change and willingness to save energy related to flood experience*, Nature Climate Change, published online 20 March 2011;

Stern, P.C., *Toward a Coherent Theory of Environmentally Significant Behavior*, Journal of Social Issues, 2000, Vol. 56, No. 3; 407–424;

Strauss, S., *Global Models, Local Risks: Responding to Climate Change in the Swiss Alps*, in Crate, S.A., Nuttal, M. (eds.), *Anthropology and Climate Change: From Encounters to Actions*, Walnut Creek, CA: Left Coast Press, 2008;

Sunstein, C., *The availability heuristic, intuitive cost-benefit analysis, and climate change*, Climatic Change, 2006, 77; 195-210;

Sunstein, C.R., Thaler, R.H., *Nudge. Improving Decision About Health, Wealth, and Happiness*, Penguin, USA 2009;

Tversky, A., Kahneman, D., *Rational Choice and the Framing of Decisions*, Journal of Business, 1986, Vol. 59, No. 4, pt. 2; 251-278;

Ungar, S., *Knowledge, ignorance and the popular culture: climate change versus the ozone hole*, Public Understanding of Science, 2000, Vol. 9; 297-312;

Weber, E.U., *Psychology: Climate Change hits home*, Nature Climate Change, published online 20 March 2011;

Weitzman, M., *On modeling and interpreting the economics of catastrophic climate change*, Review of Economics and Statistics, 2009, 91; 1-19.

Whitmarsh, L., *Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioral response*, Journal of Risk Research, April 2008, Vol. 11, No. 3; 351–374.

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http://ideas.repec.org/s/fem/femwpa.html
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