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The Importance of Pro-Environmental Attitudes and How They Might be Modelled in Economics

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Abstract

A case is made for the importance of pro-environmental attitudes in the response to climate change. Reasons for the current (parlous) state of implementation of solutions to the climate crisis are discussed, and solutions including carbon taxes and Fee and Dividend (Feebates) are explored. A general framework for modelling pro-environmental attitudes is discussed, (based on the discrete choice framework of Brock and Durlauf, 2001) which describes the diffusion of pro-environmental attitudes through a population, not just in a single individual. Potential uses of the model are discussed, including the ability to describe the creation and evolution of social norms through society.

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Introduction

This paper establishes the importance of pro-environmental attitudes and the need for a model of the diffusion[1] of those attitudes throughout a population, taking a survey approach to the literature on attitudes to climate change.

After summarising the approach taken in the main part of this paper, I provide short introductions to some of the concepts discussed here - social norms, social tipping points, sustainable transitions, and the Environmental Overton Window.

Summary of Approach

The detailed steps supporting the central claim of this paper are laid out in section 2 (Main). As that is such a long section, I give a summary of the approach taken here, for the sake of clarity.

The logic linking the steps runs as follows. First, I look at the threat caused by the climate crisis. There is widespread agreement that current actions to address climate change have been insufficient, and I discuss that briefly, before

[1] Peyton Young (2009) identifies three classes of diffusion model, of which we are concerned with *social influence*: individuals change their attitudes when enough other individuals have changed. The other models are *social learning*, in which individuals base their change on observed evidence that the change produces favourable results, and *contagion*, where simple contact with others is all that is required.

moving on to conclude that the chief cause is insufficient pressure to take action (both on governments and also to some extent on individuals).

I take some time to consider social norms, social tipping points and the concept of a sustainable transition.

Having established the need for solutions, I then point out that solutions already exist. An obvious question is why governments are not already implementing these solutions and I address the two most commonly cited answers: public acceptability (which for environmental projects can be equated to pro-environmental attitudes) and affordability. I briefly discuss the Stern Review (N. Stern, 2007), and the impact it had in changing the understanding of how to decide whether environmental projects can be considered affordable.

An open question for policy makers is how to decide whether the likelihood of delivering a particular goal is increased or decreased if the initial goal is deliberately curtailed. There are projects where public acceptability *diminishes* once the project starts. In these cases public acceptability may be kept higher with a larger, more ambitious goal, avoiding the risk of having to seek renewed public approval during a dip that may occur in public acceptance.

Carbon pricing, and carbon taxes in particular are discussed. Carbon pricing has great potential to address many of the issues faced in the climate crisis. I look at the debate on how a carbon tax compares to emissions trading schemes and hybrid solutions, and discuss the hopes that "Fee and Dividend," or so-called "Feebate" proposals can address many of the key objections people have levelled against carbon pricing.

In leading the reader through this chain of reasoning, I highlight the several places where pro-environmental attitudes have a telling influence.

That leads to a section on the attitudes themselves - a summary of the effects that individuals' pro-environmental attitudes have on governments, on firms, and on the creation of social norms, which influence other individuals to adopt pro-environmental behaviour.

I then summarise the benefits that would accrue from a model of pro-environmental attitudes and discuss the features that such a model would need to have.

In the third section of this paper, I explore what such a model would look like, basing it on the discrete choice framework first laid out by Brock and Durlauf, 2001.

The model will need to incorporate psychological factors, and I discuss the leading psychological theories of pro-environment behaviour.

In the concluding section I speculate on how the model might be created and the impact it could have on helping policy makers address climate change.

A Short Introduction to Social Norms

This paper makes frequent reference to social norms, and this section introduces them. Social norms are "rules and standards that are understood by members

of a group, and that guide and/or constrain human behaviour without the force of laws" (Bell et al., 1996, section 18.2). Note that they describe the behaviour (and approval) of others, as opposed to *personal* norms, which are concerned with the individual's own such rules and standards. Following Bicchieri (2006), this paper will consider social norms as being *informal* norms, and not *formal* norms, such as laws or regulations.

Bell et al. distinguish between *injunctive norms*, which refer to the approved (or disapproved) behaviours, and *descriptive norms*, which refer to the behaviour actually displayed by others.

Studies have shown that social norms (of both kinds) can have a strong influence on individuals' behaviour, but that the effect is under-estimated by the individual concerned - we are not aware of the full extent of the effect of social norms (Nolan et al., 2008).

As a thought experiment[2] consider the behaviour of a smoker, who after a long-haul flight finds herself in the baggage retrieval hall of an airport, wanting very much to smoke, but seeing "No Smoking" signs on every pillar. She is likely to observe the rule and not smoke. But now imagine that the smoker notices that six or seven people nearby are smoking. It is easy to imagine that she may well now light up, observing the strong descriptive norm set by those around her.

[2] A thought experiment is "an experiment that purports to achieve its aim without the benefit of execution" (Galili, 2009, p.11). While some might claim this makes it merely an argument without evidence, the use of thought experiments in scientific papers is an established practice dating back more than a century (see for example Einstein, 1911).

Although there is a strong connection between social norms and pro-environmental attitudes, the precise relationship has not been settled. For the purpose of this paper, all that is required is to note that:

- the observance of pro-environmental behaviour contributes to the formation of social norms, and
- social norms can be very strong and can influence pro-environmental attitudes and behaviours.

Social Tipping Points and Sustainable Transitions

In climate science, a tipping point is a threshold level of some input variable, typically CO_2, which when exceeded leads to non-linear behaviour.

As this paper will show, pro-environmental attitudes form a social norm that is an important input variable for many of the potential responses to climate change. So a *social tipping point* is a threshold level of pro-environmental attitudes which, when exceeded, results in a non-linear change in pro-environmental behaviour.

Social tipping points show up in some discrete choice models (such as Zeppini, 2015, for example). They are a desirable feature of the type of model described in this paper, as they mimic the kind of behaviour seen when, for instance, an increasing proportion of an electorate lobby their government for a change.

Initially there are too few advocates to make a difference, then as the numbers build up there comes a point at which lobbying success is inevitable.

It is widely known that in all developed countries today resource utilisation rates exceed the level that the planet can sustain (Hertwich and Peters, 2009).

A *sustainable transition* occurs when a society has reduced its resource requirements to a level that is sustainable.

One might expect that a social tipping point would lead to a sustainable transition, but this is not guaranteed.

Introducing the Environmental Overton Window (EOW)

In politics the term "Overton Window" is used to refer to a set of policies that are by some measure "politically acceptable" at a point in time (see for example Szałek, 2013). The term tends to be applied to projects that can be placed on a political (that is, left-right) spectrum, but the term can be applied to climate change solutions too.

Athough stable, the window is not completely static, but can *move* over time, as public knowledge and pressures change.

Some proposals, for instance placing restrictions on single-use plastics, are clearly within the Overton Window (see Xanthos and Walker, 2017). Other proposals find much less public acceptance, at least today. An example is the

suggestion to remove the reliance on Gross Domestic Product (GDP) from our economy and replace it with national accounting measures that value "hidden" inputs, such as household and care work. Arguments have been made that the perversities in how GDP reacts to climate disasters present a strong disincentive to take effective action on climate change (Scott Cato, 2012, pp.113-121). Rewiring our economy to function without GDP could potentially improve our ability to build a better world and address climate change (Stiglitz, Sen and Fitoussi, 2017; Victor, 2010). Despite this, the public pressure for this initiative is not there - or rather, evidence is lacking for its visibility.

As we have seen, policies that affect pro-environmental attitudes also affect the public acceptance of environmental policies - thus moving the EOW. As acceptance of the need for solutions to climate change grows, so the EOW will move, bringing into the realm of public acceptability projects that were heretofore politically non-viable. The sooner the window moves, the sooner those projects can be suggested, debated, and started, and the sooner the results can be realised.

Main

> "Today, rapidly changing atmospheric conditions and warming above typical interglacial temperatures as CO_2 levels continue to rise, habitat fragmentation, pollution, overfishing and overhunting, invasive species and pathogens (like chytrid fungus), and expanding human biomass are all more extreme ecological stressors than most living species have previously experienced. Without concerted mitigation efforts, such stressors will accelerate in the future and thus intensify extinction, especially given the feedbacks between individual stressors."
>
> Barnosky et al., 2011, p.56

Barnosky's paper was published in Nature in 2011. Since then the world has been subject to a steady stream of bad climate news, including recently a massive melt of Greenland's ice sheet, high levels of melting of Siberian permafrost and extensive fires in the Amazon. We may already have reached a number of tipping points (Feldmann and Levermann, 2015).

An increasingly large and media-savvy minority of individuals are treating this like the emergency it is and are demanding that their governments take action. In the last year alone we have seen mass action from Extinction Rebellion and the Children's School Strike movement, with the sixteen-year-old Swede Greta Thunberg as its figurehead.

We can expect this activism to increase - Extinction Rebellion is predicting "a phase of ecological action unlike anything in history," (Extinction Rebellion,

2019, personal communication) and involving a long list of groups across the planet. Currently they still represent a minority but their hope is large numbers of people will either get directly involved or else be swayed by the increasing strength of the arguments for immediate action. We may be heading towards a *social* tipping point.

In an ingenious set of experiments published recently in Science, Centola et al. (2018) found that a minority group with a size of 25% of the population was sufficient to persuade the population to change behaviour, and that this result was consistent across their experiments. It will be interesting to see whether this result holds when the experiments are replicated more widely.[3]

This section of the paper lays out a sequence of logical connections: between the threat posed by runaway climate change, solutions that exist to deal with it, carbon taxes, and pro-environmental attitudes. This establishes the need for a model of how pro-environmental attitudes are created, and how they diffuse through a population. The subsequent section asks what that model might look like.

1. The Threat Caused by Climate Change

The disruption caused by global warming and environmental destruction are threatening not just the existence of humanity, but much of all life on earth.

[3] We may be about to witness one such natural experiment as the percentage of the German electorate supporting *die Grüne* has recently reached 26%.

We are probably living through the sixth mass extinction (Barnosky et al., 2011).

Climate change is "one of the greatest challenges of our time," (G20, 2015, p.6). There is now an overwhelming consensus for this view, both in the scientific community and in the wider population at large (Hamilton et al., 2015; Leiserowitz et al., 2018).

1.1 The Ineffectiveness of Actions to Date

Although the need for concerted effort to tackle this has been internationally recognised, little headway has yet been made in addressing this challenge (den Elzen et al., 2019; Masson-Delmotte et al., 2018; Tong et al., 2019; UNFCCC, 2015).

Studies of global energy subsidies by the International Monetary Fund (IMF) reveal that governments across the world are subsidising the fossil fuel industry (by around $5 trillion per year) (Coady, I. Parry, Le et al., 2019). They find that because these subsidies largely relate to air quality and local environmental damages, "most of the environmental benefits from energy subsidy reform would accrue to the local population" (Coady, I. Parry, Sears et al., 2015, p.29), implying that removing the subsidies would represent a net benefit to the country, even before international obligations are factored in.

A World Resources Institute working paper from January 2019 makes the summary that "for the best chance of limiting temperature increase to 1.5°C‘,

global greenhouse gas (GHG) emissions must peak by 2020 and dramatically decline thereafter" but finds that "while meaningful progress has been made, we are not yet on track to achieve the 2020 climate turning point" (Ge et al., 2019, p.1).

Scheffer, Westley and Brock (2003) shed some light on the reasons for delay by building a model that predicts lags between the acceptance of an issue and effective regulation. They suggest that the more complex the issue, the longer the delay. They also argue that the delay will be longer in the absence of a strong central decision-making authority.

Bhargava and Loewenstein, 2015 (2015, p.399) suggest that "the paucity of actual progress may be due, in large part, to psychological factors, such as motivated disbelief, the ostrich effect, confirmation bias, present-bias, adaptation, and intangibility." These factors are expounded upon by George Marshall, who takes a strongly behavioural approach to explain our collective inaction (Marshall, 2015).

1.2 The Insufficiency of Pressure to Date

Governments around the world are under varying amounts of pressure from their citizens to take action. There is evidence for increasing acceptance both of anthropogenic global warming and also of the need for individuals to change their consumption patterns (Hamilton et al., 2015; Leiserowitz et al., 2018). However, many of the mitigation policies proposed come with an economic price tag. Given the lack of progress made, it is sensible to conclude that the

pressure applied on governments to take action has so far been insufficient to overcome other political pressures, such as the economic desire for short-term growth (see for example Bows and Anderson, 2007). Roberts and Geels (2019) conclude that pressure from individuals is one of the key causes of "politically accelerated transitions."

As well as considering action taken by governments, it is important to remember that the actions taken by individuals are still important, even if we have now passed the point where individual actions alone could have been enough to address climate change. This is primarily because the lifestyle choices individuals make have a huge effect on that individual's carbon footprint even when holding culture static (Baiocchi, Minx and Hubacek, 2010).

But it is also because the pressure felt by an individual as the result of their observation of the pro-environmental actions of others is an example of a social norm. Increases in this pressure, caused for example by an increase in the number of people taking pro-environmental actions, will result in an increase in individual pro-environmental attitudes.

This feedback, between the pressures on an individual to take action, and the impact their own actions have on others, represents the chief challenge in modelling pro-environmental attitudes.

2. Solutions Exist

A very wide range of solutions to the climate crisis have been proposed, many of which are supported by plausible claims of effectiveness.

Governments have the power to implement solutions through several channels, primarily:

- International Treaties

  The Kyoto Protocol laid the groundwork for the first international agreement on reducing GHG emissions, and in 2015 the Paris Agreement required signatory countries to commit to voluntary "Nationally Determined Contributions" (NDCs) (UNFCCC, 2015). Unfortunately, if all countries were to fully meet these NDCs, the total reduction in GHGs would still not be sufficient to limit future global temperature rise even to 3°C, let alone 2°C or the aspirational 1.5°C target.

  And yet other international agreements are possible (Pizer, 2006). James Hansen, for example, is among those calling for the Kyoto Protocol to be replaced with a global Fee and Dividend scheme (Hansen, Bernard and Semmler, 2015), which could be initially implemented by a substantial economic block, such as Europe and the US or Europe and China (see page 28).

- Tax

Various "point" taxes are already in place in many countries. Kenya has had a complete ban on plastic bags since 2017 and will ban all single-use plastics from 2020. The UK has a tax on landfill use, and Sweden taxes nitrous oxide (NOx). Most countries have some form of road tax, gasoline tax or fuel duty.

In addition, a number of countries are going further and implementing (or plan to implement) carbon taxes - a comprehensive tax not just on fossil fuels, but also indirectly on all products and services that are reliant on fossil fuels (see below).

- Regulation

  Common targets of regulation include water and air quality, industrial gas emissions, fishing, forestry, national park protection and controls over waste disposal.

- Information Campaigns

  Governments generally have had mixed results from information campaigns, as Evert and van der Doelen Frans (2017, p.125) conclude in their book chapter on this subject: "Information programs are generally not very costly and the effects on behavior are often hard to detect. This leads to an evaluation paradox: the policy instrument that perhaps needs the most intensive evaluation, due to the inherent invisibility of its impacts, is less evaluated because of its relative cheapness and flexibility." The authors suggest that information campaigns are undertaken often assuming that lack of knowledge is the key issue, when in fact sometimes it can simply be self-interest (see for example Kahan et al., 2012). They sug-

gest therefore that information campaigns that strengthen well-reasoned self-interest can be a very efficient tool.

- Research

  As well as the direct result of fostering innovation in a particular area (the environment), government-direct research funding has the additional indirect effect of focusing private sector investment in that direction. This can form an important component of a policy package.

- Other Direct Investment

  In addition to research, the government is also in a position to fund investment in projects likely to spur economic activity in ways that align with environmental policy. This may be particularly important for big-ticket infrastructure projects that might not get off the ground without the government underwriting in some way the risks involved.

It is easy to find proposed solutions designed for each of these channels. It is also clear that efficient and effective government policy will include policy initiatives utilising *all* of these channels.

But solutions need not only be top-down. The polycentric approach (Ostrom, 2012), whereby local instigation of projects is paramount, could well result in benefits as large as those offered by global initiatives, and benefit from being much easier to get off the ground. They are also likely to contribute to the establishment of pro-environmental attitudes without the extent of "pushback" to be expected from larger-scale initiatives.

This pushback could come from a number of sources. One such source is the reaction of firms that face falls in profit as more people make pro-environmental purchases (see "The Effect on Production," on page 32 for a more detailed treatment). Another source could be a growing awareness by individuals of the disbenefits of a solution, particularly if the benefits only accrue much later in time, or only to other people. Consider for example the *"Gilets jaunes"* protests in France in the winter of 2018-2019, which were provoked by the imposition of additional taxes on fuel, which disproportionately affected poorer, rural individuals (Algan et al., 2019).

2.1 Public Acceptability

In discussions about policy responses to climate change, a word that repeatedly appears is "acceptability." For government-led projects, political viability is a key concern, and for locally-inspired projects, the enthusiasm and determination of the core team driving the projects are similarly vital.

If, per Ajzen in his Theory of Planned Behaviour (see "Psychological Theories of Pro-Environmental Behaviour," on page 41), attitudes are defined in terms of the individual's positive or negative evaluation of performing a behaviour (Ajzen, 1985; 1991), then public acceptability (of an environmental policy) is simply the aggregate of individuals' environmental attitudes. Thus pro-environmental attitudes are the fundamental *sine qua non* of both government and local initiatives.

When politicians assess the public acceptability of an environmental initiative, they are asking about pro-environmental attitudes (see for example Ščasný et al., 2017). The existence of a model of such attitudes would therefore be of great benefit to policy makers and might be expected to lead to more effective and better-targeted environmental policies.

Of course, it is not necessary to assume that pro-environmental attitudes will always increase over time. Given the interplay of factors influencing both positive and negative attitudes, one might expect distinctly non-linear behaviour. This too would be something that a model of pro-environmental attitudes should be capable of delivering.

2.2 Selecting Over- or Under-Ambitious Policy Goals

Of particular interest is the degree to which policy decisions (whether by governments or individuals) lead to a strengthening or weakening of pro-environmental attitudes. There are cases of environmental policies being implemented to partially address an issue, only to encounter "pushback" resulting from a weakening of pro-environmental attitudes, caused by increased salience of the disbenefits of the project.

Another reason that a positive but inadequate project can be harmful is the effect it might have in forming one of Robert Gifford's seven "Dragons of Inaction," - psychological barriers that prevent an individual from taking

positive action[4] (Gifford, 2011). His argument is that if an individual already feels that they've done *something* to address the issue, the motivation for taking further actions is reduced, and the strength or quality of the action does not really matter.

On the other hand, some projects experience a "snowballing" effect, as popularity for an initiative increases after an initial foray.

Note that this dilemma is separate from the concept of pilot projects. The goals of a pilot are typically to build up experience, gather implementation data, and in so doing learn how to make a full roll-out more successful. Here, the debate is whether to deliberately target a partial solution with the goal of creating a social norm in the desired direction. This would then act to accelerate a subsequently more comprehensive solution.

Policy makers have a particularly difficult time therefore in deciding whether the best course of action is to "grasp the nettle" and attempt to address the whole issue, or to start small and implement a partial policy solution, with the perhaps explicit goal of aiming to increase acceptability as part of the initial implementation.

[4] The other six "dragons" are *limited cognition about the problem*, *ideological worldviews that tend to preclude pro-environmental attitudes and behavior*, *comparisons with key other people*, *sunk costs and behavioral momentum*, *discredence toward experts and authorities*, and *perceived risks of change*.

2.3 Example: Environmental, Ecological or Green Economics

One example of this dialectic in economics is the debate between environmental and ecological economists about whether or not it is possible to address climate change (and other issues) without a wholesale change to the policy-making approach.

There is no generally-accepted definition of terms, but broadly speaking, *environmental economics* is the study of natural resources seen as elements in a neo-classical economics model. *Ecological* or *Green Economics* (Scott Cato, 2012) takes a more fundamentalist approach by attempting to take account of factors that classical (environmental) economics finds hard to fully account for, such as the value to society of an unsullied landscape, or the inter-connection between well-being and the environment. In between these extremes are approaches such as *Ecological Modernisation* (Barry, 2007), which attempts to correct for the missing externalities in the Environmental Economic outlook by introducing concepts such as damage functions and *Ecosystem Services*[5].

Because of the difficulty in estimating the value of nebulous concepts, Ecological Modernisation is open to criticism by both extremes of the debate: by green economists because of all the value that by necessity has to be omitted from any analysis (see for example Monbiot, 2014), and by environmental economists because it introduces error margins large enough that any results lose their specificity.

[5] This is an attempt to quantify the value to society of, for example, a tropical rainforest, or the pollination of crops performed by bees, or even the effect on the human psyche of a pretty view (Guerry et al., 2015).

It is interesting to note that this debate is between people whose worldviews are, in spacial political terms, extremely proximate. Most of the arguments in this sphere take place between people who share common values, attitudes and even goals. The debate is about the priority of those values and how challenging the goals should be.

There are environmentalists who believe that it is not possible to properly address climate change without a comprehensive rejection of the systems and processes that brought about a society in which the climate is so undervalued. For example, colonialism, patriarchy, inequality, the class system, mainstream (neo-classical) economics and capitalism have all been blamed as root causes for our manifest reluctance to tackle climate change.

While there is much evidence to support these claims, others believe that tackling any of these issues is setting too high an objective: that any sympathy for the cause of addressing climate change is likely to be lost if the target is broadened so far.

When deciding between policy A, which is well within the EOW but has limited upside, and policy B which has the potential to make a big difference, but is on the fringes of where public acceptability lies (on the edge of the EOW), it is clear that a good understanding of pro-environmental attitudes could make the difference between success and failure. This is one of the arguments underlying the need for a model of pro-environmental attitudes (see page 37).

2.4 Perceived Affordability

The most common question asked of any proposed climate change policy is how much it will cost. All projects have costs, and prudent governance demands at least some level of awareness of whether those costs outweigh the benefits. And yet there is already a methodological issue here.

Externalities abound when considering the environment. What kinds of pollution might be produced? What wildlife will be affected? What will be the knock-on effects to other ecosystems? How will these matters affect human (and non-human) lives, in the short- and long-term?

Although thorough cost/benefit analysis involves an estimation of environmental damages, it is easy to see how this might be difficult to accurately assess, leading either to under-estimation, or else unacceptably high levels of uncertainty.

Some have argued (for example, Douthwaite, 1993) that the kind of thinking that led us to today's state of environmental crisis is not the thinking we need to get out of it, and that merely adding an extra term to a damage function will not suffice, and may have contributed to the delays we have seen in addressing climate change.

However much merit this argument has, it is difficult to imagine a quick and simple way to address the systems and cultures at the root of the issue. One could argue that the solutions to addressing this methodological issue are outside the current EOW.

One option is to look for short-term solutions that will at least improve the situation - both in terms of actual results and also in terms of the effect on pro-environmental attitudes. One approach towards meeting this requirement is that represented by Ecological Modernisation (see above) - to add in that damage term, so to speak - and to make estimates of what is now called the Social Cost of Carbon (SCC).

In 2006 Nicholas Stern produced a review that did just that (N. Stern, 2007). It allowed a mainstream economist to claim for the first time that the costs of inaction over climate change outweighed the costs of action, even taking discounting into account.

The report was open to criticism on several fronts (Nordhaus, 2017; Sterner and Persson, 2008; Weitzman, 2007; 2014), but it provided a stimulus for further research into Integrated Assessment Models (IAMs) - an area that has, in the thirteen years after the report, grown considerably (Tol, 2013). Today we have, if not an agreed price for the SCC, at least an agreed range (IMF, 2019; Marron and Toder, 2014).

This is not to say that we have solved the question of affordability - far from it. The story of the development of IAMs shows just how hard it can be to evaluate affordability.

3 The Need for Carbon Pricing

Carbon pricing addresses the major externality at the heart of the climate crisis - that no-one pays for the CO_2 we add to the atmosphere. It is thus a key component of any suite of policies designed to address the climate crisis (I.W.H. Parry and Williams, 2011).

Baranzini et al. (2017) provide seven arguments for carbon pricing, and also makes the point that the pricing should be global, to avoid spillover effects.

They list:

1. As Carbon pricing alters relative prices, firms and consumers automatically internalise global warming effects
2. Carbon pricing accounts for heterogeneity of emitters, which reduces the overall abatement cost
3. Carbon pricing provides a continuous incentive for adoption and innovation of carbon-efficient technologies
4. Carbon pricing represents the most effective way to limit energy/carbon rebound
5. Global carbon pricing curtails emissions leakage between countries
6. Carbon pricing decentralizes policy, reducing regulators' need for information

7. Carbon pricing takes into account that in making purchasing decisions, most consumers are more influenced by prices than by environmental concerns

Although Baranzini et al. (2017) and Nordhaus (2019) take the view that for efficiency, the carbon pricing needs to be a single, global price, Stiglitz argues that in the real-world, we may need second- or even third-best solutions (Stiglitz, 2019): markets are not always (are in fact, never) perfect and information is not always complete, for instance.

In summary, there are three challenges with all carbon pricing policies:

1. The need to change consumption patterns
2. Building a consensus in favour of further action to address climate change
3. Avoiding exacerbating inequality.

The first of these is met to the degree that the tax internalises the externality. If all of the costs are captured by the tax (or the emissions trading system), then consumption patterns will naturally adjust automatically.

Building a consensus is a matter of ensuring that pro-environmental attitudes continue to grow and do not take a step backwards. This would be a lot easier to achieve if there were a model predicting the effect on attitudes of a given set of policies.

Distributional effects (inequality) is an issue with any tax of this kind. However, if the money raised from the tax is returned to individuals in the form of a dividend (or rebate), this can address the issue (see below).

3.1 Carbon Taxes and Emissions Trading

Although there is widespread agreement about the benefits of carbon pricing in general, there has been much debate about which would be the best way to implement it: an efficient Pigouvian carbon tax with floating price, or an emissions trading scheme with business confidence-inspiring predictability on pricing (Goulder and Schein, 2013).

J. Andrew, Kaidonis and B. Andrew (2010) note a preference for emission trading schemes and argue that carbon taxes warrant more consideration, on the grounds that they are efficient.

In their review of the literature, Goulder and Schein (2013) conclude that much of the debate is unnecessary, as both systems can be modified to circumvent criticisms. In particular, they note, a hybrid solution, consisting of a carbon tax but with pre-set floor and ceiling prices, ought to satisfy most critics.

As far as this paper is concerned, it is not necessary to decide on a "best" approach. Whichever method is chosen, two things remain the same:

1. Pro-environmental attitudes will have a large impact on the success or failure of the policy

2. A model predicting changes to pro-environmental attitudes would enable timely action by policy makers, thus increasing the success rates of those policies.

An interesting variant on the emissions trading scheme is personal carbon trading (Bristow et al., 2010). Permits can be allocated to individuals who then have to buy additional permits if they exceed their allocation. A similar economic analysis applies as to country-level permit trading, and Bristow et al. (2010) showed that the public acceptance of personal carbon trading was broadly similar to that for a (standard) carbon tax, depending on implementation details.

3.2 Addressing Distributional Effects

Perhaps the biggest challenge to implementing a carbon tax is public acceptability. It has been shown (Unmel, 2016) that carbon taxes are inherently distributional, and unless this is addressed, there is at least one subgroup of the population (the poor) that will not accept a carbon tax.

Fortunately, as Klenert et al. show (2018), the addition of a distributional policy to the carbon tax can address this issue. The policy advocated by the Citizens' Climate Lobby, Fee and Dividend, is an example of an implementation of this (Unmel, 2016). Their analysis shows that there is a non-linear relationship between an individual's income and how much they consume: most consumption is done in the top two or three deciles. As a result, if the revenue from a carbon tax is redistributed evenly to all individuals, then a large majority of individuals

(in their US analysis) would benefit financially from such a policy, with the welcome result that such a tax would be *popular* with its target base.

The term "Feebate" is sometimes used in the context of a Fee and Dividend scheme. A Feebate is a system of charges (fees) and repayments (rebates) with the aim of redistributing damages based on consumption.

The overall effect of this policy is to move the EOW such that further, possibly more radical, carbon change policies and interventions are seen as possible, and desirable. High levels of public acceptance means that pro-environmental attitudes can remain high, and increase the likelihood of reaching a social tipping point.

One potential trap for policy makers is the danger of spillover effects. The generally-proposed solution to this is a system of tariff controls known as "Border Carbon Adjustment" (BCA). Nordhaus (2019) talks about the creation of a "Carbon Club" of nations that all agree to implement carbon taxation, in return for tariff-free trade. Because these tariffs impose a particular burden on countries without the quality of institutions and infrastructure of western developed nations, the proposal is to redistribute the results of those BCA tariffs back to the countries concerned.

3.3 Questions to be Answered Regarding Carbon Taxes

If a carbon tax (or emission trading scheme, or hybrid of the two) is to be introduced, then there are several questions to be answered:

1. Carbon tax, or emission scheme, or both?

   See above. The decision is not critical to the success of carbon pricing, as all three options can be made viable, but it does affect the secondary questions (below).

2. What is the correct pricing of carbon to use?

   This has been widely addressed, notably by Marron and Toder (2014), who summarise the issues usefully but without going so far as to make recommendations. As IAMs are updated, and more data become available, on both warming and the likely effects of the warming, calculations of the SCC can be expected to continue to converge.

3. How will this change over time and how will that affect the dividend?

4. How much of the money raised needs to be returned in the dividend?

5. What would be the effects on other taxes and policies?

6. What are the expected reactions from individuals, firms, and government?

7. How to gauge the success of this policy?

A great deal of work has gone into answering questions 1-6 (see for example Stiglitz, N. Stern et al., 2017) but very little into question 7. Reductions in GHG concentrations and improvements in biodiversity can be measured, but as the results are more likely to be long-term effects, there is a need to produce short-term performance indicators too.

Given that a key requirement (or at least co-benefit) of an environmental policy is that it has a positive effect on the EOW, a desirable key performance indicator of any policy is the measurement of pro-environmental attitudes.

There are three ways to obtain this information:

a. Measurement of the public acceptance of climate change policies via surveys

b. Measuring pro-environmental behaviour, using appropriate empirical methods (either self-reported, or based on observation)

c. Direct monitoring of pro-environmental attitudes.

Using surveys and similar methods of measurement is expensive and involves a lag - a delay, between the event causing the effect and the availability of reliable and usable results from the study. Self-reports are also subject to response bias and measurement error (Bell et al., 1996, section 16.3). A method of directly monitoring, or even predicting, changes to pro-environmental attitudes would therefore be very valuable.

4. The Importance of Environmental Attitudes

An observer of the discussion of potential solutions to climate change might well conclude that all debate is about the supply side of the economy. This section will address this shortcoming by considering the role that individuals play in shaping society's response to climate change.

Pro-environmental attitudes are important for three reasons:

1. They bring pressure on governments (as well as on local organisations) to take action
2. (When they induce pro-environmental behaviour) they provide firms with evidence that there is demand for more pro-environmental products and services
3. They move the EOW (page 8) so that previously unacceptable climate change solutions become more acceptable (and previously acceptable but environmentally unfriendly solutions become less acceptable).

In this section, we look at the last two of these reasons in more depth.

4.1 The Effect on Production

Firms are highly motivated to observe, predict, and if possible influence changes in consumer behaviour. Those that perform poorly in this regard are at a huge competitive disadvantage, and a Darwinian "survival of the fittest" might be thought to apply (Darwin, 2004).[6]

[6] Johnson et al. have shown that as firms are by definition groups, Darwin's theory cannot apply, because it speaks to individual selection and not groups (Johnson, Price and Van Vugt, 2013). The authors instead propose an alternate theory, Multi-Level Selection (MLS), which explains both the benefit to firms of competition and also why individuals would suborn their goals to those of the firm.

As consumer behaviour changes, demand is created for new products, and products that were once popular may lose their appeal. In the context of changing attitudes to climate change, examples of increased demand could include a growing preference for locally-produced foods, for example.

Firms observing this change in behaviour have three basic options:

1. Adapt.

   A manufacturer of plastic toothbrushes for example may see an opportunity to introduce a bamboo alternative, even if the initial profit margin is low, because the long-term trend indicates the need to move into this new market.

   Aa decision to move into a new market will often be accompanied by a marketing campaign aimed to establish brand presence, and this campaign may well have the effect of accelerating the change in consumption patterns. For example, the toothbrush manufacturer may find it advantageous to highlight the pro-environmental attributes of the new product, or claim to be providing a social benefit, either of which might reasonably be expected to increase uptake and hence accelerate the change to consumption.

2. Do Nothing.

   Changes to product lines are typically expensive, profits on pro-environmental goods or services may be lower, and changes in consumer

demand do not always progress predictably and linearly. Business as usual may be the best response.

This option is likely to have little direct impact on the rate of change of consumption behaviour.

3. Slow or Reverse the Trend.

   Methods available include advertising the benefits of the old product, running campaigns to discredit or tarnish the credentials of the pro-environmental products, and lobbying government for regulation changes protecting their product.

   Note that it is not necessary for a campaign to "win" the battle for attitudes here. If the product values are high enough, then even a small slowing effect could save considerable revenues.

Depending on the industry, the value of the product line, and the resources available to the firm, any of the above options may be chosen. It is possible that in some cases the firm will choose all options, as a hedge against uncertainty.

The net effect on the rate of change of consumption pattern is thus likely to depend primarily on the prevalence of the "Slow the Trend" option.

One particularly strong example of an industry that collectively adopted this option is the tobacco industry.

A World Health Organisation report summarising thousands of documents made available through litigation and whistle-blowing, revealed that the industry launched a series of misinformation campaigns, designed to obfuscate the science and through doubt on health facts (Bates and Rowell, 2004). For instance, money was invested in research projects designed to show that factors other than second-hand smoke (SHS) were responsible for the observed ill-health.

Barnoya and Glantz report that "in 1993 Philip Morris started its 'sound science' programme whose objective was to stimulate criticism of the 1992 US Environmental Protection Agency report that identified SHS as a class A human lung carcinogen and the cause of other serious respiratory problems" (Barnoya and Glantz, 2002, p.311).

The industry also spent billions influencing law making: "the tobacco lobby engaged in a comprehensive and aggressive political effort in state legislatures to sell tobacco with the least hindrance using lobbying, the media, public relations, front groups, industry allies, and contributions to legislators. These efforts included campaigns to neutralise clean indoor air legislation, minimise tax increases, and preserve the industry's freedom to advertise and sell tobacco. The tobacco lobby succeeded in increasing the number of states that enacted state pre-emption of stricter local tobacco control laws and prevented the passage of many state tobacco control policies" (Givel and Glantz, 2001, p.124).

Activities such as these were successful in protecting revenues for several decades after the point at which tobacco companies became aware their products were harmful.

It is clear that certain industries today, notably the petrochemical industry, are similarly positioned to benefit from this third strategy. If the result of that is a delay measured in decades before politicians take concerted efforts to address global warming, then our chances of avoiding runaway climate change seem bleak in the extreme.

It is therefore important to monitor environmental attitudes closely, and to look for policies that will accelerate the move towards a sustainable transition.

4.2 Attitudes Only Weakly Predict Behaviour

It is the subject of considerable frustration that psychology is still not fully able to account for the gap between attitudes and behaviour. Much has been written on this subject and various models have been proposed to explain the gap (Ajzen, 1985; 1991; Bell et al., 1996; Benabou and Tirole, 2006; Bierhoff, 2005; Blake, 1999; De Groot and Steg, 2009; Fietkau and Kessel, 1981; Hines, Hungerford and Tomera, 1987; Kollmuss and Agyeman, 2002; Lindenberg and Steg, 2013; Rogers, 1983; Schwartz, 1977; P. Stern, 2000).

There is evidence for two-way connections between some psychological factors. As well as being the end result of a sequence of cognition, behaviours are also one of the direct determinants of future behaviour. For some this is close to a definition of *habits* (Verplanken, 2009; 2012), which also have a large role to play here.

It is possible that a comprehensive psychological theory would have to take into account not just the factors themselves but their strength too. A study of Dutch students published in 2002 found evidence that strong attitudes had different characteristics from weak attitudes (Holland, Verplanken and Van Knippenberg, 2002).

For the purposes of this paper, a definitive theory of behaviour is not required. It is sufficient to understand the psychological factors at play. A more accurate appreciation of the factors influencing behaviour will lead to the creation of models with greater predictive power.

4.3 Behaviour Creates Social Norms

The third and final effect of consumer attitudes is that of creating a social norm. It has been shown (Bell et al., 1996) that individuals are strongly influenced by their perception of social descriptive norms.

The strength of the evidence that social norms determine attitudes further underlines the need to keep a close eye on levels of pro-environmental attitudes.

5. The Need for a Model of Pro-Environmental Attitudes

As discussed above, current psychological theories of behaviour are at the level of the individual. They tend to take observable (or inferable) factors such as social norms, feelings of guilt and knowledge of issues and form abstract

constructs (attitudes, intentions and values). Empirical analysis is typically Ordinary Least Squares (OLS) regression, or similar, looking for correlation between these factors and constructs, and observed behaviour. Structural Equation Modelling (SEM) can be performed (see for example Bamberg and Moser, 2007) to ascertain which factors seem to be affecting which other factors - at least in the case of the dataset used for the analysis.

This approach to modelling is heavily reliant on the "correct" definition of factors and constructs, and it is perhaps not surprising that the leading models are only able to explain about 52% of observed pro-environmental behaviour (Bamberg and Moser again).

We do not yet have a model that describes the dynamics of a social norm as it diffuses through a population.

As reported by S.A. Levin, 2006, there is a small but growing literature that develops models of the dynamics of norms, but to date this been restricted to game-theoretic models, which do not lead to tractable predictions (Axelrod, 1997; Bowles and Gintis, 2004; Boyd and Richerson, 1996; Cavalli-Sforza and Feldman, 2003; Durrett and S. Levin, 1998; Miller, 1996; Nakamaru and Iwasa, 2005).

A model predicting the prevalence of pro-environmental attitudes in a population would allow us to describe (and observe and potentially predict) the creation and evolution of social norms.

Model

In this section a general framework for modelling pro-environmental attitudes is discussed.

Basing the model on the discrete choice framework of Brock and Durlauf, 2001 has several advantages over alternative approaches:

- The model can look at the prevalence of pro-environmental attitudes in a population, rather than just a single individual.
- The inclusion of a stochastic component (or noise) allows for heterogeneity of agents, and this gives rise to models in which there is a variety of different actions taken. This is in line with natural expectations of individual actions. Even in cases where it can be argued that a "best" decision exists, in real life we do not expect everyone to make the same choice.

  Models based on purely rational decision-making do not have this feature.
- It is relatively simple to introduce additional factors into discrete choice models. Thus psychological factors, such as feelings of guilt, moral and social norms, can easily be accommodated into the model.
- The framework allows the creation of dynamic models, which is important given the desirability to mimic the behaviour that individuals show when they adjust their choices based on their observation of others.

- The model allows the investigation of innovation diffusion through the population.
- The models are amenable to simulations, which allows exploration of the behaviour of the model under varying conditions, and makes it possible to design experiments that both build on the model and allow for verification against real data.

Agovino, Cerciello and Musella (2019) shows that social norms can have either positive or negative effects. As a result, the dynamics of such a system can be non-linear. Models based on the discrete choice framework typically show non-linear and often chaotic dynamics. It is common to see bifurcations in the diagram representing the number of equilibria, for example (Assenza et al., 2014; Brock and C.H. Hommes, 1997; C. Hommes, 2011; C. Hommes and Zeppini, 2014; Zeppini, 2015). This is another good tie-in to the requirement of modelling pro-environmental attitudes, because it allows us to look at the concept of sustainable transitions, and ask what parameters are necessary for a transition to occur.

Psychological Theories of Pro-Environmental Behaviour

In this section the various models of pro-environmental behaviour are summarised. Many of these theories used shared concepts (values, personal norms, for example) but there is no overall agreement for a definitive list of factors which might potentially affect behaviour. There are also factors (such as Andreoni's *warm glow*, (Andreoni, 1990; 1995) and virtue signalling, which, while being shown to be connected with pro-environmental behaviour, do not immediately fit into the psychological theories listed here.

Norm Activation Model (NAM)

The NAM model (Schwartz, 1977) has pro-social behaviour directly determined by personal norms. Awareness and knowledge of environment problems are predictors of the creation of personal norms (Bierhoff, 2005). Internal causal attribution leads to feelings of guilt, which can lead to social norms. The model allows for feedback from the individual's behaviour, which can for example conflict with social norms to lead to increased feelings of guilt. Social norms also lead to moral norms. See Figure 1 on page 42.

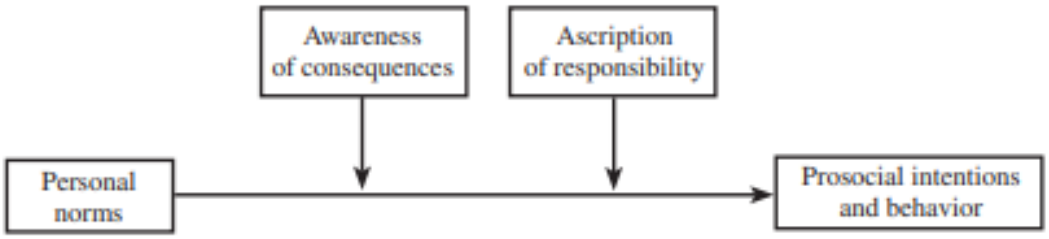

Figure 1: The Norm Activation Model. Source: Adapted from De Groot, J.I.M. and Steg, L., 2009. Morality and prosocial behavior: the role of awareness, responsibility, and norms in the norm activation model. *The Journal of social psychology*, 149(4), pp.425–449

Model of Ecological Behaviour

Fietkau and Kessel (1981) used sociological as well as psychological factors to build their model[7]. They describe pro-environmental behaviour as being predicted by four factors: *possibilities to act environmentally*, *environmental attitudes and values*, *incentives for pro-environmental behaviour* and *perceived consequences of behaviour*. In addition, *environmental knowledge* feeds environmental attitudes, which they model as also partially influenced by perceived consequences of behaviour. See Figure 2 on page 43.

Protection Motivation Theory (PMT)

PMT (Rogers, 1983) requires that individuals make appraisals of the costs and benefits of both pro-environmental ("coping appraisal") and environmentally unfriendly behaviour ("threat appraisal") before making decisions. Coping appraisal depends on "perceived self-efficacy", which may be the same as PBC

[7] A closely related theory to the Model of Ecological Behaviour is that by Grob (Grob, 1995, not discussed in detail here)

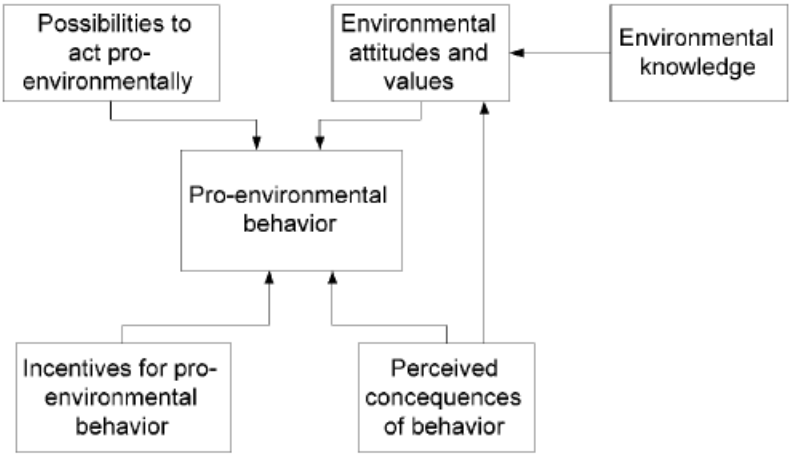

Figure 2: Model of Ecological Behaviour. Source: Kollmuss, A. and Agyeman, J., 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental education research*, 8(3), pp.239–260

in TPB (see above), costs of pro-environmental behaviour and "perceived outcome efficacy."

The theory suggests that individuals will display pro-environmental behaviour when both threat and coping appraisal are high. See Figure 3 on page 43.

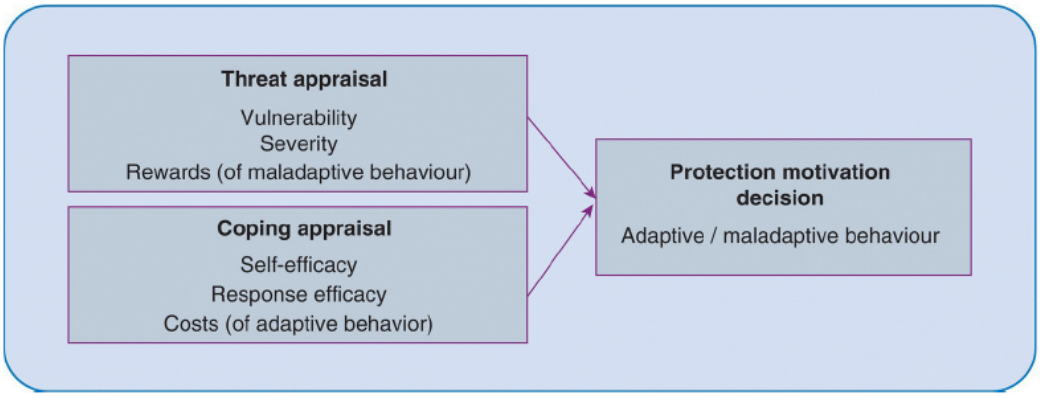

Figure 3: Protection Motivation Theory. Source: Bell, P.A. et al., 1996. *Environmental Psychology.* Harcourt

Model of Responsible Environmental Behaviour

Hines, Hungerford and Tomera (1987) based their model of responsible environmental behaviour on TPB and a meta-analysis of 128 pro-environmental behaviour studies. They identified the following factors as influencing behaviour: *knowledge of issues*, *knowledge of action strategies*, *locus of control*, *attitudes*, *verbal commitment*, *individual sense of responsibility*, and *situational factors*, which included economic constraints, social pressures and opportunities to choose different actions (Kollmuss and Agyeman, 2002). See Figure 4 on page 44.

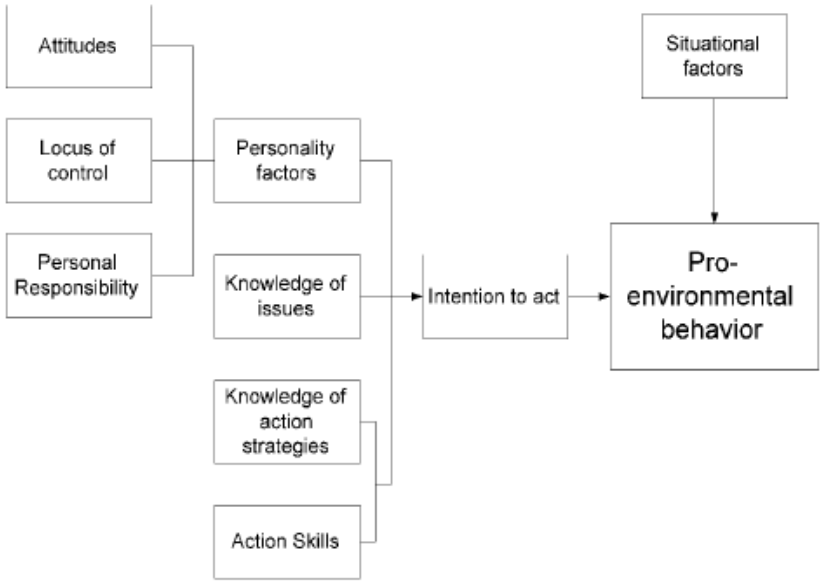

Figure 4: The Model of Responsible Environmental Behaviour. Source: Kollmuss, A. and Agyeman, J., 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental education research*, 8(3), pp.239–260

Theory of Planned Behaviour (TPB)

The TPB model (Ajzen, 1985; 1991) is more closely aligned with self-interest. Decisions are made in light of an estimation of consequences. Attitudes lead to intentions, which themselves then lead to behaviour. It includes a concept called "Perceived Behavioural Control" (PBC), which is the individual's evaluation of their own ability to perform a given behaviour. This is a determinant of intention, along with attitude and social norms. Motivations for following social norms are defined in terms of self-interest. (Individuals are assumed to follow social norms out of a fear of social exclusion.) TPB also allows PBC to directly influence behaviour, in some cases. See Figure 5 on page 45.

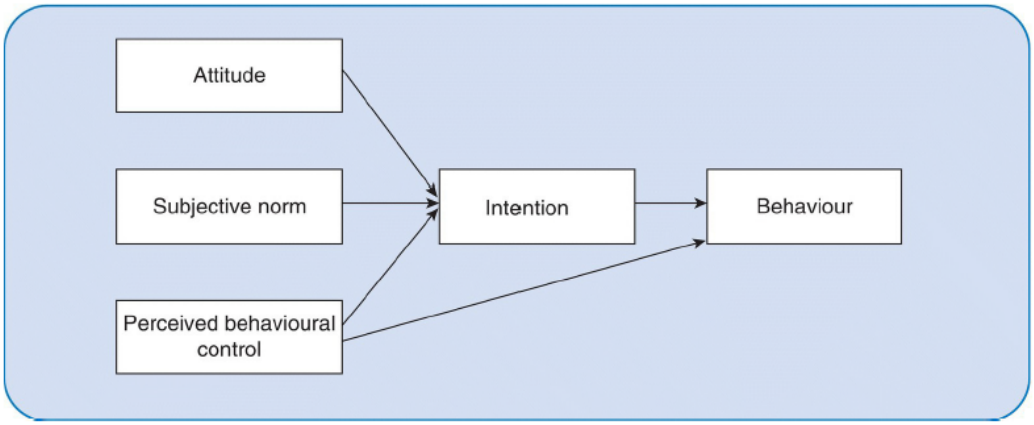

Figure 5: The Theory of Planned Behaviour. Source: Bell, P.A. et al., 1996. *Environmental Psychology.* Harcourt

The Value Action Gap

Blake (1999) set about to identify the causes of what he called the "value-action gap," the difficult in predicting pro-environmental behaviours from pro-environmental attitudes. He believed that the gap was due to the difficulty

in incorporating individual, social and institutional constraints, and identified three "barriers to action:" *individuality*, *responsibility* and *practicality*. See Figure 6 on page 46.

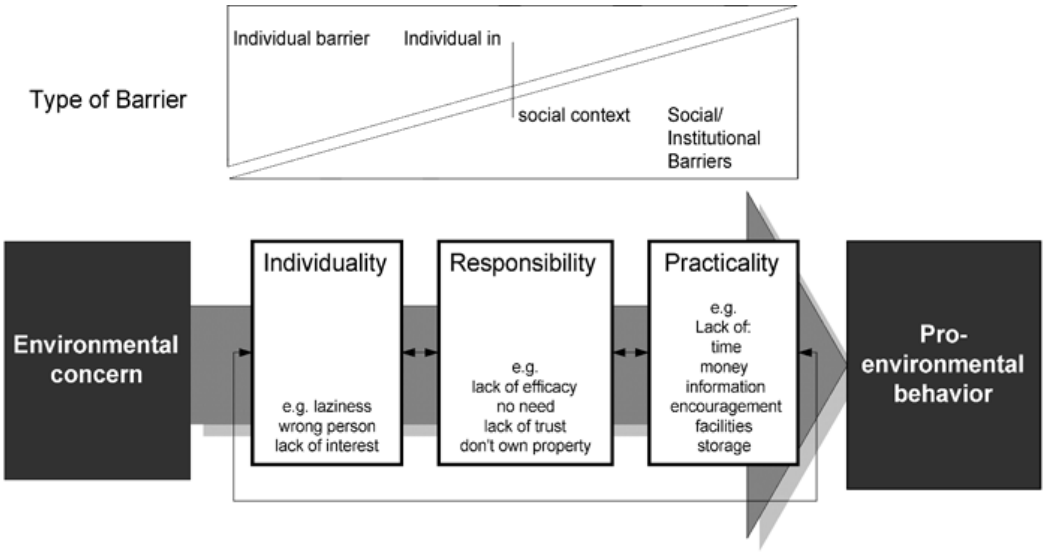

Figure 6: The Value Action Gap. Source: Kollmuss, A. and Agyeman, J., 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental education research*, 8(3), pp.239–260

The Value Belief Norm Theory (VBN)

VBN theory (P. Stern, 2000) is a modification of NAM, with values (which can be biospheric, altruistic or egoistic) predicting awareness, via "ecological worldviews." Experimental validation of this theory (for example, Chen, 2015) shows this model to have a high degree of flexibility.

See Figure 7 on page 47.

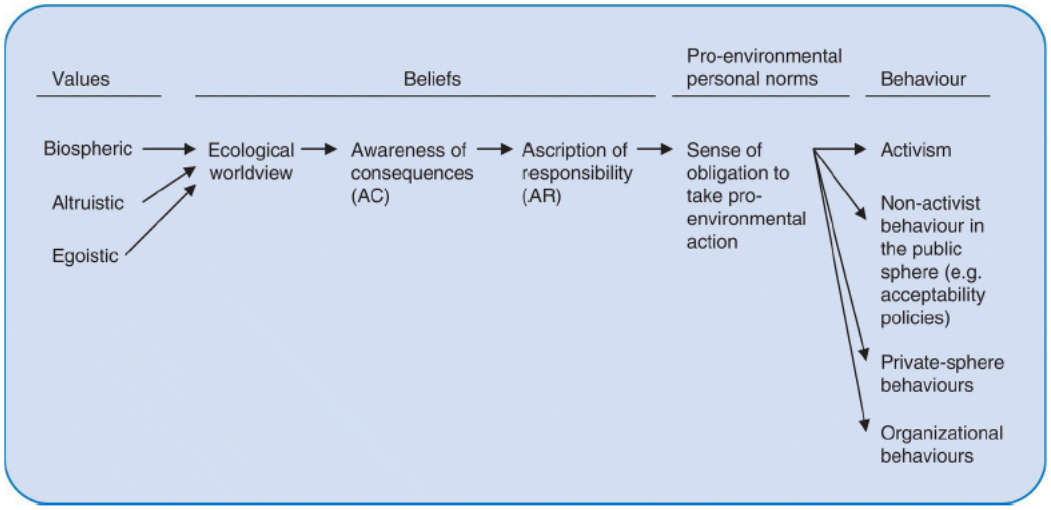

Figure 7: The Value Belief Norm Theory. Source: Bell, P.A. et al., 1996. *Environmental Psychology.* Harcourt

Goal Framing Theory (GFT)

GFT (Lindenberg and Steg, 2013) describes "norm-guided behaviour," (social norms) as "precarious," meaning that high levels of pro-environmental attitudes are necessary to sustain them, and he backs this up with reference to several empirical studies. Possibly shedding light on the difficulty that attitudes (or intentions) have in predicting behaviour, Lindenberg and Steg highlight how "focal goals" (such as short-term hunger) are able to override even well-supported social norms. And, with a nod to the work on "Nudge" factors (Thaler and Sunstein, 2017), he describes various goal-framing techniques that have been shown to increases the chances of pro-environmental behaviour. See Figure 8 on page 48.

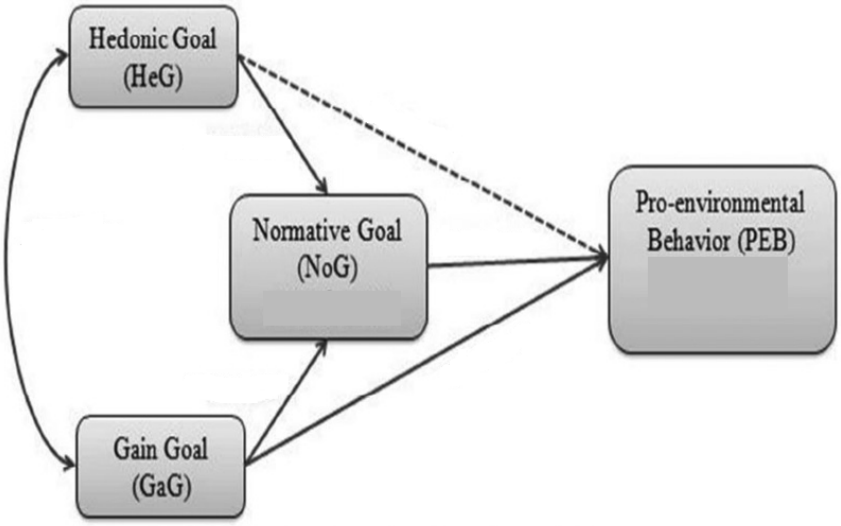

Figure 8: Goal Framing Theory. Source: Chakraborty, A., Singh, M.P. and Roy, M., 2017. A study of goal frames shaping pro-environmental behaviour in university students. *International Journal of Sustainability in Higher Education*, 18(7), pp.1291–1310

A Model Based on Discrete Choice

All of the factors mentioned in the above theories can be included in a model of pro-environmental attitudes. It is not necessary to decide which of the various theories is "right," since the model itself can be used with data to validate any given theory. Indeed, a successful pro-environmental attitude model could shed light on how these factors influence each other and suggest a way to build a more synthetic theory of pro-environmental behaviour.

Previous economic theories, such as the model of moral motivation of Brekke, Kverndokk and Nyborg (2003), have not admitted the ability to both model heterogeneous individuals and also capture psychological factors.

This section describes the general form of a class of discrete choice models that is capable of modification to include a number of psychological factors and also meets all of the requirements mentioned in the previous sections.

Consider an individual i who at each point in time t decides how much ω_i of a public good G to consume. There are a total of N individuals.

The domain of ω_i can vary depending on the model. In a simplistic model it might be $\{0, 1\}$. Or we may have $\omega_i \in [0, 1]$.

Let us define $x \equiv \Sigma_i(\mathbb{1}(\omega_i = 1))/N$ or $x \equiv \Sigma_i \omega_i / N$ depending on the model. The intuition is that x is the proportion of individuals that have chosen $\omega_i = 1$ or the degree to which the whole population have chosen high values of ω_i. This x will represent the pro-environmental percentage of the population.

In the case of climate change, the public good could be constructed as the inverse of a pollution measure. For instance if the maximum safe capacity of CO_2 is CO_2^{max} parts per million and the current concentration is CO_2^{cur} then the public good G could be defined as $CO_2^{max} - CO_2^{cur}$.

The individual's utility function is given by

$$U_i = \alpha u_i(\omega_i) + X_i \omega_i + \epsilon_i \tag{1}$$

Here u_i is the individual's utility of consumption, X is a n by 1 vector of psychological factors, α is a constant with the purpose of allowing the utility of

consumption to be arbitrarily big (or small) in comparison with the psychological factors. ϵ_i is a noise component.

It makes sense to consider the special case where individuals have common utilities of consumption $u = u_i$ and that all of the noise components are independent and identically distributed. $\epsilon_i = \epsilon \sim N(0, \sigma)$

Note that if X_i is constant over time, then U_i is soluble and we can denote the solution by U_i^*.

Let us now decompose the matrix $X_i = SA_i$ where S is an n by n matrix that is constant (for any point t in time) across all individuals and A_i is the unique psychological profile for each individual i.

We can further split $S = P + N$ where P is the n by n matrix of positive pyschological factors and N is the n by n matrix of negative pyschological factors. That gives us

$$U_i = \alpha u_i(\omega_i) + (P + N)A_i\omega_i + \epsilon_i \tag{2}$$

For the purposes of examining the interaction with social norms let us consider the subclass:

$$U_i = \alpha u_i(\omega_i) + x(P + N)A_i\omega_i + \epsilon_i \tag{3}$$

where x is the pro-environmental proportion, defined above.

Conclusion

We have seen just how important pro-environmental attitudes are in applying pressure to governments, firms and other individuals. We have also seen how a model describing the progression of pro-environmental attitudes in a population can be created using a discrete choice framework as a base, and adding to it psychological factors.

Such a model would need to be validated against real data, but having done so, it should be possible to use the model to predict the dynamics (evolution) of pro-environmental attitudes, given changes in psychological factors. This then would be the first model to be capable of tracking the creation and diffusion of a social norm through a population.

In the realm of environmental policy, pro-environmental attitudes correspond to public acceptability. The implication is that this model could be a useful tool to assist policy makers in determining the likely success or failure of a given policy package. Such a model could predict how environmental social norms are affected by specific events and policy decisions, providing policy makers with the opportunity to respond with measures that guide public opinion, and indeed public behaviour, in a direction more conducive to a timely solution to the issues presented by climate change.

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