Distinguishing Dimensions of Pro-environmental Behaviour

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Non-Technical Summary

There is a lot of interest in the extent to which people behave in environmentally-friendly ways and in what makes some people behave in more environmentally-friendly ways than others. However, it is not a simple matter to classify a person as being more or less environmentally-friendly. A person might, for example, be very environmentally-friendly in their choice of energy supplier but not at all environmentally-friendly in their travel habits. It is therefore important to identify the different dimensions of people's behaviour and how they relate to one another.

In this study, we identify dimensions of behaviour within which people tend to act consistently, but between which they may act inconsistently. We find that there seem to be three main dimensions. These relate to behaviour at home, transport behaviour, and purchasing behaviour. Different types of people act in a more environmentally-friendly way in each dimension. For example, young adults are more environmentally-friendly in their transport behaviour but less environmentally-friendly in their behaviour at home. Also, attitudes towards the environment are more strongly associated with at-home or purchasing behaviours than with transport-related behaviours. This suggests that people have stronger constraints on their transport choices than on their at-home or purchasing behaviours. Overall, we find that people who are more environmentally-friendly in their at-home behaviour tend to also be more environmentally-friendly in their purchasing behaviour, but people who are more environmentally-friendly in either of those two dimensions are not much more likely than anyone else to be environmentally-friendly in their transport-related behaviour.

The findings have implications for policies designed to encourage people to act in more environmentally-friendly ways. The Government, local councils, and various other organisations often attempt to implement such policies, but they need to be aware that the kinds of people who might be able and willing to change their behaviour, and the extent to which people's attitudes influence their behaviour, can be very different for different dimensions of behaviour.

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Abstract: This study empirically identifies dimensions of behaviour that are distinct in terms of the extent to which people act pro-environmentally. Three dimensions are identified, relating to at-home, transport-related and purchasing behaviour. The correlation between behaviour in each dimension is explored and the characteristics and attitudes associated with the extent to which behaviour is pro-environmental in each dimension are compared. The correlates of pro-environmental behaviour are found to differ between the dimensions. Attitudes towards the environment are more strongly associated with at-home or purchasing behaviours than with transport-related behaviours. The findings have implications for the design of policies intended to influence behaviours with environmental impact and for marketing of pro-environmental behaviours.

1. Introduction

The reduction of carbon emissions as a means to limit the likely extent of damaging climate change has long since been accepted as a necessity (Oreskes, 2004). It is now more than twenty years since 154 countries signed the United Nations Framework Convention on Climate Change in Rio de Janeiro and more than fifteen years since the Kyoto Protocol set legally-binding emission reduction targets (Metz et al, 2007). In the United Kingdom, it is a decade since the 2003 Energy White Paper committed the country to a 60% reduction in carbon dioxide emissions by 2050 and it is more than five years since the 2008 Climate Change Act mandated an 80% cut by 2050 in emissions of six major greenhouse gases.

The actions of domestic households have a large impact on the volume of carbon emissions nationally. The UK Department of Energy and Climate Change has estimated that in 2012, private households were directly responsible, as end-users, for almost half of the country's greenhouse gas emissions (DECC 2014). It has been estimated that around 25% of the carbon footprint of UK households result from domestic energy consumption, 10% from private transport and 33% from purchase of food and clothing (Druckman & Jackson, 2012). While consumers do not have direct influence on how goods are manufactured or transported, or how electricity is produced, their consumption choices certainly sustain these sources of emissions.

Many policy initiatives have aimed to change the behaviour of consumers in ways consistent with emissions reduction, though these have had limited success (Jackson, 2005; Shove, 2010; Steg & Vlek, 2009). Even when climate change communications succeed in changing attitudes and behaviours, the effects may not be long-lasting (Howell, 2014). It therefore remains of concern to policy makers that people should regularise environmentally-friendly behaviour though a barrier to achieving this seems to be the complexity of people's behavioural choices. There is a need for better understanding of the drivers of behaviour and the interactions between them. These drivers may be different for different behavioural dimensions, a point that would be missed by research seeking to identify drivers of overall summary measures of behaviour. Instead, it may make sense to first identify distinct dimensions of behaviour that affect carbon emissions and then to study each separately and the interactions between them. This would be consistent, for example, with the attempt of the UK Department for Environment and Rural Affairs to develop a framework for pro-environmental behaviours in order to support the ultimate aim, "to protect and improve the

environment by increasing the contribution from individual and community action" (DEFRA, 2008).

This paper explores the existence of distinct behavioural dimensions, identifies factors associated with pro-environmental behaviour in each dimension, and compares these factors between dimensions. In doing so, we extend the literature by neither assuming the existence of a single overall tendency to behave in a pro-environmental way nor studying pre-defined dimensions in isolation. Instead we identify empirically distinct dimensions of behaviour and study them in combination, thereby gaining insight into the overall patterns of individual behaviour. A further contribution of the paper is that we are able to identify a broad set of socio-economic and circumstantial factors associated with each dimension of pro-environmental behaviour thanks to the particular richness of the data set that we employ.

The next section sets out and justifies the research objectives of the paper. The following section introduces the data and analysis methods that will be employed, with the subsequent section presenting the results. The final section of the paper draws conclusions and discusses implications, both for policy and for further research.

2. Background: Studying Pro-Environmental Behaviour

This study is concerned with pro-environmental behaviour, also referred to as environmentally-friendly behaviour and closely related to the concept of climate-friendly behaviour given that most of the behaviours we study are ones whose prime impact is via carbon emissions. In using the term pro-environmental behaviour, we are not implying that the behaviour has a positive benefit on the environment, but rather that it has less of a negative impact than an alternative behaviour. Thus it is a relative term. Ultimately this study is concerned with discriminating between individuals whose behaviours are likely to have different environmental impacts, ceteris paribus, so an individual who scores higher on an index of pro-environmental behaviour is one whose negative impacts on the environment are likely to be lesser than those of an individual with a lower score. It should also be clarified that in referring to pro-environmental behaviour we are neither implying nor assuming that the behaviour is driven by pro-environmental attitudes. We classify behaviours by their impacts rather than by the motivation for the behaviour. The factors associated with environmental attitudes and behaviours are many and heterogeneous (Gifford & Nilsson, 2014) and the relationship between attitudes and behaviours is likely to be mediated by many

other factors (Enqvist Jonsson & Nilsson, 2014; Kollmuss & Agyeman, 2002; Steg, Perlaviciute, van der Werff, & Lurvink, 2014). We make no assumptions regarding the nature of these multivariate associations but rather view them as a subject of empirical study.

A strand of previous research has developed and analysed individual-level summary measures of pro-environmental behaviour (e.g. Boeve-de Pauw & Van Petegem, 2013). We question whether such measures are meaningful given the likely heterogeneity between behavioural dimensions of the extent to which an individual's behaviour tends to be pro-environmental. We evaluate whether a simple sum of behavioural indicators from multiple dimensions provides a good summary measure of the extent to which a person tends to act in an environmentally-friendly way. We do this by comparing it to an empirically-derived weighted sum with respect to an internal validity criterion. Furthermore, we assess the extent to which such measures explain the overall variability in behaviour across a range of relevant behaviours.

This analysis is then extended by seeking to identify distinct behavioural dimensions and to develop summary measures of the extent to which an individual's behaviour is pro-environmental in each dimension. We identify the dimensions by seeking behaviours that exhibit consistency. Consistency of behaviour could arise either because people perceive the actions to be related (Kellogg, 2007) or because the actions imply similar habits and therefore tend to cluster. Consistency of action can therefore be interpreted as indicating either that an individual sees the behaviour as related or that the behaviours are driven by common factors. We test empirically which of a set of environmentally-related behavioural indicators tend to be consistent and therefore can be interpreted as belonging to a single dimension. If environmental considerations are a major driver of behaviour for a majority of people, then all items should be on a single dimension.

Having identified empirically distinct dimensions, we develop a measure of each, and describe the relationships between them. Our rich data set enables us to examine the extent to which people who are environmentally-friendly on one dimension are also environmentally - friendly on another and whether environmentally-friendly behaviour on each dimension has similar or different correlates. In addition to socio-economic correlates, we explore the role of attitudinal measures. The absence of an association between relevant attitudes towards the environment and pro-environmental behaviour would tend to suggest that the behaviour is being driven by factors other than environmental considerations. Exploration of these

associations can also contribute to knowledge about the value-action gap (Blake, 1999; Kollmuss & Agyeman, 2002; Owens, 2000; Poortinga, Steg, & Vlek, 2004; Schultz, Gouveia, Cameron, Tankha, Schmuck, & Franek, 2005) regarding pro-environmental behaviour.

3. Method

Data

Data are from wave 1 of the United Kingdom Household Longitudinal Study (UKHLS), a multi-disciplinary academically-led probability-based national survey involving structured at-home interviews with over 47,000 individuals aged 16 or over (Buck & McFall, 2012; Hobcraft & Sacker, 2012). Having a nationally-representative sample allows us to estimate the population prevalence of behaviours, attitudes and the relationships between them. The unusually large sample size allows us to identify these associations with considerable precision. We are also able to identify the roles of relatively rare characteristics and attitudes, in contrast to studies based on much smaller sample sizes. Interviews were carried out between January 2009 and March 2011 and lasted an average of 37 minutes. On completion of the interview, participants were additionally requested to fill in a self-completion questionnaire booklet. A total of 47,732 sample members completed the interview, of whom 40,513 also completed the questionnaire booklet.

Central to the analyses presented in this paper are two sets of survey items. The first set concerns behaviours that have environmental impact, predominantly via carbon emissions. These items were asked as part of the main interview and we refer to them as the environmental behaviours module. The second set concerns attitudes towards environmental issues and these were administered in the self-completion booklet. We refer to these as the environmental attitudes module. The analysis also draws upon other items, particularly relating to socio-demographic characteristics. These were asked as part of the main interview.

The environmental behaviours module consisted of a battery of eleven items, each referring to a common behaviour. For each, the respondent was asked to choose a response option indicating how often they personally act in that way, the options offered being "very often", "quite often", "not very often", "never" and "not applicable, cannot do this." The items are listed in Table 1, along with the sample proportions choosing each option. The environmental attitudes module contained fourteen items. Respondents were asked whether

or not they believed each of eleven statements regarding climate change and the environment, whether they agreed that being green is an alternative lifestyle (4-point agree-disagree response scale), to what extent they do things that are environmentally friendly and whether they are happy with what they currently do to help the environment. The items are listed in Table 2, along with the sample proportions choosing each option. These items are intended to tap the dimensions of environmental concern (Schaffrin 2011) environmental beliefs (De Groot & Steg, 2007; Gooch, 1995; O'Connor, Bord, &Fisher, 1999), and perceived locus of control (Enqvist Jonsson & Nilsson, 2014).

Data Analysis

We use canonical factor analysis to identify dimensions of behaviour and to establish the contribution of each behavioural item to the overall indicator of the extent to which behaviour in a dimension is environmentally friendly. The behavioural statements that indicate anti-environmental, rather than pro-environmental, behaviour, were first reverse-coded, so that in all cases a more positive score in the analysis indicates more pro-environmental behaviour.

We use simple Pearson correlation coefficients to summarise the extent of linear association between scores. As the indicators of the extent to which behaviour in a dimension is environmentally friendly are continuous variables and are approximately Normally distributed, we use ordinary least squares linear regression to identify the predictors of each indicator.

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Table 1: Environmental Behaviour Questions

How often do you personally …… (row percentages)	Always	Very Often	Quite Often	Not very often	Never	Not applicable, cannot do this	n
Leave your TV on standby for the night (`tv`)	23.0	5.9	5.4	9.2	55.0	1.6	*47,569*
Switch off lights in rooms that aren't being used (`lgts`)	62.0	21.0	10.0	4.3	2.6	0.2	*47,577*
Keep the tap running while you brush your teeth (`water`)	30.7	8.0	9.1	12.8	38.3	1.0	*47,573*
Put more clothes on when you feel cold rather than putting the heating on or turning it up (`heat`)	27.7	23.6	22.0	15.0	11.1	0.7	*47,550*
Decide not to buy something because you feel it has too much packaging (`pack`)	2.3	5.4	10.6	23.7	55.6	2.5	*47,446*
Buy recycled paper products such as toilet paper or tissues (`prod`)	10.4	13.8	19.6	22.5	29.6	4.1	*47,261*
Take your own shopping bag when shopping (`bags`)	42.6	15.6	11.6	9.2	17.0	4.0	*47,567*
Use public transport (e.g. bus, train) rather than travel by car (`pubt`)	16.2	10.7	11.8	24.0	31.3	6.1	*47,574*
Walk or cycle for short journeys less than 2 or 3 miles (`walk`)	19.6	19.5	18.7	17.1	19.6	5.5	*47,581*
Car share with others who need to make a similar journey (`car`)	4.7	7.5	11.8	14.0	36.6	25.4	*47,574*
Take fewer flights (`fly`)	5.4	3.8	4.5	9.8	36.2	40.4	*47,456*

Notes: The total number of people interviewed was 47,732. The numbers answering each item are slightly smaller due to some respondents refusing to answer an item or stating that they do not know the answer. Data are weighted to reflect variation in selection probabilities and participation probabilities (McFall, 2013).

Table 2: Environmental Attitudes Questions

Do you personally believe or not believe each of the following?	% agree	*n*
I don't believe my behaviour and everyday lifestyle contribute to climate change	39.7	*38,083*
I would be prepared to pay more for environmentally friendly products	49.5	*37,757*
If things continue on their current course, we will soon experience a major environmental disaster	57.3	*37,241*
The so-called 'environmental crisis' facing humanity has been greatly exaggerated (`exag`)	41.7	*36,905*
Climate change is beyond control – it's too late to do anything about it (`bcon`)	20.2	*37,177*
The effects of climate change are too far in the future to really worry me	28.6	*38,243*
Any changes I make to help the environment need to fit in with my lifestyle	59.6	*37,919*
It's not worth me doing things to help the environment if others don't do the same	30.2	*37,754*
It's not worth Britain trying to combat climate change, because other countries will just cancel out what we do	29.3	*37,597*
People in the UK will be affected by climate change in the next 30 years	73.4	*37,787*
People in the UK will be affected by climate change in the next 200 years	85.6	*37,188*
How do you feel about your current lifestyle and the environment? (`domore`)		
I'm happy with what I do at the moment	65.9	
I'd like to do a bit more to help the environment	29.4	
I'd like to do a lot more to help the environment	4.7	*40,172*
Which of these best describes your current lifestyle? (`current`)		
I really don't do anything that is environmentally friendly	6.9	
I do one or two things that are environmentally friendly	40.8	
I do quite a few things that are environmentally friendly	36.0	
I'm environmentally friendly in most things I do	14.7	
I'm environmentally friendly in everything I do	1.7	*40,074*
Do you agree or disagree that being green is an alternative lifestyle, it's not for the majority? (`alternative`)		
Agree strongly	6.6	
Agree	49.5	
Disagree	35.8	
Disagree strongly	8.0	*39,680*

Notes: The total number of people who completed the self-completion questionnaire was 40,513. The numbers answering each item are smaller as some respondents left items blank. The proportion not answering varied between 0.8% and 8.9% across the 14 items in the environmental attitudes module. Data are weighted to reflect variation in selection probabilities and participation probabilities (McFall, 2013).

4. Results

Identifying Dimensions of Behaviour

To identify dimensions of behaviour a canonical factor analysis was carried out on the set of eleven UKHLS behavioural items (see Table 1). The results (Table 3) indicated four significant factors. The first factor identified by the analysis loads positively on all eleven items and can therefore be interpreted as identifying a general tendency to behave in an environmentally-friendly way. The other three factors each appear to identify a meaningful behavioural dimension (shaded cells). Factor 2 is primarily identified by a contrast between the four transport-related behavioural domains (positive loadings) and the other seven domains (negative loadings). Factor 3 contrasts behaviours at home (leaving the tap running, leaving the television on standby, switching off lights, wearing warmer clothes rather than turning up the heating) plus the use of one's own shopping bags with the other behavioural domains. Factor 4 instead distinguishes the remaining domains that are related to purchasing behaviour (buying recycled products and avoiding excess packaging). The analysis seems therefore to clearly identify three dimensions of behaviour, relating respectively to transport, home, and purchasing behaviour.

We compared the measure of general tendency to behave in an environmentally-friendly way implied by the factor analysis (a standardised weighted sum of the item scores which we will refer to as `wtdsum`, where the loadings on factor 1 constitute the weights) with a simple standardised unweighted sum of the item scores, as used by Longhi (2013), which we refer to as `unwsum`. A strong correlation (0.958) was observed between the two measures. Internal validity was compared by using each measure in turn to predict a measure of attitudes towards environmentally-friendly behaviour. The dependent variable was a dichotomous indicator derived from the variable current (see Table 2). The indicator took the value 1 if the respondent indicated that they felt themselves to be environmentally-friendly in "most things" or "everything" they do. Results are summarised in Table 4. Both measures of behaviour are strongly predictive of the attitudinal measure, with a predicted odds ratio of around 1.8 (which can be interpreted as an 80% increase in the odds of holding a green attitude for an increase of one standard deviation in the behaviour score). `wtdsum` is a slightly stronger predictor (odds ratio departs further from 1.00) than `unwsum`, but the difference is small. In this case, then, it would seem that `unwsum` can be used as a summary

measure of behaviour with just a little loss of statistical power and some advantages in simplicity of calculation and interpretation.

Table 3: Factor Analysis of Environmental Behaviour Items

Variable	Factor 1	Factor 2	Factor 3	Factor 4
tv	0.193	-0.047	-0.134	0.084
lgts	0.250	-0.116	-0.162	0.074
water	0.296	-0.080	-0.077	0.048
heat	0.309	-0.088	-0.072	0.064
pack	0.424	-0.088	0.162	-0.101
prod	0.439	-0.108	0.103	-0.104
bags	0.307	-0.204	-0.128	-0.030
pubt	0.294	0.376	-0.047	-0.034
walk	0.353	0.312	-0.023	0.004
car	0.113	0.022	0.259	0.021
fly	0.268	0.050	0.243	0.091

See table 2 for a description of the behavioural items.

Table 4: Internal Validation of Summary Behaviour Scores

	Model 1	Model 2
Dependent variable	current	current
Independent variable	wtdsum	unwsum
Odds ratio	1.833	1.798
Standard error	0.031	0.030
P	<0.001	<0.001
n	40,074	40,074

Developing Dimension-Specific Behaviour Scores

Having identified three distinct dimensions of behaviour, the next step of the analysis was to develop a summary measure, for each dimension, of the extent to which behaviour in that dimension is pro-environmental. To do this, separate factor analyses were performed on the

behavioural domains within each of the dimensions identified by the initial factor analysis. For each dimension a summary measure of behaviour was then constructed, consisting of the sum of the weighted item responses, where the factor loadings acted as the weights. Each of the three summary measures was then standardised to facilitate comparison (Table 5).

Table 5: Dimension-Specific Measures of Behaviour

Dimension	Measure
Transport	$\texttt{trans}=[(0.467\texttt{pubt}+0.458\texttt{walk}+0.107\texttt{car}+0.217\texttt{fly}) - 3.140] / 1.1856$
Home	$\texttt{home}=[(0.252\texttt{TV}+0.331\texttt{lgts}+0.305\texttt{water}+0.318\texttt{heat}+0.341\texttt{bags}) - 5.699] / 1.2022$
Purchasing	$\texttt{cons}=[(0.443\texttt{pack}+0.443\texttt{prod}) - 1.862] / 0.8580$

Each measure represents the principle factor from a canonical factor analysis of the behavioural domains within the respective behavioural dimension. The wording of the constituent items is presented in Table 1.

A modest correlation is observed between home and purchasing behaviours (0.261, Table 6). Behaviour in each of these dimensions is only weakly associated with transport-related behaviour (0.144 and 0.184 respectively). This confirms the impression given by the initial factor analysis (Table 3) that these are largely independent dimensions of behaviour. People who are environmentally-friendly in their at-home or purchasing behaviours are only slightly more likely than others to be relatively environmentally-friendly in their transport-related behaviour. To illustrate this, Table 7 shows the distribution of associations between behaviour in the at-home and transport dimensions. For each dimension, respondents have been divided into quartiles of the distribution. The middle two quartiles have been combined. It can be seen that amongst those who are in the upper quartile of the distribution for at-home behaviour, only 30% are in the upper quartile for transport-related behaviour. The proportion in the upper quartile for transport-related behaviour is only 21% amongst those in the lower quartile for at-home behaviour. There is therefore some association, as these proportions would be 25% if the two dimensions were completely independent. But the small deviations from 25% illustrate the weakness of the association between behaviour in the two dimensions.

Table 6: Correlations between Three Dimensions of Environmentally-Friendly Behaviour

	Home	Purchasing	Transport
Home	1.000		
Purchasing	0.261	1.000	
Transport	0.144	0.184	1.000

Table 7: Association of Behaviour in the At-Home and Transport Dimensions

Transport	At-Home behaviour			
	Lower Quartile	Inter-Quartile	Upper Quartile	Total
	%	%	%	%
Lower Quartile	30.5	21.7	17.8	22.9
Inter-Quartile	48.9	53.0	52.1	51.8
Upper Quartile	20.6	25.3	30.1	25.3
Base	11,932	24,190	11,610	47,732

Comparing Correlates of Behaviour

A series of regression models were fitted to predict each of the three dimension-specific environmental behaviour indicators. The first set of models used as predictor variables a set of socio-demographic characteristics, namely age, sex, marital status, economic activity status, net income and immigrant status. The second set of models used as predictors a set of subjective indicators. These included attitudes towards the environmental impacts of one's own behaviour, belief in the effectiveness of climate change mitigation measures, and an indicator of scepticism regarding the importance of environmental issues. The third set of models combined the socio-demographic and attitudinal measures.

The first and third sets of models are presented in Table 8. The second set are omitted to save space, as the estimated coefficients for the subjective measures are generally similar to those in the third set of models, though with a tendency for effects to appear slightly stronger in the second set of models. There are some similarities in the predictors of each of the behavioural dimensions. Notably, being born outside of the UK, considering oneself to be environmentally-friendly in most or all things one does, wanting to do more to help the

environment, and not concurring that the environmental crisis has been greatly exaggerated, are all associated with an increased tendency to behave in a more environmentally-friendly way in all three dimensions.

However, there are also some clear differences in predictors between the behavioural dimensions. For example, income is a significant predictor of environmentally-friendly behaviour in both the home and transport domains, but not in the purchasing domain. One of the most notable differences is the association of behaviour with age. The tendency to be environmentally-friendly in at-home behaviour increases with age, though the relationship becomes almost flat above age 65 (Figure 1). For purchasing behaviour, the relationship with age is similar but far more pronounced, increasing with age until around age 50, and then decreasing slightly at older ages. However, the association of transport-related behaviour with age is opposite in direction to that for the other two behavioural dimensions. Young people are the most environmentally-friendly in their transport behaviour, but this reduces steeply with age, reaching a minimum in the late fifties before then increasing, such that 80 year-olds are similar in their transport-related behaviour to 35 year-olds. This relationship is most likely driven by car ownership, disposable income and physical mobility. Levels of car ownership and disposable income are lowest amongst adults in their teens and early twenties and then increase with age until retirement age, at which point physical mobility also begins to decline. However, we should note that we cannot be sure, from these data, whether the association with age is a life-stage effect or a cohort effect. The latter seems unlikely, though, given the non-linear nature of the relationship and given the known life-stage associations with car ownership, income and physical mobility.

Table 8: Dimension-Specific Models of Pro-Environmental Behaviour

	Behavioural Dimension					
	Home	Purchasing	Transport	Home	Purchasing	Transport
Age	0.036**	0.044**	-0.007**	0.024**	0.034**	-0.012**
age-sqd	-0.0003**	-0.0004**	0.0001	-0.0002**	-0.0003**	0.0001**
Sex	0.172**	0.224**	0.050**	0.127**	0.191**	0.029*
marstat (ref=never married)						
Married or Living as married	0.083**	-0.066**	-0.321**	0.066**	-0.070**	-0.313**
Divorced, widowed or separated	-0.001	-0.065**	0.193**	0.015	-0.038	-0.181**
econstat (ref=employed)						
Self-employed	-0.039	0.085**	-0.153**	-0.048	0.068**	-0.160**
Unemployed	-0.001	0.019	0.345**	0.017	0.009	0.352**
Retired	0.161**	0.084**	0.212**	0.123**	0.052	0.192**
Student	0.167**	0.057	0.418**	0.127**	-0.001	0.403**
Other	0.006	0.022	0.124**	0.023	0.028	0.115**
Not UK-born	0.188**	0.322**	0.369**	0.157**	0.278**	0.334**
Log-income	-0.054**	0.005	-0.048**	-0.071**	-0.007	-0.059**
current (ref = not at all)						
In one or two things				0.320**	0.131**	0.041
In a few of things				0.664**	0.434**	0.187**
In most things				0.871**	0.664**	0.322**
In all things				0.734**	0.758**	0.395**
domore (ref = no)						
Yes, a bit				0.071**	0.218**	0.076**
Yes, a lot				0.163**	0.356**	0.184**
exag				-0.071**	-0.133**	-0.078**
bcon				-0.070**	-0.024	0.006
Constant	-0.986**	-1.472**	0.532**	-0.959**	-1.408**	0.640**
Pseudo-R^2	0.081	0.047	0.092	0.143	0.118	0.110

** indicates $P < 0.001$; * indicates $0.001 < P < 0.01$

Figure 1: The Association of Age with Three Dimensions of Environmentally-Friendly Behaviour
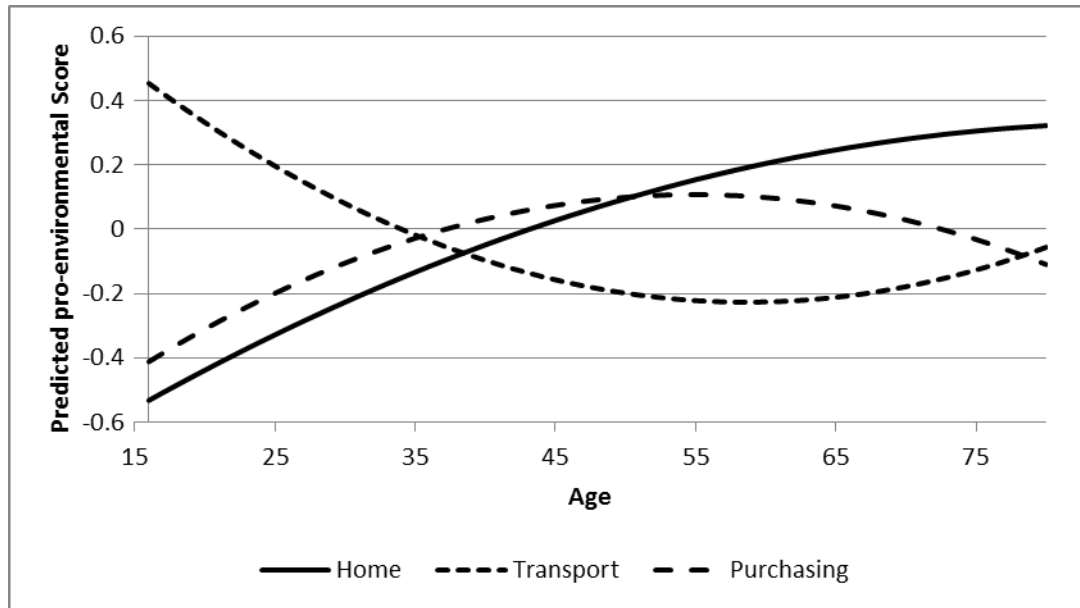
Differences between the behavioural dimensions in the association of behaviour with subjective measures are more modest. Belief that climate change is beyond control is associated with a lower propensity to act in environmentally-friendly way at home, but is not associated with behaviour in the purchasing or transport domains. Considering oneself to be environmentally-friendly in most or all things is much more strongly associated with an increased tendency to behave in an environmentally-friendly way in the home and purchasing dimensions than in the transport dimension.

It is notable that the predictive power of attitudes varies considerably between the three behavioural dimensions, a fact that would be missed in any research that uses a single index of environmentally-friendly behaviour (such as `wtdsum` or `unwsum`). For purchasing behaviour, model fit improves substantially when the subjective measures are added to the model with socio-demographic predictors alone (Δ pseudo-R^2 = 0.071). The improvement in fit is also considerable for at-home behaviour (Δ pseudo-R^2 = 0.062) but is negligible for transport behaviour (0.018). This may indicate that, of the three dimensions, purchasing is the one that is least strongly determined by situational constraints and therefore responsive to attitudinal influences (consistent with the findings of Opinion Leader Research, 2007), whereas transport choices are the most heavily constrained.

5. Conclusions

This study has identified three distinct dimensions of pro-environmental behaviour, relating to at-home, transport-related and purchasing behaviour. There is only weak correlation between the behavioural dimensions. People who act in a more pro-environmental way in one dimension do not necessarily do so in another dimension. This is particularly true of the transport dimension. The extent to which a person's transport-related behaviour is pro-environmental is almost independent of the extent to which their behaviour in either of the other two dimensions is pro-environmental. Additionally, it was found that the socio-demographic and attitudinal correlates of pro-environmental behaviour varied between the behavioural dimensions. Thus, for example, younger people and those who believe climate change is beyond control are less likely to behave in pro-environmental ways at home, while pro-environmental behaviour in the transport dimension is least likely amongst middle-aged people and not associated with belief that climate change is beyond control.

These findings suggest that attempts to measure or explain the extent to which individual's behaviour is, overall, pro-environmental - such as the population segmentation exercise undertaken by the UK Department for Environment and Rural Affairs (DEFRA, 2008) - may have limited potential. A more powerful approach may be to measure and explain behaviour in each of a set of coherent behavioural dimensions such as those identified in this study. It is likely that the drivers of behaviour could be very different for different behavioural dimensions. Similarly, policy measures intended to influence behaviour, particularly with a view to reducing energy demand and/or carbon emissions, are likely to be more effective for different population subgroups depending on the specific nature of the behavioural change of interest. This has implications both for the marketing and targeting of initiatives and for the nature of the initiatives themselves, as these would ideally be tailored to the characteristics, constraints and motivations of people who tend to behave in particular ways.

The findings of this study are also consistent with the value-action gap that has been observed by others in the context of environmental attitudes and behaviour (e.g. Poortinga, Steg, & Vlek, 2004; Schultz, Gouveia, Cameron, Tankha, Schmuck, & Franek, 2005). In our models, values, attitudes and beliefs (see Schultz & Zelezny, 1999, for discussion of the relationship between environmental values and attitudes) are not strong predictors of the extent to which behaviour is pro-environmental in any of the three behavioural dimensions studied. They are particularly weak predictors of transport-related behaviour. Indeed, we would expect a higher

correlation between the dimensions in the extent to which behaviour is pro-environmental if environmental attitudes were a strong common influence. Instead we observe only weak correlations. It seems clear that the main drivers of the extent to which behaviour is pro-environmental are something other than environmental values and attitudes. Further study is needed to better understand what these drivers are and how they operate.

The current study has some important limitations that should be recognised. Our measures of behaviour do not directly relate to environmental impact. For example, a survey respondent reporting that they do not regularly re-use shopping bags may have a big impact if they instead regularly go shopping and use disposable bags each time. But another respondent giving the same answer may have very little impact if they rarely go shopping at all. Thus, the absence of a reported environmentally-friendly behaviour could be either due to environmentally-unfriendly behaviour or due to a lack of opportunity (essentially, little or no behaviour of any kind in that domain). Our measures of behaviour should therefore be interpreted as a tendency to have certain behavioural traits, rather than as measures of the environmental impact of behaviour.

This study has only measured association between characteristics and behaviours. No specific evidence on the nature of causality has been provided. However, *Understanding Society*, the source of the data used in this study, will repeatedly administer the items on pro-environmental behaviour and attitudes to the same nationally-representative sample every three years. In due course this will provide a rich longitudinal data set which will permit identification of individual-level changes in behaviour and attitudes and will provide a stronger basis upon which to draw conclusions about causal effects (Kalton & Citro, 1993; Lynn, 2009).

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