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Edward Boyes, Martin Stanisstreet

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ABSTRACT

One of the aims of environmental education is to persuade people to act in pro-environmental ways. This is particularly important with environmental problems that are believed to be both major and imminent, such as global warming; in such cases it is important that education be effective. There being no clear link between a person's overall environmental awareness and friendliness, this study aims to focus on specific environmental actions. Using quantitative methods to investigate students' beliefs about the usefulness of *specific* actions and their willingness to adopt them, it has been possible to construct a number of novel indices which indicate the potential effectiveness of education about those specific actions. The findings imply that altering a student's belief about some actions will likely have little effect on their willingness to undertake them. For some of these issues, this was because even those students with only a weak belief in the efficacy of the action were prepared to do it anyway. For others, such as supporting more use of nuclear power, it was because even those students who believed it would reduce global warming would not countenance nuclear energy. Education in these two areas may be ineffective because other incentives or disincentives dominate. For another set of issues, however, the practical benefits of education seemed more positive; increasing recycling, reducing the use of artificial fertilisers and planting more trees are examples of this.

INTRODUCTION

“The literature on public understanding of climate change indicates widespread awareness of the issue and a general concern, but limited behavioural response”

(Lorenzoni, Nicholson-Cole & Whitmarsh, 2007)

Twenty years ago the scientific evidence for an exacerbation of global warming¹ by a range of anthropogenic atmospheric pollutants was considered by some to be contentious (Stevenson, 1987; Boyes & Stanisstreet, 1993). Today, however, the weight of objective evidence persuades most people that the increase in global warming is a real phenomenon, caused by human-sourced greenhouse gases. Furthermore, authoritative sources agree that this is an increasing threat to the world’s environmental integrity, its social well-being (IPCC, 1997; 2001, 2007), economic stability (Stern, 2007) and political security (Solana, 2008). In view of these persuasive predictions, it is increasingly important to design and apply effective measures for reducing greenhouse gas emissions. In part, this will depend on central government policies. The UK government, amongst others, set ambitious targets to reduce by 12.5% the levels of the major greenhouse gases by 2010 (relative to 1990 levels), with a reduction by 20% for carbon dioxide in particular. Furthermore, the political goal is to reduce carbon dioxide by 60% by 2050 (DTI, 2003). Unfortunately, since these targets were set it has become apparent that the 20% reduction in carbon dioxide will not be achieved, throwing doubt on the attainability of the 2050 target of a 60% reduction (DEFRA, 2006).

In a complementary manner, it is estimated that about half of UK energy use is by individuals, for domestic use and personal transport. In these sectors, however, energy consumption is in fact increasing (DEFRA, 2008). What is needed, then, are mechanisms to persuade individuals to reduce their carbon contribution by limiting their energy use. One of the aims of environmental education is to engender in learners a willingness to act in more environmentally sustainable ways

¹ In this paper, for economy of words, we use the term ‘global warming’ to refer to the exacerbation of the natural greenhouse effect by the addition of anthropogenic pollutants to the atmosphere.

1 (Mentzer & McEwen, 1999; Jurin & Fortner, 2002; Heimlich & Ardoin, 2008) and, in the context
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3
4 of global warming, this practical role of eliciting behaviour modification, has assumed new
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6 importance and urgency.
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10 Early models of behaviour change in an environmental context became known as 'information
11
12 deficit models' (Burgess, Harrison & Filius, 1998). These were presaged on the assumption that if
13
14 people understood more about the environment and the actions that would cause, or avoid,
15
16 environmental degradation, they would behave in a rational manner and adopt environmentally
17
18 sympathetic behaviour patterns. In other words, it was believed that there was a relatively direct
19
20 and positive relationship between a person's cognitive base about environmental problems and their
21
22 willingness to act in such a way as to reduce these problems. Some studies have shown that
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24 knowledge and behaviour are indeed related (Yencken, 2000). In many other cases, however, it
25
26 seems that the relationship between knowledge and action is not robust (Rajecki, 1982; Hungerford
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28 & Volk, 1990; Posch, 1993; Kollmus & Agyeman, 2002); there is what has come to be known as a
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30 'gap' between cognition and action (Kollmus & Agyeman, 2002).
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39 In part, this 'gap' is due to the fact that behaviour is influenced by a plethora of other factors, not
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41 just knowledge. Other beliefs, social pressures, physical facilitators and inhibitors can
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43 synergistically influence whether or not a particular action is pursued (Corraliza & Berenguer,
44
45 2000). Similarly, descriptive and injunctive social norms influence whether or not a person acts in
46
47 an environmentally sympathetic fashion (Cialdini, Reno & Kallgren, 1990). Perhaps most relevant
48
49 to the present study is the finding that situational influences such as a person's belief in their own
50
51 self-efficacy also partly determines the extent to which he or she acts in a pro-environmental
52
53 manner (Devine-Wright, Devine-Wright & Flemming, 2004; Laskova, 2007). A further issue that
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55 has emerged as workers have attempted to generate models of the incentives and disincentives to
56
57 pro-environmental behaviour is that there are limitations in studying links between *general*
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1 environmental attitudes and potential behaviour patterns (Fishbein & Ajzen, 1975; Ajzen &
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4 Fishbein, 1980; Dietz, Stern & Guagnano, 1998; Stern, 1992).
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9 Given this complexity, and the pressing need for a reduction in the emission of anthropogenic
10
11 greenhouse gases, we have attempted to explore the role that education about the usefulness of *more*
12
13 *specific* pro-environmental actions might play in eliciting changes in behaviour. We have designed
14
15 an instrument that questions respondents about their willingness to countenance *specific* pro-
16
17 environmental behaviours and, separately, their beliefs about the possible benefits of these
18
19 *particular* behaviours on one environmental problem - global warming. Three research questions
20
21 have been addressed. Firstly, the degrees to which students report being willing to undertake a
22
23 variety of specific 'environmentally friendly' actions have been ascertained. Secondly, the extents
24
25 to which students believe these particular actions would be effective in reducing global warming
26
27 have been investigated. Thirdly, the relationship between these two things, students' reported
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29 willingness to undertake specific actions and their beliefs about the usefulness of the same actions,
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31 has been explored. The overall aim was to determine how effective increasing understanding about
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33 particular actions through specific environmental education of a practical nature might be in
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35 persuading individuals to increase their willingness to undertake those actions, so that
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37 environmental education might be targeted to those areas in which it is likely to be most effective.
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46 **METHODS**

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48 This study employed a novel questionnaire to probe the views of secondary students. The study
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50 was initiated in the UK, but has since extended to Australia, the USA and a number of countries in
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52 mainland Europe; here we report the findings of the UK study.
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58 **Design of the questionnaire**

1 The questionnaire consisted of a coversheet, two main sections and a short final section. The
2
3 wording of the questionnaire items from the two main sections is shown in Figure 1, where the
4
5 ordering is different to that in the questionnaire for the reasons given below. The coversheet asked
6
7 respondents to record their Year Group and gender, and the fourth section, at the end of the
8
9 questionnaire, contained 4 items designed to probe the level of students' concern about global
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11 warming, the extent of their perceived knowledge about global warming, the degree to which they
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13 considered themselves to be environmentally 'friendly', and whether or not they believed that
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15 global warming was a real phenomenon that was already happening. These questions, and the
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17 available responses, are shown in Figure 2.
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25 The first of the two main sections of the questionnaire contained 20 items, 16 of which were about
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27 actions that would contribute to the amelioration of global warming; these actions were chosen to
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29 be representative and generally accepted as important. Most of the ideas in these items related to
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31 carbon dioxide emissions from energy use and wastage, although two were concerned with other
32
33 greenhouse gases, methane and nitrogen oxides. Four of the items concerned indirect actions, such
34
35 as ways of supporting increased environmental taxation or legislation. The four remaining items
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37 were more idiosyncratic in nature; these focused on ideas that had been raised by students
38
39 themselves in earlier research (Boyes & Stanisstreet, 1993). These four distracters were added to
40
41 the 16 so that respondents would not feel obligated to respond positively to all questions; the results
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43 from the four items will not be considered in this paper.
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51 The focus of the first main section of the questionnaire was the degree to which students would be
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53 willing to undertake a particular action "for the sake of the environment and the future of the
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55 Earth"; no mention was made of global warming at this stage. Thus, the items took the form of a
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57 conditional clause indicating the personal cost or inconvenience of the action, followed by a
58
59 simplified description of the action. The wording of the items can be seen in the right hand column
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1 of Figure 1, and the available responses to these items, which ranged from “I would definitely do it”
2
3 to “I would probably not do it”, and the ways in which they were scored, are shown in the right side
4
5 of Figure 3. The scored responses produced by the items in this section of the questionnaire were
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7 designated students’ *Degree of Willingness to Act*.
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12 The 20 items in the second main section of the questionnaire concerned the same pro-environmental
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14 actions as those in the first main section, although the order was different so that the pairing of the
15
16 questions was not immediately apparent to the respondents. Here, however, the focus of the
17
18 questioning was on the extent to which respondents believed that the actions were useful in
19
20 alleviating global warming. The wording of these items can be seen in the left column of Figure 1,
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22 and the available responses, which ranged from “quite a lot” to “nothing at all really”, and the ways
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24 in which they were scored, are shown in the left side of Figure 3. The scored responses were
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26 designated students’ *Believed Usefulness of Action*.
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34 Figure 1 also illustrates the pairing of the items and the themes within the questionnaire. Not only
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36 were the items paired, however, the available responses in the two main sections of the
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38 questionnaire were designed to ‘match’, in semantic terms. Figure 3 illustrates this, where the two
39
40 response scales are shown in apposition. If, for example, a student believed that a particular action
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42 would help by ‘quite a lot’, this was matched in the other section to the response that they would
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44 ‘definitely’ be willing to do it; each of these responses received a score of 1. Conversely, if a
45
46 student believed that an action would reduce global warming ‘by nothing at all’, this is matched to
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48 the action section response that they would ‘probably not’ do it, and both responses received a score
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50 of zero. The intermediate responses were also designed to correspond in a similar way, by
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52 semantics and score.
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1 The final wording of the paired questionnaire items and matched response scales came about from a
2 series of discussions with a group of researchers and teachers. The questionnaire was trialled with
3
4 series of discussions with a group of researchers and teachers. The questionnaire was trialled with
5
6 134 students (age 14 years), and the only modification entailed the removal of the word 'insulation'
7
8 and the rephrasing of the pair of questions concerned.
9

10 11 12 13 **Construction of the indices**

14 From the responses to the two sections of the questionnaire, the *Degree of Willingness to Act* and
15
16 *Believed Usefulness of Action*, a number of derived indices were produced which have been used to
17
18 explore the connections between them. Although the two response scales are ordinal and although
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20 they measure different things, it was felt that because of their semantic matching (Figure 3), some
21
22 mathematical manipulation of the data is acceptable; this will be explored below.
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30 *Potential Effectiveness of Education*

31 The indices we wish to focus on here relate to the extent to which increasing the understanding
32
33 about the efficacy of a particular action through specific environmental education might persuade
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35 individuals within a cohort to be willing to undertake that action. To obtain these for a particular
36
37 action, student measures of the *Degree of Willingness to Act* were plotted against their value of the
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39 *Believed Usefulness of Action*, and the trend line was fitted. This produced a graph of the type
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41 exemplified in Figure 4. The semantic matching of the responses means that linear regression is
42
43 less sensitive to the errors involved in using ordinal scales. The slope of such a graph represents
44
45 the extent to which, in general, the willingness of students to undertake an action might be said to
46
47 be dependent upon their belief in the usefulness of that action. The gradient, therefore, provides a
48
49 measure of the extent to which willingness to undertake an action might be increased by persuading
50
51 students of the environmental effectiveness of that action; we have called this gradient the *Potential*
52
53 *Effectiveness of Education*. Once the line has been determined for a pair of questions, two other
54
55 derived indices can be calculated from the intercepts. The intercept when the *Believed Usefulness*
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1 *of Action* is zero represents the likely action of those students who believed that such an action
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3 would be ineffective in reducing global warming; we term this the *Natural Willingness to Act*, and
4
5 Figure 4 is annotated to show this. In a complimentary fashion, the distance marked *Natural*
6
7 *Reluctance to Act* in Figure 4 is a measure of the extent to which students will not take action, even
8
9 though the *Believed Usefulness of Action* is at its maximum. These three indices may be useful in
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11 comparing the potential effect of education about different specific pro-environmental actions.
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18 Comparing the values of the *Potential Effectiveness of Education* for different actions gives an
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20 indication of those actions for which education about their potential effectiveness might lead to
21
22 behaviour change, and other actions where education will probably be less effective. On a
23
24 population basis, however, there is another measurement that will influence the efficacy of
25
26 education to this end, namely the proportion of the population who are not already reporting an
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28 intention to take action. Thus, education would be most productive in terms of behaviour change if
29
30 directed at those actions which relatively few of the population are already willing to undertake. A
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32 final index was therefore calculated, the *Potential Usefulness of Education*, by multiplying the
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34 *Potential Effectiveness of Education* by the proportion of students in who would 'probably not' or
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36 only 'perhaps' undertake the action.
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44 RESULTS

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46 In all, 961 students in Year Groups 7 through 11 from four state Community Comprehensive
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48 schools in the North West of England completed the questionnaire. Of this sample, 18% were in
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50 Year 7, 23% were in Year 8, 25% were in Year 9, 17% were in Year 10, and 17% were in Year 11.
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52 Males comprised 52% of the cohort, females 48; males and females were evenly distributed over
53
54 the years. The responses to the final four questions provided some background information about
55
56 the beliefs and views of the students. Some 61% of the students thought or were sure that global
57
58 warming was happening, with half of this figure (31%) being sure of this. About half of the
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1 students expressed concern about global warming, with 16% reporting being 'very worried' and a
2
3 further 33% reporting being 'quite worried'. Few students, about 14%, thought that they were well
4
5 informed (knew 'a lot') about global warming, although a further 39% considered they knew
6
7 'something' about it. Nearly half of the cohort (45%) thought of themselves as being either 'very'
8
9 or at least 'quite' environmentally friendly. Thus, many of this group of students believed that
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11 global warming is a real phenomenon, few thought that they were especially well informed about it,
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13 and about half were concerned about its consequences.
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20 **Students' Degree of Willingness to Act**

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22 The findings concerning students' Degree of Willingness to Act for different pro-environmental
23
24 actions are given in the first column of Figure 5 and illustrated graphically in Figure 6. In Figure 6,
25
26 the items are arranged in descending order according to the combined percentages of students who
27
28 would 'definitely' or 'almost certainly' undertake the action; in the descriptions below, these same
29
30 percentages are reported. The direct action to which most students were amenable (68%) was to
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32 switch off un-used electrical appliances. The prospect of installing home insulation was acceptable
33
34 to about half of the students (49%), as were the ideas of recycling materials (48%) and paying more
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36 for energy-efficient domestic appliances (44%). Over a third of the cohort (39%) were willing to
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38 pay for more tree-planting, although fewer (28%) would accept the increased price premium for
39
40 food grown without artificial fertilisers, and even fewer (21%) would be prepared to reduce their
41
42 consumption of meat. In terms of personal transport, only about a fifth of the students (20%) would
43
44 consider getting a smaller car and a similar proportion (19%) would accept reducing car use by
45
46 using public rather than private transport. Rather few of the students (15%) would accept buying
47
48 fewer fashion items. In terms of energy production, few students (10%) felt that using nuclear
49
50 power was acceptable and, perhaps surprisingly, relatively few (23%) would consider paying more
51
52 for renewable energy sources. Most of the indirect actions were also unpopular. Only about a
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54 quarter of the students would be prepared to undertake more education about environmental issues
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1 (23%) or allow their vote to be influenced by support for new environmental legislation (21%),
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3 international agreements (21%) and, for even fewer, increased environmental taxation (16%). Thus,
4
5 students were willing to undertake different environmental behaviours to varying extents. There
6
7 was a strong association between most of the 16 *Degree of Willingness to Act* items and the
8
9 question in the third section of the questionnaire about the extent to which students were worried
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11 about global warming. This will be discussed later.
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18 **Students' *Believed Usefulness of Action***

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20 Items in the second main section of the questionnaire explored students' beliefs about the
21
22 usefulness of the various actions in reducing global warming, their *Believed Usefulness of Action*,
23
24 and the data from the responses are given in the second column of Figure 5 and illustrated
25
26 graphically in Figure 7. In Figure 7, the items are arranged in descending order according to the
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28 combined percentages of students who thought that the action would reduce global warming by
29
30 'quite a lot' or by 'a fair amount'. In the descriptions which follow, these same percentages are
31
32 reported. Students apparently made a link between global warming and personal transport; two
33
34 actions thought by many of the students to contribute to a reduction in global warming were to
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36 reduce car use (68%) and drive smaller cars (50%). Energy production also seemed to be linked
37
38 with global warming in students' minds, since many believed that production of energy from
39
40 renewable sources (64%) and from nuclear sources (47%) could play a role in reducing global
41
42 warming. Perhaps linked to this, another relatively popular idea was energy conservation by
43
44 switching off unused electrical items (51%). Surprisingly, rather fewer students realised that
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46 installing home insulation (39%) or the use of energy-efficient domestic appliances (37%) could
47
48 reduce global warming. Tree planting was also thought to contribute to decreasing global warming
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50 by more than half of the students (54%), and almost as many (47%) appreciated the role that
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52 increased recycling could play. Rather fewer of the students (35%) realised that reducing the use of
53
54 artificial fertilisers and decreasing meat consumption (16%) could lessen global warming, perhaps
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1 because the mechanisms involved gases other than carbon dioxide, the latter being perhaps the most
2 well-known greenhouse gas. Just over a quarter of the students (28%) appreciated that buying
3 fewer new items could help to reduce global warming. Of what we have termed the 'indirect
4 actions', those related to international agreements were thought to be the most effective (59%), with
5 education (49%), legislation (43%) and taxation (37%) being thought less so. Thus, students
6 believed that the various environmentally-friendly actions which had been suggested in the
7 questionnaire would be differentially effective in reducing global warming.
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20 **Relationship between the Degree of Willingness to Act and Believed Usefulness of Action**

21 As explained above, a number of indices can be obtained from the responses to the two main
22 sections of the questionnaire, where the scored items were called the Degree of Willingness to Act
23 and the Believed Usefulness of Action. Some of these will now be discussed.
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32 The Potential Effectiveness of Education provides an indication of the extent to which increasing
33 understanding about particular actions through specific environmental education might persuade
34 individuals to be willing to undertake those actions. This relationship was quantified by linear
35 regression, and the results are illustrated schematically in Figure 4; the values of the indices from
36 the regression are summarised in the last four columns of Figure 5. The first of these, the slope of
37 the regression line constructed when the Degree of Willingness to Act and the Believed Usefulness
38 of Action for pairs of actions are plotted, has been designated the Potential Effectiveness of
39 Education; a high value of this index represents a steep relationship between the extent to which
40 students believe an action to be effective and their willingness to undertake that action. In such
41 cases, persuading students of the efficacy of the action should result in more students purporting to
42 take that action. Where the relationship is shallower, indicated by a lower value of the Potential
43 Effectiveness of Education, education about the action is less likely to result in more students from
44 this cohort adopting it. The other two indices, the two vertical dimensions marked in Figure 4,
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1 provide indicators of the extent to which students will undertake the action anyway, without
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3 believing in its effectiveness (*Natural Willingness to Act*), and of the extent to which students will
4
5 avoid the action even if they believe it is highly effective (*Natural Reluctance to Act*).
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10 Figure 5 shows that for some actions the value of the slope of the line, the *Potential Effectiveness of*
11 *Education*, was low, suggesting that there was little change in the willingness to undertake an action
12
13 for different beliefs in the effectiveness of that action. For example, this was true for the action of
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15 switching off unused electrical items (0.14). In this case, the slope of the line was shallow because
16
17 the *Natural Willingness to Act* was relatively high (0.63); students were prepared to take this action
18
19 in any case. In this case it is likely that other motivators, such as reducing electricity bills, coupled
20
21 with a relatively low level of inconvenience, meant that students would be taking this action
22
23 anyway. The value of the *Potential Effectiveness of Education* was also fairly low for some other
24
25 actions such as adopting more nuclear power (0.15), reducing car use (0.18), avoiding buying new
26
27 fashion items (0.15) or purchasing smaller cars (0.17). In these cases, however, the slope of the line
28
29 was shallow because the *Natural Reluctance to Act* tended to be quite high; even if students
30
31 believed these actions to be effective in reducing global warming, they seemed unwilling to
32
33 undertake them. In these cases it is probable that other disincentives, such as major inconvenience,
34
35 substantial changes in lifestyle or concerns over nuclear energy, would prevent students taking
36
37 these actions even though they believed that the actions could make a substantial contribution to the
38
39 reduction of global warming. In yet other cases there was a steeper association between a belief in
40
41 the effectiveness of an action and a willingness to undertake it. Increasing the amount of material
42
43 that is recycled (0.34), reducing the use of artificial fertilisers (0.27) and tree planting fell into this
44
45 category (0.26). In these cases, the *Natural Willingness to Act* and the *Natural Reluctance to Act*
46
47 were both relatively low, and so the slope of the line was fairly steep. For these specific actions,
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49 then, education which persuades students of the effectiveness of the action might well result in
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51 more of the students adopting the action. In summary, there are some pro-environmental actions
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1 that will probably not be induced by convincing students of their efficacy, and there are other,
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3 different, environmentally sympathetic actions which may well be encouraged by persuading
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5 students of their effectiveness.
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10 There is one other factor that will impinge upon the degree to which environmental education might
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12 be effective on a population level. The overall effectiveness of such education will be maximised
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14 when directed at those actions which a high proportion of the population are not already
15
16 undertaking. In an attempt to give some quantitative comparison to the various actions raised in the
17
18 questionnaire, a final index, the *Potential Usefulness of Education*, was constructed by multiplying
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20 the *Potential Effectiveness of Education* by the proportion of students who would 'probably not' or
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22 only 'perhaps' undertake the action; these data are shown in the final column of Figure 5. This
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24 multiplication produces much smaller numbers, but the bigger of these indicate that teaching about
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26 the effects of reducing meat consumption (0.14), lowering the use of artificial fertilisers (0.12),
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28 decreasing car use (0.11) and increasing the proportion of energy generated from renewable sources
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30 (0.11) should be useful areas on which to concentrate teaching.
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39 **Differences between subsets of students**

40 Differences between various groupings of students were explored in a number of ways. ANCOVA
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42 was used for the basic scores on the 32 items when looking at gender and year group together. For
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44 the derived indices, gradient and intercept were compared for any two groups using the standard
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46 technique of dummy variable creation and fitting a multiple linear regression model against the
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48 independent variable, the comparison variable (dichotomous) and the derived variable. Differences
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50 from any of these tests are noted below only if they are at the 0.05 level or better. When discussing
51
52 these differences, percentages will be used for the main questions (defined as in the first two
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54 columns of Figure 5), whilst the derived indices will simply have their values compared (explained
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56 in the later columns of Figure 5).
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Differences between male and female students

For three of the issues, more females than males were prepared to take action; these involved switching off unused electrical items (65%, 71%), reducing car use (15%, 23%) and eating less meat (15%, 27%). In terms of belief or understanding, a further three issues showed that females once again had a greater sensitivity to: using energy-efficient domestic white goods (33%, 40%), reducing the purchase of new fashion items (26%, 31%), taking into account a politician's willingness to legislate on the environment when voting (38%, 48%). Measures of the *Potential Effectiveness of Education*, showed only one difference between the sexes and that was for the question relating to international agreements (0.15, 0.33), where it appears that females seem likely to be more influenced by education. On two issues there was a difference in the *Natural Willingness to Act*; for eating less meat females showed a greater natural willingness (0.22, 0.31), in line with the overall measurement for the question, but they seemed less naturally willing to vote in accordance with politicians views on international agreements (0.29, 0.15).

Differences between students in different year groups

In the descriptions below, the figures given are those for students in Year 7, 8, 9, 10 and 11. Differences between students in different year groups are reported below only if ANCOVA revealed statistically significant differences giving a trend across the year groups. By these criteria there were no significant and consistent trends across the year groups for students *Degree of Willingness to Act*. There were a number of differences, however, for students' *Believed Usefulness of Action*. For the most part, the level of students' *Believed Usefulness of Action* decreased over the year groups. So, fewer of the older students believed that adopting the use of smaller cars (57%, 55%, 52%, 51%, 33%), insulating homes (44%, 45%, 42%, 39%, 21%), switching off un-used electrical items (61%, 57%, 48%, 48%, 39%), recycling more (54%, 60%, 47%, 37%, 33%), reducing the use of artificial fertilisers (35%, 46%, 37%, 29%, 22%), buying fewer fashion items

1 (35%, 33%, 27%, 25%, 21%), reducing car use (76%, 70%, 65%, 71%, 58%), eating less meat
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4 (19%, 21%, 16%, 8%, 10%), using energy-efficient domestic appliances (47%, 42%, 31, 39%,
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6 25%) would reduce global warming either by 'quite a lot' or by 'a fair amount'. Confidence in the
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8 effectiveness of the indirect actions also declined over the year groups. Thus, fewer of the older
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10 students thought that voting in accordance with promises on environmental legislation (53%, 46%,
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12 38%, 45%, 36%) and taxation (47%, 38%, 34%, 38%, 27%), and international agreements (72%,
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14 60%, 55%, 60%, 51%) could help to reduce global warming.
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20 There were statistically significant increases in the *Potential Effectiveness of Education* across the
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22 year groups for the actions of planting trees (0.19, 0.16, 0.21, 0.28, 0.50) and increasing adoption of
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24 renewable energy (0.16, 0.23, 0.09, 0.24, 0.38), suggesting perhaps that persuading older school
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26 students of the effectiveness of these actions might be more effective than teaching younger
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28 students. This trend was also evident in two of the indirect actions, related to supporting
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30 international agreements (0.16, 0.20, 0.11, 0.19, 0.43) and being prepared to undertake more
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32 environmental education (0.19, 0.10, 0.18, 0.25, 0.36). However, it was also noticed that for these,
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34 and only these issues, the *Natural Willingness to Act* started high and decreased across the year
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36 groups, as the *Potential Effectiveness of Education* increased. The conclusion would seem to be
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38 that young students are less discriminatory and have a high willingness to act regardless of their
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40 understanding of the issue. Older students are more able to process the information which they
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42 have, or which they believe, and with these issues show a response in their intended actions which
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44 is more in line with their understanding. This perhaps suggests that the teaching of these issues
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46 might be best targeted at older students.
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56 Differences between more and less concerned students

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58 Finally, the relationship between the extent of students' concern and their willingness to act in
59
60 various pro-environmental manners was investigated. Students were grouped according to their

1 responses to a question in the final section of the questionnaire about how worried they are about
2 global warming. Those who indicated that they were 'very' or 'quite' worried were considered to
3 be 'more concerned' (n=452); those who responded that they were 'a little bit worried' or 'not
4 worried at all' were considered to be 'less concerned' (n=460).
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13 When the derived indices were compared for these two groups of students, it became apparent that
14 the values for the *Natural Willingness to Act* indices were consistently higher for the more
15 concerned students than for the less concerned students for all actions other than the increased
16 adoption of nuclear power. In contrast, only two of the values of *Potential Effectiveness of*
17 *Education* showed statistically significant differences between the two groups, and these differences
18 were relatively small. The details can be seen in Figure 8. It seems clear that, regardless of the
19 degree of worry about global warming, the sense in which action might be influenced by
20 understanding or belief is fairly stable, though different for each issue. On the other hand, the
21 *Natural Willingness to Act*, the likely action even when it is believed to be ineffective, is
22 significantly greater for almost all issues for those who are more concerned about global warming.
23 Interestingly, the biggest differences are for the use of smaller cars (0.40, 0.25) and for the use of
24 public transport instead of cars (0.37, 0.15). These issues seem to be little affected by education
25 (the *Potential Effectiveness of Education* is small whether students are worried or not, varying
26 between 0.07 and 0.12) and, as noted above, these are demanding behaviour changes that affect
27 people's personal freedom and status. Worry about global warming, on the other hand, does seem
28 to have some impact on action in this area. It has been suggested by research on air pollution
29 (Boyes, Stanisstreet, Myers, Skamp & Yeung, 2007) that fear or worry, especially for western
30 students, has a considerable influence on their stated willingness to take certain actions. In this case
31 it would seem to be regardless of what students believe about the effectiveness of that action. Thus
32 it would appear that the worry about global warming and its consequences might precipitate action,
33 even if that action is thought unlikely to be helpful: a kind of insurance policy.
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4 The one exception from Figure 8 is for the idea of being willing to pay more for electricity if it were
5 produced by nuclear power. The *Natural Willingness to Act* in this way is small (around 0.2) and
6 the same for both groups of students. Clearly there are other concerns which, in the case of nuclear
7 power, take precedent.
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13 14 15 16 **DISCUSSION**

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18 Approximately two thirds of the students in this study appreciated that global warming is a real
19 phenomenon, paralleling the high general awareness of global warming in the adult population
20 (DEFRA, 2008). Furthermore, about half of the respondents expressed concern about the
21 consequences of global warming, again similar to the adult population (DEFRA, 2008), suggesting
22 that consciousness of, and apprehension about, global warming are beginning to develop early
23 through education and publicity. Perhaps because of this concern and anxiety, UK adults in general
24 appear to support, in principle at least, both individual and political action to reduce global warming
25 (BBC, 2007); about half of the UK population believe that modifying individuals' behaviour would
26 diminish global warming. In a complementary manner, a proportion of the population in general
27 would support the introduction of further environmental legislation, partly because this is seen as
28 fairer, but also because it means that pro-environmental behaviour does not rely only on an
29 individuals' willingness to act (Darier & Schule, 1999).
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49 In the context of these general attitudes, the findings of the present study indicate that among UK
50 secondary students there is a differential willingness to undertake various pro-environmental actions
51 - what we have termed the *Degree of Willingness to Act*. For the more direct actions, what might be
52 considered individual actions, for example, many students report a willingness to switch off unused
53 electrical items in the home, whereas far fewer are prepared to alter their habits concerning personal
54 transport by using public rather than private transport, or by countenancing the use of smaller, more
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1 energy-efficient private vehicles, unless they are particularly worried about global warming. The
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3 differential willingness to undertake diverse pro-environmental actions is similar to that reported for
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5 adults, who are more prepared to increase recycling or to take action to conserve energy in domestic
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7 situations, but less willing to modify their travel habits (Shackley *et al*, 2004; Kasemir *et al*, 2003;
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9 O'Connor *et al*, 1999). Each of the pro-environmental actions raised in this study has associated
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11 incentives and disincentives for young people, the nature and extent of which will differ between
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13 different actions. Switching off un-used electrical items, for example, causes only minor
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15 inconvenience and may carry an additional incentive in that it aligns with parental exhortations to
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17 'save electricity' for financial reasons. Use of public transport, on the other hand, may be perceived
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19 as carrying a major inconvenience and could be associated with a negative social image amongst
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21 school students' peer groups, with social norms acting as a disincentive (Cialdini, Reno & Kallgren,
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23 1990). Thus, when considered in isolation, the likelihood of undertaking any particular pro-
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25 environmental action is a balance of a general feeling of benefiting the environment, coupled with
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27 more concrete personal incentives, disincentives and concern. For indirect actions such as the
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29 influencing of voting patterns, rather few of the students were willing to consider increased
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31 environmental taxation, legislation or education or, perhaps surprisingly, even international
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33 agreements. Whilst it is unclear what voting priorities young people may have, a part of their
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35 unwillingness to consider such issues may be because any outcomes would be brought about by
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37 *politicians*, and because they have a general distrust of politicians (Smith, Stanisstreet & Boyes,
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39 2005). Such mistrust has major implications for a population that approves in principle of the
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41 imposition of pro-environmental actions by central government, but seems less willing to take this
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43 into account when voting. This may be through lack of faith in its politicians to put such actions
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45 into place, because of a perceived lack of competence or integrity.

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58 The findings of the present study also indicate that students consider that different actions may have
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60 different levels of usefulness in reducing global warming, a measurement we termed the *Believed*

1 Usefulness of Action. For example, reducing car use, generating electricity from renewable sources
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3 and switching off un-used electrical items were thought to contribute to reducing global warming.
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5 In addition, tree planting was seen as useful in this context. The prime effect of all of these
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7 behaviours relate to atmospheric carbon dioxide, either by decreasing carbon dioxide emissions or,
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9 in the case of tree planting, by increasing the rate of removal of carbon dioxide from the
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11 atmosphere. Reducing the use of artificial fertilisers or decreasing the use of meat production was
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13 thought to be less effective. In these cases the greenhouse gases involved are nitrogen oxides and
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15 methane, respectively. It may be that the efficacy of such pro-environmental behaviours in terms of
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17 global warming may be less well appreciated because the effect of these two gases is less well
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19 known than that of carbon dioxide (Boyes & Stanisstreet, 1993, 2001), the role of which has been
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21 more recently re-enforced by phrases such as ‘carbon footprint’, ‘carbon dependency’ and ‘carbon
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23 trading’. Students were also not strongly aware of the link between consumption of new ‘fashion’
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25 items and global warming, perhaps because the energy consumed in their manufacture and transport
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27 to the point of purchase does not come immediately to the minds of young people.
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37 By combining the data obtained from the two main sections of the questionnaire, the Degree of
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39 Willingness to Act and the Believed Usefulness of Action, it was possible to derive a series of
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41 indices to gain insight into the probable advantage, in terms of changing behaviour, of persuading
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43 young adults of the efficacy of different pro-environmental behaviours in ameliorating global
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45 warming. In particular, the Potential Effectiveness of Education is a measure of the association
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47 between belief in the effectiveness of an action and the willingness to undertake it. Certain actions
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49 had a rather low Potential Effectiveness of Education, indicating that education might be less
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51 effective for such actions. In some cases, such as switching off un-used electrical items, this was
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53 because students showed a high Natural Willingness to Act - they would perform such actions
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55 irrespective of a belief or not in their merit. Education about the way in which such actions might
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57 reduce global warming might be of only marginal benefit, to this age group, in terms of behaviour
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1 change. In other cases a low *Potential Effectiveness of Education* was associated with a high
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3 *Natural Reluctance to Act*. Here, even a belief in the efficacy of an action did not promote its
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5 uptake, presumably because there were other disincentives in place; the nature of such disincentives
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7 would, of course, vary between different actions. For example, adoption of nuclear power may
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9 show a high *Natural Reluctance to Act* because of fears about environmental or health impacts of
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11 nuclear power. Change in transport habits, such as the use of smaller cars or substitution of public
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13 for private transport, could be somewhat impervious to education because environmental sensitivity
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15 would be out-weighed in decision-making by preferences about lifestyle or personal convenience,
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17 an example of a physical inhibitor acting as a disincentive (Corraliza & Berenguiar, 2000). In
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19 addition, students were resistant to reducing their purchase of new 'fashion' items, perhaps because
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21 consumption of this sort is perceived as a natural characteristic of a their western life-style. In such
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23 cases, as above, education alone might be of only limited benefit, although it might be a useful
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25 component in a series of measures. For example, introduction of potentially unpopular
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27 environmental legislation might be made more acceptable if there is a general understanding of why
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29 it is necessary.
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39 In the case of other types of pro-environmental action, there was a stronger relationship between the
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41 extent to which an action was believed to be effective in reducing global warming and a willingness
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43 to undertake it. Increasing recycling, reduction in the use of synthetic fertiliser, tree planting and
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45 the benefits of home insulation and energy-efficient domestic appliances were examples of these
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47 actions. The first of these might be especially relevant because this action is within the locus of
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49 control of individual young people; indeed, in some cases young people may influence the practices
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51 of the whole family in which they live.
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58 With virtually all of the issues, the relationship between belief about an action and stated intention
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60 to act did not depend on how worried the students were about global warming. On the other hand,

1 the extent to which the more worried students were prepared to take action even when they did not
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3 believe it to be effective, was considerably greater; that is, the *Natural Willingness to Act* was
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5 greater in the more concerned individuals. Perhaps the more concerned students make the risk
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7 assessment that, even though the action might have little or no effect, it is worth taking *just in case*,
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9 because they worry about the outcome being so devastating. The one issue that did not follow this
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11 pattern was the idea of being willing to pay more for electricity if it were produced by nuclear
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13 power. The risk assessment for global warming seems to pale into insignificance compared to the
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15 risk assessment made for the proliferation of nuclear energy in the minds of even those students
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17 who are concerned about global warming.
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25 When the size of the potential education audience, the proportion of those who do not already
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27 intend to undertake such actions, is compounded into an index, the *Potential Usefulness of*
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29 *Education*, certain specific actions emerge as useful targets for education. Thus, a reduction in meat
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31 consumption (and therefore production) and a willingness to pay more for vegetables and cereals
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33 grown without the use of artificial fertilisers, together with a decrease in car use and production of
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35 energy from renewable sources are all actions that have a potential audience, and for which
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37 intended behaviour seems to be strongly influenced by a belief in their effectiveness. As above, the
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39 first two of these are under at least partial control of the individual concerned.
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46 This study reveals that for different actions there is a different degree of association between a
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48 belief in the efficacy of an action and a willingness to undertake it; this is one reason why
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50 environmental education in *general* terms might be less than fully effective. Even in the case of
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52 specific actions, it is apparent that for some actions education to persuade learners of their
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54 usefulness in terms of a major environmental problem has little potential on its own to be effective
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56 in terms of behaviour modification.
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1 The present findings suggest that where there were differences between the responses of male and
2
3 female students, females tended to be more sensitive to the benefits of certain pro-environmental
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5 actions, and more willing to undertake other pro-environmental actions. This is congruent with the
6
7 observation that females tend to score more highly than males on instruments that measure of
8
9 environmental attitudes (Burger *et al*, 1998; Taskin, 2009). The results also indicate that the degree
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11 of association between belief in the effectiveness of an action and a willingness to undertake it
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13 differs across different age groups of students. It appears, in contrast to our intuition, that older
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15 secondary students might respond more to teaching than their younger counterparts. Perhaps a
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17 potential hazard, then, of initiating education about pro-environmental actions too early might be
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19 that of over-exposure; the possibility is that by the time that students reach their most receptive
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21 stage they may be in a state of environmental 'fatigue', in the same way that donors to charity are
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23 thought, eventually, to suffer 'compassion fatigue'. In addition to this heterogeneity that could be
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25 linked to overt independent factors such as gender and year group, it appears that there is an
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27 association between the level of concern among students about global warming, and their
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29 willingness to undertake pro-environmental actions. Education strategists and practitioners should
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31 be aware, therefore, of this further heterogeneity within the student population; like adults
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33 (Lorenzini, Nicholson-Cole & Whitmarsh, 2007) students will not be uniform in their behavioural
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35 responsiveness to environmental education even about specific actions.
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46 This research has sought not only to elicit opinions of students about their understanding (belief)
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48 and purported actions, but also to find some indicators of the likely usefulness of education in
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50 bringing about a change of behaviour. Space has not allowed us to discuss here the straightforward
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52 discrepancy between the two measures of belief and action, but from manipulation of them, and the
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54 indices produced, it has been possible to see the effect of different inhibitors and facilitators to
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56 action for each of the issues investigated. It would be interesting, in further research, to investigate
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58 the detail of those things which restrain or encourage action, remembering that a wide variety of
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1 factors are likely to be involved, and that these will differ extensively for each action under
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3 consideration.
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Figure 1 Wording of the questionnaire items. The main items of the questionnaire displayed so that the 'pairing' of the items can be seen.

Themes	Items about the <i>Believed Usefulness of Action</i>	Items about the <i>Degree of Willingness to Act</i>
<i>Direct actions</i>		
Transport (use)	If people didn't use their cars so much, global warming would be reduced	Even if it took me longer and was more inconvenient, I would try to use buses and trains instead of a car
Transport (type)	If people had smaller cars that used less petrol or diesel, global warming would be reduced	Even if it was not as fast or luxurious, I would try to get a car that uses less petrol or diesel
Power generation (renewable)	If more of our energy was produced from the wind, waves and sun, global warming would be reduced	Providing more of our energy was produced from the wind and waves and sun, I would be willing to pay more for electricity
Power generation (nuclear)	If more of our energy was produced from nuclear power stations, global warming would be reduced	Providing more of our energy was produced from nuclear power stations, I would be willing to pay more for electricity
The home (electricity use)	If people used less electricity in their homes, global warming would be reduced	To save electricity, I would switch things off at home when I didn't need them
The home (insulation)	If people got their homes insulated better, global warming would be reduced	Even though it cost me money, I would get extra insulation for my home
The home (consumer durables)	If people got things for their homes (like fridges and washing machines) that used less energy, global warming would be reduced	Even if it cost me more, I would buy things for my home (like fridges and washing machines) that use less energy
The home (consumables)	If people were prepared to buy fewer new things and make do with the old ones, global warming would be reduced	Even if it meant that I didn't always have the latest 'gear' or fashion, I would be prepared to buy new things less often
Environmentally-friendly (trees)	If more trees were planted in the world, global warming would be reduced	Even if I had to pay more taxes, I think there should be more trees planted in the world
Environmentally-friendly (recycle)	If people recycled things more, global warming would be reduced	Even if it was more trouble for me, I would recycle things rather than just throw them away
Food (Reducing meat)	If people eat less meat, global warming would be reduced	Even if I really liked meat, I would eat fewer meals with meat in them
Food (Reducing artificial fertilizers)	If farmers stopped using artificial fertilisers with nitrogen in them, global warming would be reduced	Even if it was more expensive, I would buy food grown without the use of artificial fertilisers
<i>Indirect actions</i>		
Environmental legislation	If politicians made the right kind of new laws, global warming would be reduced	I would vote for a politician who said they would bring in laws to reduce global warming, even though it would stop me doing some of the things I enjoy
Environmental taxation	If politicians made people pay more tax and spent the money on the right kind of things, global warming would be reduced	I would vote for a politician who said they would increase taxes to pay for reducing global warming, even though it meant me having less money to spend
Environmental education	If people were taught more about it, global warming would be reduced	I would like to learn more about global warming, even though it would mean extra work for me
Environmental International cooperation	If there could be more agreement between different countries about not putting certain gases into the air, global warming would be reduced	Even though it might mean some inconvenience to me (like changing my job), I would vote for a politician who said they would sign agreements with other countries on global warming

The items of the questionnaire are displayed so that the 'pairing' of the items can be seen. In the actual questionnaire, the items were in random order, and paired items were in different orders in the two main sections.

Figure 2 Wording and available responses for the final four items of questionnaire

Items	Available responses
How worried are you about what Global Warming might do to the environment?	I am very worried I am quite worried I am a little bit worried I am not worried at all
How much do you think you know about Global Warming?	I know a lot about global warming I know something about global warming I know a little about global warming I know almost nothing about global warming
How 'environmentally friendly' do you think you are? (How much do you think you 'take care of' the environment by the things you do?)	I am very environmentally friendly I am quite environmentally friendly I am a bit environmentally friendly I am not at all environmentally friendly
Do you think that Global Warming is really happening now?	I am sure global warming is happening I think global warming is happening I don't know whether global warming is happening or not I am think global warming is not happening I am sure global warming is not happening

Figure 3 Wording of the permissible responses to the two sets of items.

<i>Believed Usefulness of Action</i> If I thought an action would help global warming by...	Score	<i>Degree of Willingness to Act</i> Then I would...	Score
by quite a lot	1.00	definitely do it	1.00
by a fair amount	0.75	almost certainly do it	0.75
by a small but useful amount	0.50	probably do it	0.50
by a very small amount - hardly noticeable	0.25	perhaps do it	0.25
by nothing at all really	0.00	probably not do it	0.00

The wording of the permissible responses is displayed 'matched'. This 'matching' suggests the minimum action ('then I would') that might reasonably be expected for a given belief about the usefulness of that action. The figures show the scores assigned to the different responses; these enabled various coefficients to be constructed.

Figure 4 Annotated graph to show relationship between the *Degree of Willingness to Act* and the *Believed Usefulness of Action*

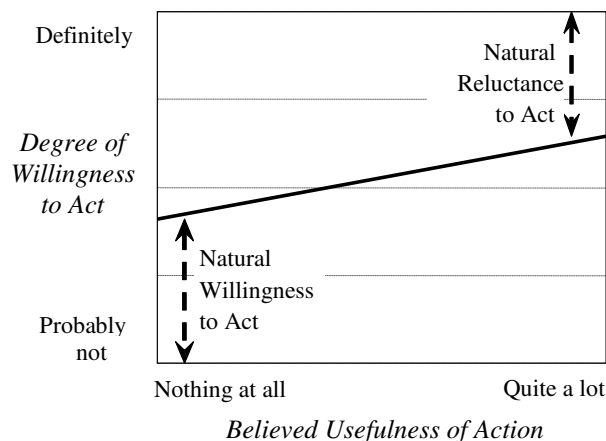
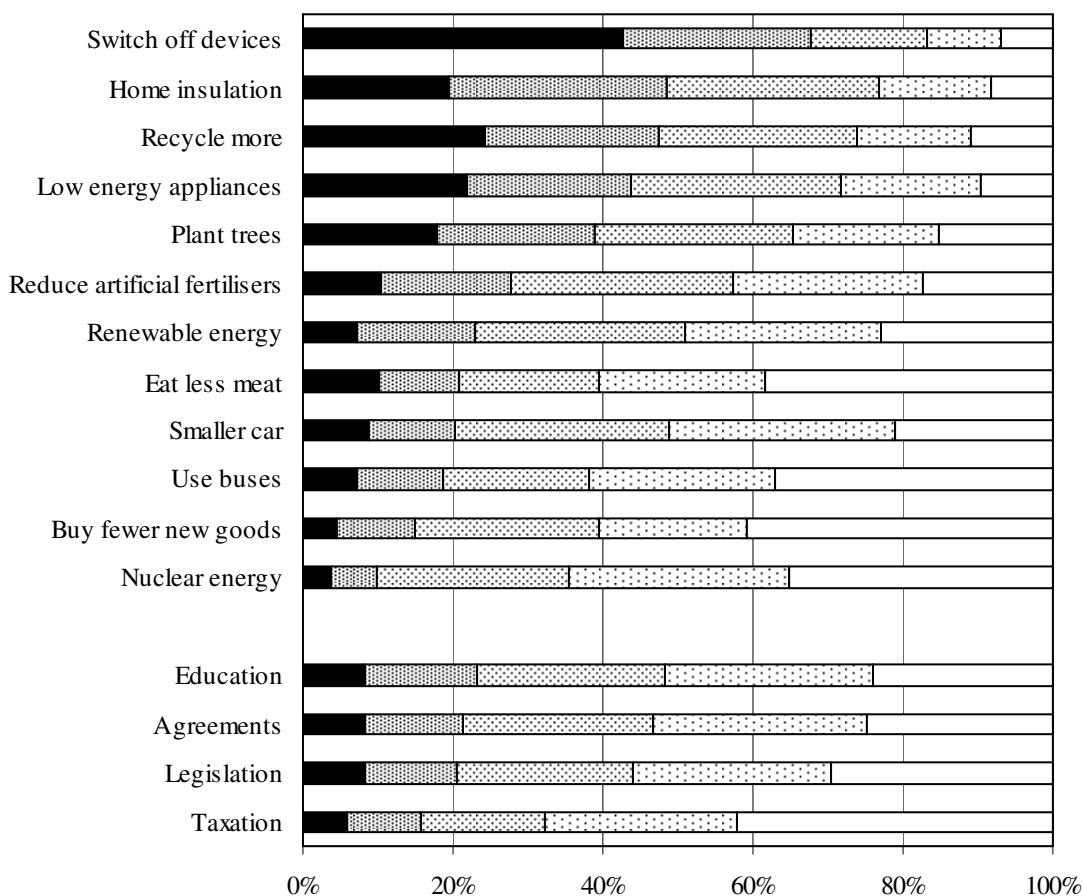


Figure 5 Secondary Students' willingness to undertake various pro-environmental actions, their beliefs about the usefulness of such actions and the relationships between these two measurements.

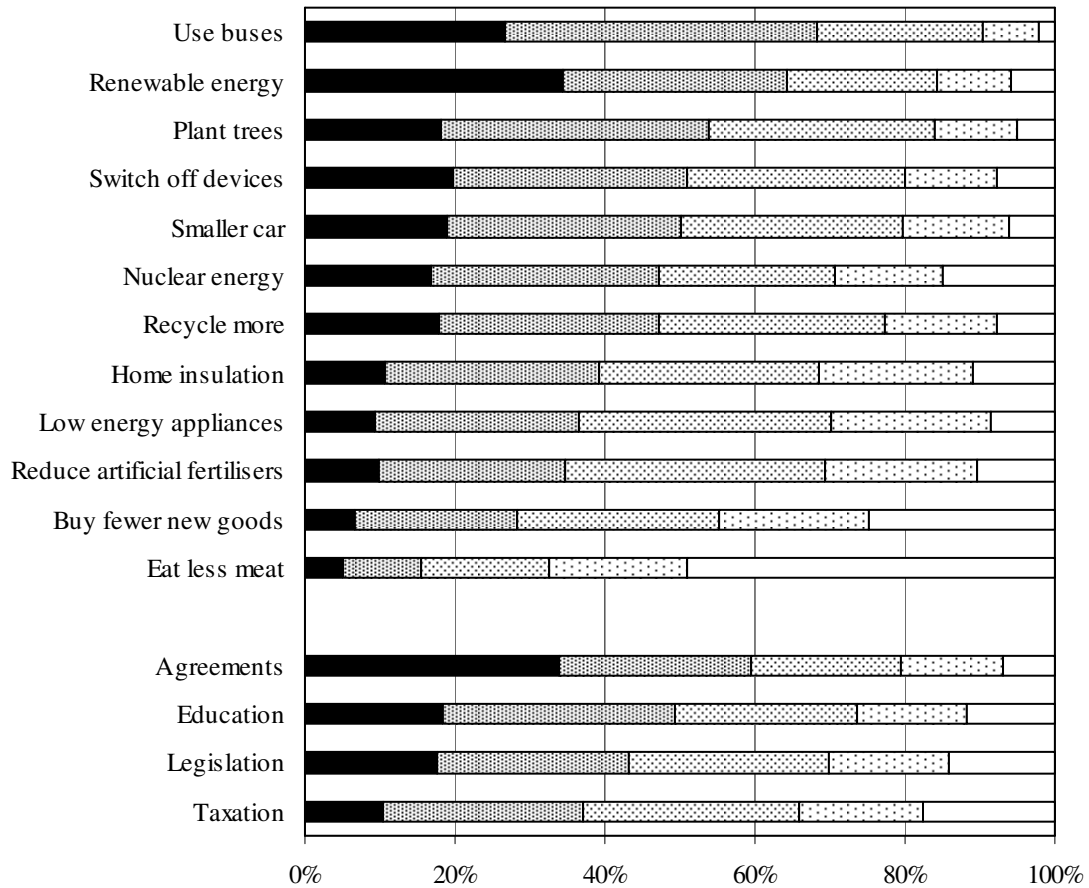
	<i>Degree of Willingness to Act</i>	<i>Believed Usefulness of Action</i>	<i>Potential Effectiveness of Education</i>	<i>Natural Willingness to Act</i>	<i>Natural Reluctance to Act</i>	<i>Potential Usefulness of Education</i>
	(% 'definitely' + 'almost certainly')	(% 'quite a lot' + 'a fair amount')	(Slope of <i>Degree of Willingness to Act</i> plotted vv <i>Believed Usefulness of Action</i>)	(Intercept when <i>Believed Usefulness of Action</i> is at minimum)	(Measurement between unity and the intercept when <i>Believed Usefulness of Action</i> is at maximum)	(<i>Potential Effectiveness of Education</i> x proportion of 'perhaps do it' and 'probably not do it')
<i>Direct actions</i>						
Smaller cars	20	50	0.17	0.29	0.54	0.09
Nuclear energy	10	47	0.15	0.20	0.64	0.10
Home insulation	49	39	0.25	0.46	0.28	0.06
Switch off unused devices	68	51	0.14	0.63	0.23	0.02
Plant trees	39	54	0.26	0.36	0.38	0.09
Recycle more	48	47	0.34	0.39	0.27	0.09
Reduce artificial fertilisers	28	35	0.27	0.31	0.42	0.12
Buy fewer new goods	15	28	0.15	0.23	0.62	0.09
Renewable energy	23	64	0.23	0.24	0.54	0.11
Use buses	19	68	0.18	0.19	0.63	0.11
Eat less meat	21	16	0.23	0.27	0.50	0.14
Low energy appliances	44	37	0.25	0.44	0.31	0.07
<i>Indirect actions</i>						
Legislation	21	43	0.23	0.24	0.54	0.13
Taxation	16	37	0.25	0.16	0.59	0.17
Agreements	21	59	0.24	0.23	0.54	0.13
Education	23	49	0.22	0.27	0.52	0.11

Figure 6 Secondary students' *Degree of Willingness to Act* to undertake different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who would 'definitely' undertake the action; the next, slightly lighter bar those who would 'almost certainly' undertake the action; the next, lighter bar, those who would 'probably' undertake the action; the next bar those who would 'perhaps' take the action; and the right hand, white bar, those who 'probably not' undertake the action. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who would 'definitely' and 'almost certainly' take the action.

Figure 7 Secondary students' *Believed Usefulness of Action* of different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who responded that the action would reduce global warming by 'quite a lot'; the next, slightly lighter bar those who believe it would reduce global warming by 'a fair amount'; the next, lighter bar, those who believe it would reduce global warming by a 'small but useful amount'; the next bar those who believe it would reduce global warming by 'a very small, hardly noticeable, amount'; and the right hand, white bar, those who believe the action would reduce global warming by 'nothing at all'. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who responded that the action would reduce global warming by 'quite a lot' and by 'a fair amount'.

Figure 8 Comparison of derived indices, *Natural Willingness to Act* and *Potential Effectiveness of Education* for two groups of students, those who are more or less concerned about global warming. The indices and categories are defined in the text.

Issue	<i>Natural Willingness to Act</i>			<i>Potential Effectiveness of Education</i>		
	More Concerned	Less Concerned	Sig	More Concerned	Less Concerned	Sig
<i>Direct actions</i>						
Smaller cars	.40	.25	**	.11	.12	
Nuclear energy	.22	.21		.18	.10	
Home insulation	.54	.44	*	.20	.23	
Switch off unused devices	.75	.60	**	.05	.09	
Plant trees	.50	.30	***	.18	.22	
Recycle more	.51	.36	**	.28	.28	
Reduce artificial fertilisers	.41	.28	**	.23	.20	
Buy fewer new goods	.32	.19	***	.10	.13	
Renewable energy	.38	.18	***	.14	.21	
Use buses	.37	.15	**	.07	.11	
Eat less meat	.38	.20	***	.11	.28	*
Low energy appliances	.54	.41	**	.18	.22	
<i>Indirect actions</i>						
Legislation	.35	.21	***	.20	.10	
Taxation	.25	.13	**	.25	.11	*
Agreements	.32	.19	**	.22	.16	
Education	.42	.21	***	.13	.15	

*** p<0.001

** p<0.01

* p<0.05

Environmental education for behaviour change: which actions should be targeted?

ABSTRACT

One aim of environmental education is to enable people to make informed decisions about their environmental behaviour; this is particularly significant with environmental problems that are believed to be both major and imminent, such as global warming. Previous research suggests that there is no strong link between a person's overall environmental awareness and their willingness to undertake pro-environmental actions, so this study focuses on some specific issues. Using quantitative methods to investigate students' beliefs about the usefulness of specific actions and their willingness to adopt them, novel indices have been constructed that indicate the potential of education to increase students' willingness to undertake those actions. The findings imply that altering a student's belief about certain issues will have little effect on their willingness to act. This can be because most students, even those with only a weak belief in the efficacy, are prepared to take action anyway. Conversely, it can be because a majority, including those convinced about the efficacy, is not prepared to take action. Support for further use of nuclear power is an example of the latter. Education about such actions, where there is only a weak link between believed effectiveness and willingness to act, may be ineffective in terms of changing practice, because other incentives or disincentives dominate. For such actions other strategies may be required. For another set of actions, however, the benefits of education in changing practice seemed more positive; increasing recycling, reducing the use of artificial fertilisers and planting more trees are examples.

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INTRODUCTION

“The literature on public understanding of climate change indicates widespread awareness of the issue and a general concern, but limited behavioural response”
(Lorenzoni, Nicholson-Cole & Whitmarsh, 2007)

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Twenty years ago the scientific evidence for an exacerbation of global warming¹ by a range of anthropogenic atmospheric pollutants was considered by some to be contentious (Stevenson, 1987; Boyes & Stanisstreet, 1993). Today, however, the weight of objective evidence persuades most people that the increase in global warming is a real phenomenon, caused by human-sourced greenhouse gases. Furthermore, authoritative sources agree that this is an increasing threat to the world’s environmental integrity, its social well-being (IPCC, 1997; 2001, 2007), economic stability (Stern, 2007) and political security (Solana, 2008). In view of these persuasive predictions, it is increasingly important to design and apply effective measures for reducing greenhouse gas emissions. In part, this will depend on central government policies. The UK government, amongst others, set ambitious targets to reduce by 12.5% (relative to 1990 levels) the levels of the major greenhouse gases by 2010, with a reduction by 20% for carbon dioxide in particular. Furthermore, the political goal is to reduce carbon dioxide by 60% by 2050 (DTI, 2003). Unfortunately, since these targets were set it has become apparent that the 20% reduction in carbon dioxide will not be achieved, throwing doubt on the attainability of the 2050 target of a 60% reduction (DEFRA, 2006).

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In a complementary manner, it is estimated that about half of UK energy is used directly by individuals, for domestic use and personal transport. In these sectors, however, energy consumption is increasing (DEFRA, 2008a). What is needed, then, are mechanisms to persuade individuals to reduce their carbon contribution by limiting their energy use, because it is individuals who perform many of the actions that are environmentally significant (Jensen and Schnack, 2006). Although there is controversy about the purposes of environmental education (Heimlich & Ardoin,

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¹ In this paper, for economy of words, we use the term ‘global warming’ to refer to the exacerbation of the natural greenhouse effect by the addition of anthropogenic pollutants to the atmosphere.

2008). it could be argued that, in view of the urgent call to reduce global warming, one of the aims of environmental education should be to engender in learners a preparedness to act in more environmentally sustainable ways (Mentzer & McEwen, 1999; Jurin & Fortner, 2002). Early models of behaviour change in an environmental context became known as 'information deficit' models (Burgess, Harrison & Filius, 1998). These were based on the assumption that if people understood more about the environment and the actions that would cause, or avoid, environmental degradation, they would behave in a rational manner and adopt environmentally sympathetic practices. In other words, it was believed that there was a relatively direct and positive relationship between a person's cognitive base about environmental problems and their willingness to act in such a way as to reduce these problems. Other models suggested a less direct link in which a decision about action is influenced by situational factors and an intention to act (Hines, Hungerford and Tomera, 1986-7). Some studies have shown that knowledge and behaviour are indeed related (Yencken, 2000). In many other cases, however, it seems that the relationship between knowledge and action is not robust (Rajecki, 1982; Hungerford & Volk, 1990; Posch, 1993; Kollmus & Agyeman, 2002). and it is acknowledged that there is what has come to be known as a 'gap' between cognition and action (Kollmus & Agyeman, 2002). In part, this 'gap' is due to the fact that behaviour is influenced by a plethora of other factors, not just knowledge; other beliefs, social pressures, physical facilitators and inhibitors can synergistically influence whether or not a particular action is pursued (Corraliza & Berenguer, 2000). Similarly, descriptive and injunctive social norms, standards by which actions are perceived as normally being undertaken, or as being approved or disapproved of, can influence whether or not a person acts in an environmentally sympathetic fashion (Cialdini, Reno & Kallgren, 1990). Perhaps most relevant to the present study is the finding that situational influences such as a person's belief in their own self-efficacy also partly determine the extent to which he or she acts in a pro-environmental manner (Devine-Wright, Devine-Wright & Flemming, 2004; Laskova, 2007). Despite these complications, many of these

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1 other factors are themselves influenced by the cognitive base of the individual concerned, and thus
 2 potentially affected by education.

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 6 A further issue that has emerged as researchers have attempted to generate models of the incentives
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 8 and disincentives to pro-environmental behaviour is that there are limitations in studying links
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 10 between general environmental attitudes and potential behaviour patterns (Fishbein & Ajzen, 1975;
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 12 Ajzen & Fishbein, 1980; Dietz, Stern & Guagnano, 1998; Stern, 1992). Given this complexity, and
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 14 a pressing need for a reduction in the emission of anthropogenic greenhouse gases, we have
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 16 attempted to explore the role that education about the usefulness of specific pro-environmental
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 18 actions might play in eliciting changes in the practices of individuals. We have designed an
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 20 instrument that questions respondents about their willingness to undertake specific pro-
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 22 environmental behaviours and, separately, their beliefs about the possible benefits of these
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 24 particular behaviours in the context of one environmental problem - global warming. Three
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 26 research questions have been addressed. Firstly, the degrees to which students report being willing
 27
 28 to undertake a variety of specific pro-environmental actions have been ascertained. Secondly, the
 29
 30 extents to which students believe these particular actions would be effective in reducing global
 31
 32 warming have been investigated. Thirdly, the relationship between these two parameters, students'
 33
 34 reported willingness to undertake specific actions and their beliefs about the usefulness of the same
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 36 actions, has been explored. In addition, measures were sought of students' degree of concern about
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 38 global warming, and the extent to which they thought that it was a real phenomenon. The overall
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 40 aim was to determine the extent to which increasing students' understanding about the efficacy of
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 42 specific actions might be in persuading individuals to increase their willingness to undertake those
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 44 actions, so that education for changes in practice might be targeted for greatest efficacy.

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 47 **METHODS**
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1 This study employed a novel questionnaire to probe the views of secondary students. The study
2 was initiated in the UK, but has since extended to Australia, the USA and a number of countries in
3 mainland Europe; here we report the findings of the UK study.
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8 **Design of the questionnaire**

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9 The questionnaire consisted of a coversheet, two main sections and a short final section. The
10 wording of the questionnaire items from the two main sections is shown in Figure 1, where the
11 ordering is different to that in the questionnaire for the reasons given below. The coversheet asked
12 respondents to record their grade and gender, and the fourth section, at the end of the questionnaire,
13 contained 4 items designed to probe the level of students' concern about global warming, the extent
14 of their perceived knowledge about global warming, the degree to which they considered
15 themselves to be environmentally 'friendly', and whether or not they believed that global warming
16 was a real phenomenon that was already happening. These questions, and the available responses,
17 are shown in Figure 2.
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28 The first of the two main sections of the questionnaire contained 20 items, 16 of which were about
29 actions that would contribute to the amelioration of global warming. Most of the ideas in these
30 items related to carbon dioxide emissions from energy use and wastage, although two were
31 concerned with other greenhouse gases, methane and nitrogen oxides. Four of the 16 items
32 concerned indirect actions, such as supporting increased environmental taxation or legislation. The
33 four remaining items were more idiosyncratic in nature; these focused on ideas that had been raised
34 by students themselves in earlier research (Boyes & Stanisstreet, 1993). These four distracters were
35 added to the 16 so that respondents would not feel obligated to respond positively to all questions
36 (Oppenheim, 1992; Parmenter and Wardle, 2000); the results from these four items will not be
37 considered in this paper.
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1 The focus of the first main section of the questionnaire was the degree to which students would be
 2 willing to undertake a particular action, in the words of the coversheet of the questionnaire, “for the
 3 sake of the environment and the future of the Earth”; no mention was made of global warming at
 4 this stage. Each item took the form of a conditional clause indicating the personal cost or
 5 inconvenience of the action, followed by a simplified description of the action. The wording of the
 6 items can be seen in the right hand column of Figure 1, and the available responses to these items,
 7 which ranged from “I would definitely do it” to “I would probably not do it”, and the ways in which
 8 they were scored, are shown in the right side of Figure 3. The scored responses produced by the
 9 items in this section of the questionnaire were designated students’ Degree of Willingness to Act.

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10 The 20 items in the second main section of the questionnaire concerned the same pro-environmental
 11 actions as those in the first main section, although the order was different so that the pairing of the
 12 questions was not immediately apparent to the respondents. Here, however, the focus of the
 13 questioning was on the extent to which respondents believed that the actions were useful in
 14 alleviating global warming. The wording of these items can be seen in the left column of Figure 1,
 15 and the available responses, which ranged from “quite a lot” to “nothing at all really”, and the ways
 16 in which they were scored, are shown in the left side of Figure 3. The scored responses were
 17 designated students’ Believed Usefulness of Action.

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18 Figure 1 also illustrates the pairing of the items and the themes within the questionnaire. Not only
 19 were the items paired, however, the available responses in the two main sections of the
 20 questionnaire were designed to ‘match’, in semantic terms. Figure 3 illustrates this, where the two
 21 response scales are shown in apposition. If, for example, a student believed that a particular action
 22 would help by ‘quite a lot’, this was matched in the other section to the response that they would
 23 ‘definitely’ be willing to do it; each of these responses received a score of 1. Conversely, if a
 24 student believed that an action would reduce global warming ‘by nothing at all’, this is matched to

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1 the action section response that they would 'probably not' do it, and both responses received a score
 2 of zero. The intermediate responses were also designed to correspond in a similar way,
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 4 semantically, and by score.
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8 The final wording of the paired questionnaire items and matched response scales came about from a
 9 series of discussions with a group of researchers and teachers. The questionnaire was trialled with
 10 134 students (age 14 years), and the only modification entailed the removal of the word 'insulation'
 11 and the rephrasing of the pair of questions concerned.
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17 Construction of the indices

18 From the responses to the two main sections of the questionnaire, the *Degree of Willingness to Act*
 19 and *Believed Usefulness of Action*, a number of derived indices were produced that have been used
 20 to explore the connections between them. Although the two response scales are ordinal and
 21 although they measure different things, it was felt that because of their semantic matching (Figure
 22 3), some mathematical manipulation of the data is acceptable; this will be explored below.
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31 Potential Effectiveness of Education

32 The indices we wish to focus on here relate to the extent to which increasing the understanding
 33 about the efficacy of a particular action through specific environmental education might persuade
 34 individuals within a cohort to undertake that action. To obtain these for a particular action, student
 35 measures of the *Degree of Willingness to Act* were plotted against their value of the *Believed*
 36 *Usefulness of Action*, and the trend line was fitted. This produced a graph of the type exemplified
 37 in Figure 4. The semantic matching of the responses means that linear regression is less sensitive to
 38 the errors involved in using ordinal scales. The slope of such a trend line indicates the extent to
 39 which the willingness of students to undertake an action might be said to be dependent upon their
 40 belief in the usefulness of that action. The gradient, therefore, provides a measure of the extent to
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1 which willingness to undertake an action might be increased by persuading students of the
 2 environmental effectiveness of that action; we have called this gradient, in the present context, the
 3 *Potential Effectiveness of Education*. Once the gradient of the line has been determined for a pair of
 4 questions, two other derived indices can be calculated from the intercepts. The intercept when the
 5 *Believed Usefulness of Action* is zero represents the likely action of those students who believed that
 6 such an action would be ineffective in reducing global warming; we term this the *Natural*
 7 *Willingness to Act*, and Figure 4 is annotated to show this. In a complementary fashion, the
 8 distance marked *Natural Reluctance to Act* in Figure 4 is a measure of the extent to which students
 9 will not take action, even though the *Believed Usefulness of Action* is at its maximum. These three
 10 indices may be useful in comparing the potential effect of education about different specific pro-
 11 environmental actions in terms of changing practice.

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22 Comparing the values of the *Potential Effectiveness of Education* for different actions gives an
 23 indication of those actions for which education about their potential effectiveness might lead to an
 24 increased willingness to undertake the action, and other actions where education will probably be
 25 less effective in this role. On a population basis, however, there is another measurement that will
 26 influence the efficacy of education to this end, namely the proportion of the population who are not
 27 already reporting an intention to take action. Thus, education might be most productive in terms of
 28 changing individuals' practices if directed at those actions that relatively few of the population are
 29 already willing to undertake. A final index was therefore calculated, the *Potential Usefulness of*
 30 *Education*, by multiplying the *Potential Effectiveness of Education* by the proportion of students in
 31 who would 'probably not' or only 'perhaps' undertake the action.

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44 **RESULTS**

45 In all, 961 students in Grades 6 (11-12 years old) to 10 (15-16 years old) (UK National Curriculum
 46 Year Groups 7 through 11) from four state Community Comprehensive schools in the North West

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of England completed the questionnaire. Of this sample, 18% were in Grade 6, 23% were in Grade 7, 25% were in Grade 8, 17% were in Grade 9, and 17% were in Grade 10. Males comprised 52% of the cohort, females 48; males and females were evenly distributed over the years. The responses to the final four questions provided some background information about the beliefs and views of the students. Some 61% of the students thought or were sure that global warming was happening, with half of this figure (31%) being sure of this. About half of the students expressed concern about global warming, with 16% reporting being 'very worried' and a further 33% reporting being 'quite worried'. Few students, about 14%, thought that they were well informed (knew 'a lot') about global warming, although a further 39% considered they knew 'something' about it. Nearly half of the cohort (45%) thought of themselves as being either 'very' or at least 'quite' environmentally friendly. Thus, many of this group of students believed that global warming is a real phenomenon, few thought that they were especially well informed about it, and about half were concerned about its consequences.

Students' Degree of Willingness to Act

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The findings concerning students' Degree of Willingness to Act for different pro-environmental actions are given in the first column of Figure 5 and illustrated graphically in Figure 6. In Figure 6, the items are arranged in descending order according to the combined percentages of students who would 'definitely' or 'almost certainly' undertake the action; in the descriptions below, these same percentages are reported. The direct action to which most students were amenable (68%) was to switch off un-used electrical appliances. The prospect of installing home insulation was acceptable to about half of the students (49%), as were the ideas of recycling materials (48%) and paying more for energy-efficient domestic appliances (44%). Over a third of the cohort (39%) were willing to pay for more tree-planting, although fewer (28%) would accept the increased price premium for food grown without artificial fertilisers, and even fewer (21%) would be prepared to reduce their consumption of meat. In terms of personal transport, only about a fifth of the students (20%) would

1 consider getting a smaller car and a similar proportion (19%) would accept reducing car use by
 2 using public rather than private transport. Rather few of the students (15%) would accept buying
 3 fewer fashion items. In terms of energy production, few students (10%) felt that using nuclear
 4 power was acceptable and, perhaps surprisingly, relatively few (23%) would consider paying more
 5 for renewable energy sources. Most of the indirect actions were also unpopular. Only about a
 6 quarter of the students would be prepared to undertake more education about environmental issues
 7 (23%) or allow their vote to be influenced by support for new environmental legislation (21%),
 8 international agreements (21%) and, for even fewer, increased environmental taxation (16%). Thus,
 9 students appeared willing to undertake different environmental behaviours to varying extents.
 10 There was a strong association between most of the 16 *Degree of Willingness to Act* items and the
 11 question in the third section of the questionnaire about the extent to which students were worried
 12 about global warming. This will be discussed later.

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25 ***Students' Believed Usefulness of Action***

26 Items in the second main section of the questionnaire explored students' beliefs about the
 27 usefulness of the various actions in reducing global warming, their *Believed Usefulness of Action*,
 28 and the data from the responses are given in the second column of Figure 5 and illustrated
 29 graphically in Figure 7. In Figure 7, the items are arranged in descending order according to the
 30 combined percentages of students who thought that the action would reduce global warming by
 31 'quite a lot' or by 'a fair amount'. In the descriptions that follow, these same percentages are
 32 reported. Students apparently made a link between global warming and personal transport; two
 33 actions thought by many of the students to contribute to a reduction in global warming were to
 34 reduce car use (68%) and drive smaller cars (50%). Energy production also seemed to be linked
 35 with global warming in students' minds, since many believed that production of energy from
 36 renewable sources (64%) and from nuclear sources (47%) could play a role in reducing global
 37 warming. Perhaps linked to this, another relatively popular idea was energy conservation by
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switching off unused electrical items (51%). Surprisingly, rather fewer students realised that installing home insulation (39%) or the use of energy-efficient domestic appliances (37%) could reduce global warming. Tree planting was also thought to contribute to decreasing global warming by more than half of the students (54%), and almost as many (47%) appreciated the role that increased recycling could play. Rather fewer of the students (35%) realised that reducing the use of artificial fertilisers and decreasing meat consumption (16%) could lessen global warming, perhaps because the mechanisms involved gases other than carbon dioxide, the latter being perhaps the most well-known greenhouse gas. Just over a quarter of the students (28%) appreciated that buying fewer new items could help to reduce global warming. Of what we have termed the 'indirect actions', those related to international agreements were thought to be the most effective (59%), with education (49%), legislation (43%) and taxation (37%) being thought less so. Thus, students believed that the various environmentally-friendly actions that had been suggested in the questionnaire would be differentially effective in reducing global warming.

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Relationship between the Degree of Willingness to Act and Believed Usefulness of Action

As explained above, a number of indices can be obtained from the responses to the two main sections of the questionnaire, where the scored items were called the *Degree of Willingness to Act* and the *Believed Usefulness of Action*. Some of these will now be discussed.

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The *Potential Effectiveness of Education* provides an indication of the extent to which increasing understanding about particular actions through specific environmental education might persuade individuals to undertake those actions. This relationship was quantified by linear regression, and the results are illustrated schematically in Figure 4; the values of the indices from the regression are summarised in the last four columns of Figure 5. The first of these, the slope of the regression line

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constructed when the *Degree of Willingness to Act* and the *Believed Usefulness of Action* for pairs of actions are plotted, has been designated the *Potential Effectiveness of Education*; a high value of

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1 this index represents a steep relationship between the extent to which students believe an action to
 2 be effective and their willingness to undertake that action. In such cases, persuading students of the
 3 efficacy of the action should result in more students purporting to take that action. Where the
 4 relationship is shallower, indicated by a lower value of the *Potential Effectiveness of Education*,
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 8 education about the action is less likely to result in more students from this cohort adopting it. The
 9
 10 other two indices, the two vertical dimensions marked in Figure 4, provide indicators of the extent
 11 to which students will undertake the action anyway, without believing in its effectiveness (*Natural*
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 14 *Willingness to Act*), and of the extent to which students will avoid the action even if they believe it
 15 is highly effective (*Natural Reluctance to Act*); they each take a value between zero and one.

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 20 Figure 5 shows that for some actions the value of the slope of the line, the *Potential Effectiveness of*
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 22 *Education*, was low, suggesting that there was little change in the willingness to undertake an action
 23 for different beliefs in the effectiveness of that action. For example, this was true for the action of
 24 switching off unused electrical items (0.14). In this case, the slope of the line was shallow because
 25 the *Natural Willingness to Act* was relatively high (0.63); students were prepared to take this action
 26 in any case. In this case it is likely that other motivators, such as reducing electricity bills, coupled
 27 with a relatively low level of inconvenience, meant that students would be taking this action
 28 anyway. The value of the *Potential Effectiveness of Education* was also fairly low for some other
 29 actions such as adopting more nuclear power (0.15), reducing car use (0.18), avoiding buying new
 30 fashion items (0.15) or purchasing smaller cars (0.17). In these cases, however, the slope of the line
 31 was shallow because the *Natural Reluctance to Act* tended to be quite high; even if students
 32 believed these actions to be effective in reducing global warming, they seemed unwilling to
 33 undertake them. In these cases it is probable that other disincentives, such as major inconvenience,
 34 substantial changes in lifestyle or concerns over nuclear energy, would prevent students taking
 35 these actions even though they believed that the actions could make a substantial contribution to the
 36 reduction of global warming. In yet other cases there was a steeper association between a belief in

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1 the effectiveness of an action and a willingness to undertake it. Increasing the amount of material
 2 that is recycled (0.34), reducing the use of artificial fertilisers (0.27) and tree planting fell into this
 3 category (0.26). In these cases, the *Natural Willingness to Act* and the *Natural Reluctance to Act*
 4 were both relatively low, and so the slope of the line was fairly steep. For these specific actions,
 5 then, education that persuades students of the effectiveness of the action might well result in more
 6 of the students adopting the action. In summary, there are some pro-environmental actions that will
 7 probably not be induced by convincing students of their efficacy, and there are other, different,
 8 environmentally sympathetic actions that may well be encouraged by persuading students of their
 9 effectiveness.

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10 There is one other factor that will impinge upon the degree to which environmental education might
 11 be effective on a population level. The overall effectiveness of such education will be maximised
 12 when directed at those actions that a high proportion of the population are not already undertaking.
 13 In an attempt to give some quantitative comparison to the various actions raised in the
 14 questionnaire, a final index, the *Potential Usefulness of Education*, was constructed by multiplying
 15 the *Potential Effectiveness of Education* by the proportion of students who would 'probably not' or
 16 only 'perhaps' undertake the action; these data are shown in the final column of Figure 5. This
 17 multiplication produces much smaller numbers, but the bigger of these indicate that teaching about
 18 the effects of reducing meat consumption (0.14), lowering the use of artificial fertilisers (0.12),
 19 decreasing car use (0.11) and increasing the proportion of energy generated from renewable sources
 20 (0.11) should be useful areas on which to concentrate teaching.

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Differences between subsets of students

Differences between various groupings of students were investigated in a number of ways.

ANCOVA was used for the basic scores on the 32 items when exploring, simultaneously,

differences between the responses of male and female students, and students in different grades.

1 ANCOVA can be used not only to analyse the effect of several categorical independent variables on
2 a dependent variable (ANOVA) but can include one or more continuous variables which may
3 predict the dependent variable. In this case grade is used as a more or less continuous variable. For
4 the derived indices, gradient and intercept were compared for any two groups using the standard
5 technique of dummy variable creation and fitting a multiple linear regression model against the
6 independent variable, the comparison variable (dichotomous) and the derived variable. Differences
7 from any of these tests are noted below. When discussing these differences, the percentage of the
8 top two categories will be reported for the main questions (defined as in the first two columns of
9 Figure 5), whereas the derived indices will simply have their values compared (explained in the
10 later columns of Figure 5).
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22 Differences between male and female students

23 In this section, the first figures in brackets will be those first for the males, followed by those for the
24 females. For the *Degree of Willingness to Act* items, more females than males were prepared to
25 take action on some issues; this included switching off unused electrical items (65%, 71%, $p<0.05$),
26 reducing car use (15%, 23%, $p<0.05$) and eating less meat (15%, 27%, $p<0.001$). In the case of
27 items to determine the *Believed Usefulness of Action*, three issues showed that females once again
28 had a greater belief in using energy-efficient domestic white goods (33%, 40%, $p<0.01$), reducing
29 the purchase of new fashion items (26%, 31%, $p<0.05$) and taking into account a politician's
30 willingness to legislate on the environment when voting (38%, 48%, $p<0.01$).
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41 Measures of the Potential Effectiveness of Education, showed only one difference between the
42 genders and that was for the question relating to international agreements (0.15, 0.33, $p<0.01$),
43 where females appeared more likely to have their behaviour influenced by their understanding or
44 belief. For two issues there were significant differences in the *Natural Willingness to Act*; for
45 eating less meat females showed a greater inherent compliance (0.22, 0.31, $p<0.001$), but they
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1 seemed less naturally willing to vote in accordance with politicians' views on international
2 environmental agreements (0.29, 0.15, $p<0.01$).
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6 *Differences between students in different grades*

8 Differences between students in different grades are reported below only if ANCOVA revealed
9 statistically significant differences giving a trend across the grades. In the descriptions that follow,
10 the percentage figures quoted are for the top two categories of response across Grades 6, 7, 8, 9 and
11 10. Within the 16 *Degree of Willingness to Act* items, there were 6 significant and reasonably
12 consistent trends downwards across the grades. These were switching off unwanted appliances
13 (81%, 65%, 63%, 69%, 66%, $p<0.01$), purchasing foods cultivated without artificial fertilisers
14 (34%, 35%, 18%, 30%, 24%, $p<0.001$), eating less meat (28%, 28%, 14%, 16%, 19%, $p<0.001$),
15 buying more efficient appliances (56%, 46%, 36%, 45%, 40%, $p<0.001$) and voting for politicians
16 in light of their policies on 'green' legislation (34%, 24%, 14%, 18%, 17%, $p<0.001$) and their
17 support for international environmental agreements (36%, 21%, 15%, 20%, 18%, $p<0.001$).
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29 In the other main section of the questionnaire, the *Believed Usefulness of Action*, there were also a
30 number of differences that for the most part showed a decrease over the grades. So, fewer of the
31 older students believed that global warming would be reduced (by 'quite a lot' or by 'a fair
32 amount') by adopting the use of smaller cars (57%, 55%, 52%, 51%, 33%, $p<0.001$), insulating
33 homes (44%, 45%, 42%, 39%, 21%, $p<0.001$), switching off un-used electrical items (61%, 57%,
34 48%, 48%, 39%, $p<0.001$), recycling more (54%, 60%, 47%, 37%, 33%, $p<0.001$), helping to
35 reduce the use of artificial fertilisers (35%, 46%, 37%, 29%, 22%, $p<0.001$), buying fewer fashion
36 items (35%, 33%, 27%, 25%, 21%, $p<0.001$), reducing car use (76%, 70%, 65%, 71%, 58%,
37 $p<0.001$), eating less meat (19%, 21%, 16%, 8%, 10%, $p<0.001$) or using energy-efficient domestic
38 appliances (47%, 42%, 31, 39%, 25%, $p<0.001$). Confidence in the effectiveness of most of the
39 indirect actions also declined over the grades. Thus, fewer of the older students saw the benefit,
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1 with regard to global warming, of voting in accordance with promises on environmental legislation
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3 (53%, 46%, 38%, 45%, 36%, $p<0.01$) and taxation (47%, 38%, 34%, 38%, 27%, $p<0.001$), and
4 international agreements (72%, 60%, 55%, 60%, 51%, $p<0.001$).
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8 There were a number of differences across the grades in the *Potential Effectiveness of Education*, as
9 tested using two groups of students (top two and bottom two grades) and the standard technique
10 described earlier. Generally, the analysis showed increases in the *Potential Effectiveness of*
11 *Education* across the grades; this included the actions of planting trees (0.19, 0.16, 0.21, 0.28, 0.50,
12 $p<0.05$) and increasing adoption of renewable energy (0.16, 0.23, 0.09, 0.24, 0.38, $p<0.05$).
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16 Although it is known that the knowledge-behaviour link is weak (Kollmus & Agyeman, 2002), it
17 would appear from these findings that it is stronger for the older students, and would suggest
18 perhaps that persuading older school students of the effectiveness of these specific actions might be
19 more effective than teaching younger students. This trend was also evident in two of the indirect
20 actions, related to supporting international agreements (0.16, 0.20, 0.11, 0.19, 0.43, $p<0.05$) and
21 being prepared to undergo more environmental education (0.19, 0.10, 0.18, 0.25, 0.36, $p<0.05$).
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25 However, it was also noticed that for these, and only these issues, the *Natural Willingness to Act*
26 started high and decreased across the grades, as the *Potential Effectiveness of Education* increased.
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30 The conclusion would seem to be that adolescents' views retain a degree of flexibility about these
31 issues, with younger students being generally less discriminatory, and having a high willingness to
32 act regardless of their belief in the efficacy of an action. Older students seem to show a response in
33 their intended actions which is more in line with their understanding, again suggesting that teaching
34 about these issues might be best targeted at older students.
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37 *Differences between more and less concerned students*

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39 Finally, the relationship between the extent of students' concern about global warming and their
40 willingness to act in various pro-environmental manners was investigated. Students were grouped
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1 according to their responses to a question in the final section of the questionnaire about how
2 worried they are about global warming. Those who indicated that they were 'very' or 'quite'
3 worried were considered to be 'more concerned' (n=452); those who responded that they were 'a
4 little bit worried' or 'not worried at all' were considered to be 'less concerned' (n=460).
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10 Rather than examine how these two groups responded to the *Degree of Willingness to Act* variables
11 directly, which inevitably contain information about students with different degrees of *Believed*
12 *Usefulness of Action*, we elected to focus on the extent to which being more or less worried might
13 affect one's inherent willingness to take action. When the 16 regressions were performed for each
14 of these two groups, and the indices compared using the dummy variable technique mentioned
15 earlier, it became apparent that the values for the *Natural Willingness to Act* indices were
16 consistently higher for the more concerned students than for those who were less concerned; this
17 was true for all actions other than the increased adoption of nuclear power. Figure 8 shows the
18 details for all the differences measured, where one may recall that the *Natural Willingness to Act*
19 mapped on to the 5 values from zero to one. In contrast to these differences, only two of the values
20 of *Potential Effectiveness of Education* showed statistically significant differences between the two
21 groups, and these differences were relatively small. It seems clear from Figure 8 that, regardless of
22 the degree of worry about global warming, the sense in which action might be influenced by
23 understanding or belief is fairly stable, though different for each issue. On the other hand, the
24 *Natural Willingness to Act*, the likely action even when it is believed to be ineffective, is
25 significantly greater for almost all issues for those who are more concerned about global warming.
26 Interestingly, the biggest differences are related to transportation, namely the use of smaller cars
27 (0.40, 0.25, $p < 0.01$) and the use of public transport instead of cars (0.37, 0.15, $p < 0.01$). Whether or
28 not action is likely seems to be little affected by belief (the *Potential Effectiveness of Education* is
29 small whether students are worried or not) and, as noted above, these issues demand behaviour
30 changes that affect people's personal freedom and status. Worry about global warming, on the
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other hand, does seem to have some impact on action in this area. It has been suggested by research on air pollution (Boyes, Stanisstreet, Myers, Skamp & Yeung, 2007) that fear or worry, particularly for western students, has a considerable influence on their stated willingness to take certain environmental actions. In this case it would seem to be relatively independent of what students believe or understand about the effectiveness of that action. Thus it would appear that the worry about global warming and its consequences might precipitate action, even if that action is thought unlikely to be helpful; perhaps such actions are viewed as a kind of insurance policy.

The one exception from Figure 8 is for the idea of being willing to pay more for electricity if it were produced by nuclear power. The *Natural Willingness to Act* in this way was small (approximately 0.2) and is essentially the same for both groups of students. This suggests that there are other concerns which, in the case of nuclear power, take precedence.

DISCUSSION

Approximately two thirds of the students in this study believed that global warming is a real phenomenon, paralleling the high general awareness of global warming in the adult population (MORI, 2004). Furthermore, about half of the respondents expressed concern about the consequences of global warming, again similar to the adult population (PEW Research Centre, 2009), suggesting that consciousness of, and concern about, global warming are beginning to develop early. Perhaps because of anxiety about global warming, UK adults in general appear to support, in principle at least, both individual and political action to reduce global warming (BBC, 2007); about half of the UK population believe that modifying individuals' practices would diminish global warming. In a complementary manner, a proportion of the population in general would support the introduction of further environmental legislation, partly because this is seen as fairer, but also because it means that pro-environmental behaviour does not rely only on an individuals' willingness to act (Darier & Schule, 1999).

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Differences between various groupings of students were explored in a number of ways. ANCOVA was used for t	[19]
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In the context of these general attitudes, the findings of the present study indicate that among UK secondary students there is a differential willingness to undertake different pro-environmental actions - what we have termed the *Degree of Willingness to Act*. Among the more direct actions, many students report a willingness to switch off unused electrical items in the home, whereas far fewer are prepared to alter their practices concerning personal transport by using public rather than private transport, or by accepting the use of smaller, more energy-efficient private vehicles, unless they are particularly worried about global warming. The differential willingness to undertake diverse pro-environmental actions is similar to that reported for adults, who are more prepared to increase recycling or to take action to conserve energy in domestic situations, but less willing to modify their travel habits (Shackley, McLachlan & Gough, 2004; Kasemir *et al*, 2003; O'Connor, Bord & Fisher, 1999). Each of the pro-environmental actions raised in this study has associated incentives and disincentives for young people, the nature and extent of which will differ between different actions. These motivators and inhibitors stem from a plethora of sources, including beliefs, the ability to act (Jensen & Schnack, 2006), social pressures (Cialdini, Reno & Kallgren, 1990), social background (Pruneau *et al*, 2007) and characteristics of the physical context (Corraliza & Berenguer, 2000). Thus, the likelihood of undertaking any particular pro-environmental action is the result of an interaction between a general feeling of benefiting the environment, coupled with more concrete personal incentives, disincentives and concerns. Switching off un-used electrical items, for example, causes only minor inconvenience so carries few such inhibitors. In addition, it may carry an incentive in that it aligns with parental exhortations to 'save electricity' for financial reasons. Use of public transport, on the other hand, may be perceived as carrying a major inconvenience and could be associated with a negative social image amongst school students' peer groups, with social norms acting as a disincentive (Cialdini, Reno & Kallgren, 1990). For indirect actions such as the influencing of voting patterns, rather few of the students seemed willing to consider increased environmental taxation, legislation or education or, perhaps surprisingly, even

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1 international agreements. Whilst it is unclear what voting priorities young people may have, a part
 2 of their general unwillingness to consider such issues may be because there is a tendency for them
 3 to distrust politicians (Smith, Stanisstreet & Boyes, 2005) and other authority figures (Stern, 2008).
 4
 5 Such mistrust has major implications for a population that approves in principle of the introduction
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 7 of pro-environmental actions by central government, but seems less willing to take this into account
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 9 when voting.

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10 The findings of the present study also indicate that students consider that different actions may have
 11
 12 different levels of usefulness in reducing global warming, a measurement we termed the *Believed*
 13
 14 *Usefulness of Action*. For example, reducing car use, generating electricity from renewable sources
 15
 16 and switching off un-used electrical items were thought to contribute to reducing global warming.
 17

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18 In addition, tree planting was seen as useful in this context. The prime effect of all of these actions
 19
 20 relate to atmospheric carbon dioxide, either by decreasing carbon dioxide emissions or, in the case
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 22 of tree planting, by increasing the rate of removal of carbon dioxide from the atmosphere.

23 Reducing the use of artificial fertilisers or decreasing the use of meat production was thought by
 24
 25 students to be less effective. In these cases the greenhouse gases involved are nitrogen oxides and
 26
 27 methane, respectively. It may be that the efficacy of such pro-environmental actions in terms of
 28
 29 global warming may be less well appreciated because the contribution of these two gases to global
 30
 31 warming is less well known than that of carbon dioxide (Boyes & Stanisstreet, 1993, 2001), the role
 32
 33 of which has been more recently re-enforced by phrases such as ‘carbon footprint’, ‘carbon
 34
 35 dependency’ and ‘carbon trading’. Students were also not strongly aware of the link between
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 37 consumption of new ‘fashion’ items and global warming, perhaps because the energy consumed in
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 39 their manufacture and transport to the point of purchase does not come immediately to the minds of
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 41 young people.

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1 By combining the data obtained from the two main sections of the questionnaire, the *Degree of*
 2 *Willingness to Act* and the *Believed Usefulness of Action*, it was possible to derive a series of novel
 3 indices to gain insight into the probable advantage, in terms of changing students' practices, of
 4 persuading young adults of the efficacy of different pro-environmental actions in ameliorating
 5 global warming. In particular, the *Potential Effectiveness of Education* is a measure, in the context
 6 of the present study, of the association between belief in the effectiveness of an action and the
 7 willingness to undertake it. Certain actions had rather low values for the Potential Effectiveness of
 8 Education, indicating that education might be less effective for such actions in terms of behaviour
 9 change. There are two reasons why the Potential Effectiveness of Education might be low. In some
 10 cases, such as switching off un-used electrical items, this was because students showed a high
 11 *Natural Willingness to Act* - they would perform such actions irrespective of a belief or not in their
 12 merit. In other cases a low *Potential Effectiveness of Education* was associated with a high *Natural*
 13 *Reluctance to Act*. Here, even a relatively strong belief in the efficacy of an action did not promote
 14 its uptake, presumably because there were other disincentives in place; the nature of such
 15 disincentives would, of course, vary between different actions. For example, adoption of nuclear
 16 power may show a high *Natural Reluctance to Act* because of fears about environmental or health
 17 impacts of nuclear power. Change in transport habits, such as the use of smaller cars or substitution
 18 of public for private transport, could be somewhat intractable, because environmental sensitivity
 19 would be out-weighed in decision-making by preferences about lifestyle or personal convenience,
 20 an example of a physical inhibitor acting as a disincentive (Corraliza & Berenguiar, 2000). In
 21 addition, students were resistant to reducing their purchase of new 'fashion' items, perhaps because
 22 consumption of this sort is perceived as a natural characteristic of their western life-style. In such
 23 cases, where the Potential Effectiveness of Education is low, education alone might be of only
 24 limited benefit in terms of altering students' actions, although it might be a useful component in a
 25 series of measures. For example, introduction of potentially unpopular environmental legislation
 26 might be made more acceptable if there is a general understanding of why it is necessary.

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In the case of other pro-environmental actions, there was a stronger relationship between the extent to which an action was believed to be effective in reducing global warming and a willingness to undertake it; in other words, the *Potential Effectiveness of Education was higher*. Increasing recycling, reducing the use of synthetic fertiliser, tree planting, installing home insulation and using energy-efficient domestic appliances were examples of these actions. The first of these might be especially relevant because this action is within the locus of control of individual young people. Indeed, it has been shown that in the case of health education (Wilcox et al, 1981; Croucher et al, 1985), young people may influence the practices of the family in which they live, even though the effect may be weak.

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With virtually all of the issues, the rate at which intended action increased with belief about that action did not depend on how worried the students were about global warming. On the other hand, the extent to which the more worried students were prepared to take action even when they did not believe it to be effective, was considerably greater; that is, the *Natural Willingness to Act* was greater in the more concerned individuals. One possible explanation is that the more concerned students make an assessment that, even though they perceive the action as having little or no effect, it is worth taking 'just in case', because they worry about the outcome being so devastating. The one issue that did not follow this pattern was the idea of being willing to pay more for electricity if it were produced by nuclear power. The perceived risk of global warming seems to pale into insignificance compared to the risk assessment made for the proliferation of nuclear energy in the minds of even those students who are concerned about global warming. Alternatively, a willingness to take action and a concern about the consequences of global warming may represent a 'constellation' of attitudes (Heimlich & Ardoin, 2008), underpinned by such students' perception of themselves as being 'pro-environmental'.

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1 Not all of those who are at present unwilling to undertake actions will be persuadable to change
 2 their practices. The adult population can be considered to consist of various 'segments' with
 3 different characteristic behaviours and attitudes, and members of some of these segments are
 4 resistant to change practice (DEFRA, 2008b). Members of other segments are more amenable to
 5 change however. A further index, the *Potential Usefulness of Education*, attempted to take account
 6 of the size of the potential education audience, that is, the proportion of students who did not
 7 already intend to undertake such actions. Actions with a high *Potential Usefulness of Education*
 8 were those for which intended behaviour appeared to be strongly influenced by a belief in their
 9 effectiveness (that is, the *Potential Effectiveness of Education* was high), and which a relatively
 10 high proportion of students are at present unwilling to undertake. Using this index, certain specific
 11 actions emerge as useful targets for education: a reduction in meat consumption (and therefore
 12 production) and a willingness to pay more for produce grown without the use of artificial fertilisers,
 13 together with a decrease in car use and production of energy from renewable sources were such
 14 actions. Furthermore, as above, the first two of these are under at least partial control of the
 15 individual concerned.

16 This study reveals that for different actions there is a different degree of association between a
 17 belief in the efficacy of an action and a willingness to undertake it; this variation is one reason why
 18 environmental education in general terms might be less than fully effective in terms of behaviour.
 19 Even in the case of specific actions, it is apparent that for some actions education to persuade
 20 learners of their usefulness in terms of a major environmental problem has little potential on its own
 21 to be effective in terms of modifying young people's practices.

22 The present findings suggest that where there were differences between the responses of male and
 23 female students, females tended to be more sensitive to the benefits of certain pro-environmental
 24 actions, and more willing to undertake other pro-environmental actions. This is congruent with the

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1 observation that females tend to score more highly than males on instruments that measure of
 2 environmental attitudes (Burger *et al*, 1998; Taskin, 2009). The results also indicate that the degree
 3 of association between belief in the effectiveness of an action and a willingness to undertake it
 4 differs across different age groups of students. It appears, in contrast to our intuition, that older
 5 secondary students might respond more to teaching than their younger counterparts in terms of
 6 behaviour change. Perhaps a potential hazard, then, of initiating education about pro-environmental
 7 actions too early might be that of over-exposure; the possibility is that by the time that students
 8 reach their most receptive stage they may be in a state of environmental ‘fatigue’, in the same way
 9 that donors to charity are thought, eventually, to suffer ‘compassion fatigue’. In addition to this
 10 heterogeneity that could be linked to overt independent factors such as gender and year group, it
 11 appears that there is an association between the level of concern among students about global
 12 warming, and their willingness to undertake pro-environmental actions. Education strategists and
 13 practitioners should be aware, therefore, of this further heterogeneity within the student population;
 14 like adults (Lorenzini, Nicholson-Cole & Whitmarsh, 2007; DEFRA, 2008b), students will not be
 15 uniform in their behavioural responsiveness to environmental education even about specific actions.

16 Research of this nature inevitably suffers from limitations. For example, there may not always be a
 17 strong correlation between a stated intention to act and an actual change in practice (Downing &
 18 Ballantyne, 2007). Furthermore, whether or not an action is undertaken is partly dependent on
 19 action competences (Jensen and Schnack, 2006). Despite this, it is still advantageous to explore the
 20 stated intentions of the upcoming generation, and so we have sought to elicit the opinions of
 21 students concerning their beliefs about the usefulness of certain actions in reducing global warming
 22 and their reported willingness to undertake them. In addition, this study has derived novel
 23 indicators of the likely usefulness of education in increasing the willingness to undertake specific
 24 actions. The discrepancies between belief and willingness to act for different actions originate in
 25 the variety of other, sometimes non-environmental, incentives and disincentives associated with the

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1 various actions, It would be interesting, in further research, to investigate the detail of those things

2 that restrain or encourage individual actions, remembering that a wide variety of factors are likely to

3 be involved, and that these will differ for each action under consideration.

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31 Yencken, D. (2000). Young people and the environment: The implications for environmentalism. In
32 D. Yencken, J. Fien, and H. Sykes (Eds), *Environment, education and society in the Asia-Pacific: Local traditions and global discourses* (pp.212-250). London: Routledge.
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Figure 1 Wording of the questionnaire items. The main items of the questionnaire displayed so that the 'pairing' of the items can be seen.

Themes	Items about the <i>Believed Usefulness of Action</i>	Items about the <i>Degree of Willingness to Act</i>
<i>Direct actions</i>		
Transport (use)	If people didn't use their cars so much, global warming would be reduced	Even if it took me longer and was more inconvenient, I would try to use buses and trains instead of a car
Transport (type)	If people had smaller cars that used less petrol or diesel, global warming would be reduced	Even if it was not as fast or luxurious, I would try to get a car that uses less petrol or diesel
Power generation (renewable)	If more of our energy was produced from the wind, waves and sun, global warming would be reduced	Providing more of our energy was produced from the wind and waves and sun, I would be willing to pay more for electricity
Power generation (nuclear)	If more of our energy was produced from nuclear power stations, global warming would be reduced	Providing more of our energy was produced from nuclear power stations, I would be willing to pay more for electricity
The home (electricity use)	If people used less electricity in their homes, global warming would be reduced	To save electricity, I would switch things off at home when I didn't need them
The home (insulation)	If people got their homes insulated better, global warming would be reduced	Even though it cost me money, I would get extra insulation for my home
The home (consumer durables)	If people got things for their homes (like fridges and washing machines) that used less energy, global warming would be reduced	Even if it cost me more, I would buy things for my home (like fridges and washing machines) that use less energy
The home (consumables)	If people were prepared to buy fewer new things and make do with the old ones, global warming would be reduced	Even if it meant that I didn't always have the latest 'gear' or fashion, I would be prepared to buy new things less often
Environmentally-friendly (trees)	If more trees were planted in the world, global warming would be reduced	Even if I had to pay more taxes, I think there should be more trees planted in the world
Environmentally-friendly (recycle)	If people recycled things more, global warming would be reduced	Even if it was more trouble for me, I would recycle things rather than just throw them away
Food (Reducing meat)	If people eat less meat, global warming would be reduced	Even if I really liked meat, I would eat fewer meals with meat in them
Food (Reducing artificial fertilizers)	If farmers stopped using artificial fertilisers with nitrogen in them, global warming would be reduced	Even if it was more expensive, I would buy food grown without the use of artificial fertilisers
<i>Indirect actions</i>		
Environmental legislation	If politicians made the right kind of new laws, global warming would be reduced	I would vote for a politician who said they would bring in laws to reduce global warming, even though it would stop me doing some of the things I enjoy
Environmental taxation	If politicians made people pay more tax and spent the money on the right kind of things, global warming would be reduced	I would vote for a politician who said they would increase taxes to pay for reducing global warming, even though it meant me having less money to spend
Environmental education	If people were taught more about it, global warming would be reduced	I would like to learn more about global warming, even though it would mean extra work for me
Environmental International cooperation	If there could be more agreement between different countries about not putting certain gases into the air, global warming would be reduced	Even though it might mean some inconvenience to me (like changing my job), I would vote for a politician who said they would sign agreements with other countries on global warming

The items of the questionnaire are displayed so that the 'pairing' of the items can be seen. In the actual questionnaire, the items were in random order, and paired items were in different orders in the two main sections.

Figure 2 Wording and available responses for the final four items of questionnaire

Items	Available responses
How worried are you about what Global Warming might do to the environment?	I am very worried I am quite worried I am a little bit worried I am not worried at all
How much do you think you know about Global Warming?	I know a lot about global warming I know something about global warming I know a little about global warming I know almost nothing about global warming
How 'environmentally friendly' do you think you are? (How much do you think you 'take care of' the environment by the things you do?)	I am very environmentally friendly I am quite environmentally friendly I am a bit environmentally friendly I am not at all environmentally friendly
Do you think that Global Warming is really happening now?	I am sure global warming is happening I think global warming is happening I don't know whether global warming is happening or not I am think global warming is not happening I am sure global warming is not happening

Figure 3 Wording of the permissible responses to the two sets of items.

<i>Believed Usefulness of Action</i> If I thought an action would help global warming by...	Score	<i>Degree of Willingness to Act</i> then I would...	Score
by quite a lot	1.00	definitely do it	1.00
by a fair amount	0.75	almost certainly do it	0.75
by a small but useful amount	0.50	probably do it	0.50
by a very small amount - hardly noticeable	0.25	perhaps do it	0.25
by nothing at all really	0.00	probably not do it	0.00

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The wording of the permissible responses is displayed 'matched'. This 'matching' suggests the minimum action ('then I would') that might reasonably be expected for a given belief about the usefulness of that action. The figures show the scores assigned to the different responses; these enabled various coefficients to be constructed.

Figure 4 Annotated graph to show relationship between the *Degree of Willingness to Act* and the *Believed Usefulness of Action*

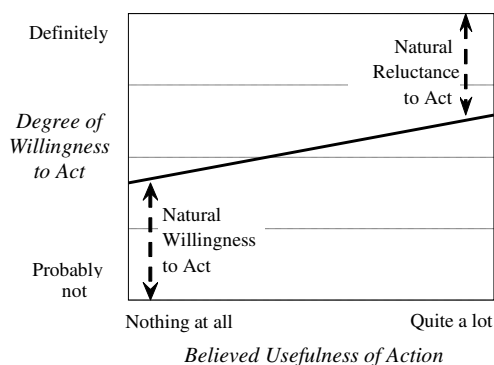
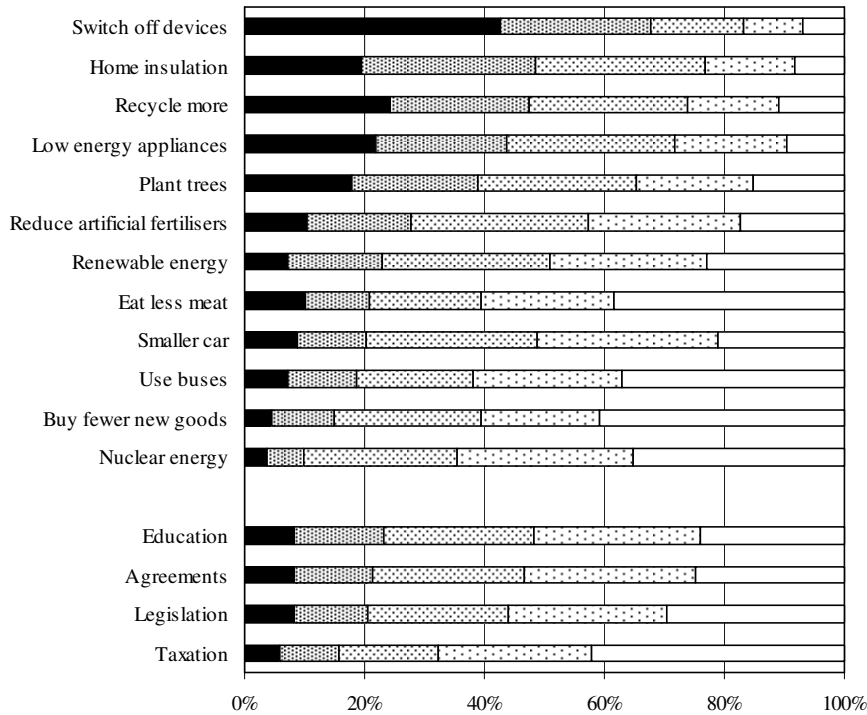


Figure 5 Secondary Students' willingness to undertake various pro-environmental actions, their beliefs about the usefulness of such actions and the relationships between these two measurements.

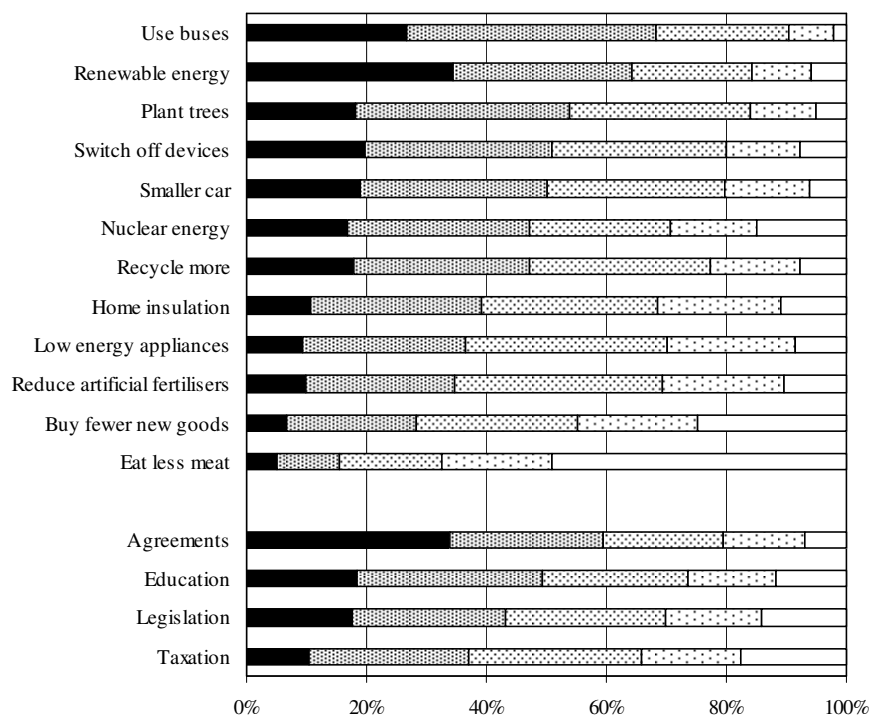
	<i>Degree of Willingness to Act</i>	<i>Believed Usefulness of Action</i>	<i>Potential Effectiveness of Education</i>	<i>Natural Willingness to Act</i>	<i>Natural Reluctance to Act</i>	<i>Potential Usefulness of Education</i>
	(% 'definitely' + 'almost certainly')	(% 'quite a lot' + 'a fair amount')	(Slope of <i>Degree of Willingness to Act</i> plotted vv <i>Believed Usefulness of Action</i>)	(Intercept when <i>Believed Usefulness of Action</i> is at minimum)	(Measurement between unity and the intercept when <i>Believed Usefulness of Action</i> is at maximum)	(<i>Potential Effectiveness of Education</i> x proportion of 'perhaps do it' and 'probably not do it')
<i>Direct actions</i>						
Smaller cars	20	50	0.17	0.29	0.54	0.09
Nuclear energy	10	47	0.15	0.20	0.64	0.10
Home insulation	49	39	0.25	0.46	0.28	0.06
Switch off unused devices	68	51	0.14	0.63	0.23	0.02
Plant trees	39	54	0.26	0.36	0.38	0.09
Recycle more	48	47	0.34	0.39	0.27	0.09
Reduce artificial fertilisers	28	35	0.27	0.31	0.42	0.12
Buy fewer new goods	15	28	0.15	0.23	0.62	0.09
Renewable energy	23	64	0.23	0.24	0.54	0.11
Use buses	19	68	0.18	0.19	0.63	0.11
Eat less meat	21	16	0.23	0.27	0.50	0.14
Low energy appliances	44	37	0.25	0.44	0.31	0.07
<i>Indirect actions</i>						
Legislation	21	43	0.23	0.24	0.54	0.13
Taxation	16	37	0.25	0.16	0.59	0.17
Agreements	21	59	0.24	0.23	0.54	0.13
Education	23	49	0.22	0.27	0.52	0.11

Figure 6 Secondary students' *Degree of Willingness to Act* to undertake different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who would 'definitely' undertake the action; the next, slightly lighter bar those who would 'almost certainly' undertake the action; the next, lighter bar, those who would 'probably' undertake the action; the next bar those who would 'perhaps' take the action; and the right hand, white bar, those who 'probably not' undertake the action. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who would 'definitely' and 'almost certainly' take the action.

Figure 7 Secondary students' Believed Usefulness of Action of different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who responded that the action would reduce global warming by 'quite a lot'; the next, slightly lighter bar those who believe it would reduce global warming by 'a fair amount'; the next, lighter bar, those who believe it would reduce global warming by a 'small but useful amount'; the next bar those who believe it would reduce global warming by 'a very small, hardly noticeable, amount'; and the right hand, white bar, those who believe the action would reduce global warming by 'nothing at all'. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who responded that the action would reduce global warming by 'quite a lot' and by 'a fair amount'.

Figure 8 Comparison of derived indices, *Natural Willingness to Act* and *Potential Effectiveness of Education* for two groups of students, those who are more or less concerned about global warming. The indices and categories are defined in the text.

Issue	<i>Natural Willingness to Act</i>			<i>Potential Effectiveness of Education</i>		
	More Concerned	Less Concerned	Sig	More Concerned	Less Concerned	Sig
<i>Direct actions</i>						
Smaller cars	.40	.25	**	.11	.12	
Nuclear energy	.22	.21		.18	.10	
Home insulation	.54	.44	*	.20	.23	
Switch off unused devices	.75	.60	**	.05	.09	
Plant trees	.50	.30	***	.18	.22	
Recycle more	.51	.36	**	.28	.28	
Reduce artificial fertilisers	.41	.28	**	.23	.20	
Buy fewer new goods	.32	.19	***	.10	.13	
Renewable energy	.38	.18	***	.14	.21	
Use buses	.37	.15	**	.07	.11	
Eat less meat	.38	.20	***	.11	.28	*
Low energy appliances	.54	.41	**	.18	.22	
<i>Indirect actions</i>						
Legislation	.35	.21	***	.20	.10	
Taxation	.25	.13	**	.25	.11	*
Agreements	.32	.19	**	.22	.16	
Education	.42	.21	***	.13	.15	

*** p<0.001

** p<0.01

* p<0.05

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5 actions, this was because even those students with only a weak belief in the efficacy of

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7 the action were prepared to do it anyway. For other actions,

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16 it was because even those students who believed that

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24 were not prepared to undertake it

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28 could not countenance nuclear energy

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22 **Differences between subsets of students**

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24 Differences between various groupings of students were explored in a number of ways.

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26 ANCOVA was used for the basic scores on the 32 items when looking at gender and year
27 group together. For the derived indices, gradient and intercept were compared for any
28 two groups using the standard technique of dummy variable creation and fitting a
29 multiple linear regression model against the independent variable, the comparison
30 variable (dichotomous) and the derived variable. Differences from any of these tests are
31 noted below only if they are at the 0.05 level or better. When discussing these
32 differences, percentages will be used for the main questions (defined as in the first two
33 columns of Figure 5), whilst the derived indices will simply have their values compared
34 (explained in the later columns of Figure 5).
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50 *Differences between male and female students*

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52 For three of the issues, more females than males were prepared to take action; these these
53 involved switching off unused electrical items (65%, 71%), reducing car use (15%, 23%)
54 and eating less meat (15%, 27%). In terms of belief in the efficacy of actions, or
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3 understanding, a further three issues showed that more females believed that once again
4 had a greater sensitivity to: using energy-efficient domestic white goods (33%, 40%),
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6 reducing the purchase of new fashion items (26%, 31%), and taking into account a
7
8 politician's willingness to legislate on the environment when voting (38%, 48%) would
9
10 contribute to reducing global warming. Measures of the *Potential Effectiveness of*
11
12 *Education*, showed only one difference between the sexes and that was for the question
13
14 relating to international agreements (0.15, 0.33¹), where it appears that females seem
15
16 likely to be more influenced by education. On two issues there was a difference in the
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18 *Natural Willingness to Act*; for eating less meat females showed a greater natural
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20 willingness (0.22, 0.31), in line with the overall measurement for the question, but they
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22 seemed less naturally willing to vote in accordance with politicians views on international
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24 agreements (0.29, 0.15).
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34 *Differences between students in different year groups*

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36 In the descriptions below, the figures given are those for students in Year 7, 8, 9, 10 and
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38 11. Differences between students in different year groups are reported below only if
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40 ANCOVA revealed statistically significant differences giving a trend across the year
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42 groups. By these criteria there were no significant and consistent trends across the year
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44 groups for students *Degree of Willingness to Act*. There were a number of differences,
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46 however, for students' *Believed Usefulness of Action*. For the most part, the level of
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48 students' *Believed Usefulness of Action* decreased over the year groups. So, fewer of the
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50 older students believed that adopting the use of smaller cars (57%, 55%, 52%, 51%,
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52 33%), insulating homes (44%, 45%, 42%, 39%, 21%), switching off un-used electrical
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58 ¹ The *Potential Effectiveness of Education* is a ratio and therefore does not have units
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3 items (61%, 57%, 48%, 48%, 39%), recycling more (54%, 60%, 47%, 37%, 33%),
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5 reducing the use of artificial fertilisers (35%, 46%, 37%, 29%, 22%), buying fewer
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7 fashion items (35%, 33%, 27%, 25%, 21%), reducing car use (76%, 70%, 65%, 71%,
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9 58%), eating less meat (19%, 21%, 16%, 8%, 10%), using energy-efficient domestic
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11 appliances (47%, 42%, 31, 39%, 25%) would reduce global warming either by 'quite a
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13 lot' or by 'a fair amount'. Confidence in the effectiveness of the indirect actions also
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15 declined over the year groups. Thus, fewer of the older students thought that voting in
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17 accordance with promises on environmental legislation (53%, 46%, 38%, 45%, 36%) and
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19 taxation (47%, 38%, 34%, 38%, 27%), and international agreements (72%, 60%, 55%,
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21 60%, 51%) could help to reduce global warming.
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29 There were statistically significant increases in the *Potential Effectiveness of Education*
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31 across the year groups for the actions of planting trees (0.19, 0.16, 0.21, 0.28, 0.50) and
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33 increasing adoption of renewable energy (0.16, 0.23, 0.09, 0.24, 0.38), suggesting
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35 perhaps that persuading older school students of the effectiveness of these *specific* actions
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37 might be more effective in terms of behaviour change than teaching younger students.
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40 This trend was also evident in two of the indirect actions, related to supporting
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42 international agreements (0.16, 0.20, 0.11, 0.19, 0.43) and being prepared to undertake
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44 more environmental education (0.19, 0.10, 0.18, 0.25, 0.36). However, it was also
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46 noticed that for these, and only these issues, the *Natural Willingness to Act* started high
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48 and decreased across the year groups, as the *Potential Effectiveness of Education*
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50 increased. The conclusion would seem to be that adolescents' beliefs retain a degree of
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52 fluidity about these issues, with that younger students are being less discriminatory, and
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having a high willingness to act regardless of their understanding belief in the efficacy of the action of the issue. This perhaps suggests that the teaching of these issues might be best targeted at older students. Firstly, older students are more able to process the information with which they are presented, or which they believe. Secondly, because the Natural Willingness to Act declined across the grades, there may be potential for increasing their preparedness to act by convincing them of the effectiveness of these *specific* actions, and with these issues show a response in their intended actions which is more in line with their understanding. This perhaps suggests that the teaching of these issues might be best targeted at older students.

Differences between more and less concerned students

Finally, the relationship between the extent of students' concern and their willingness to act in various pro-environmental manners was investigated. Students were grouped according to their responses to a question in the final section of the questionnaire about how worried they are about global warming. Those who indicated that they were 'very' or 'quite' worried were considered to be 'more concerned' (n=452); those who responded that they were 'a little bit worried' or 'not worried at all' were considered to be 'less concerned' (n=460).

When the derived indices were compared for these two groups of students, it became apparent that the values for the *Natural Willingness to Act* indices were consistently higher for the more concerned students than for the less concerned students for all actions other than the increased adoption of nuclear power. In contrast, only two of the values of

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Potential Effectiveness of Education showed statistically significant differences between the two groups, and these differences were relatively small. The details can be seen in Figure 8. It seems clear that, regardless of the degree of worry about global warming, the sense in which action might be influenced by understanding or belief is fairly stable, though different for each issue. On the other hand, the *Natural Willingness to Act*, the likely action even when it is believed to be ineffective, is significantly greater for almost all issues for those who are more concerned about global warming. Interestingly, the biggest differences are for the use of smaller cars (0.40, 0.25) and for the use of public transport instead of cars (0.37, 0.15). These issues seem to be little affected by education (the *Potential Effectiveness of Education* is small whether students are worried or not, varying between 0.07 and 0.12) and, as noted above, these are demanding behaviour changes that affect people's personal freedom and status. Worry about global warming, on the other hand, does seem to have some impact on action in this area. It has been suggested by research on air pollution (Boyes, Stanisstreet, Myers, Skamp & Yeung, 2007) that fear or worry, especially for western students, has a considerable influence on their stated willingness to take certain actions. In this case it would seem to be regardless of what students believe about the effectiveness of that action. Thus it would appear that the worry about global warming and its consequences might precipitate action, even if that action is thought unlikely to be helpful: a kind of insurance policy.

The one exception from Figure 8 is for the idea of being willing to pay more for electricity if it were produced by nuclear power. The *Natural Willingness to Act* in this

way is small (around 0.2) and the same for both groups of students. Clearly there are other concerns which, in the case of nuclear power, take precedence.

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Environmental education for behaviour change: which actions should be targeted?

ABSTRACT

One aim of environmental education is to enable people to make informed decisions about their environmental behaviour; this is particularly significant with environmental problems that are believed to be both major and imminent, such as **climate change resulting from** global warming. Previous research suggests that there is no strong link between a person's **general environmental attitudes and knowledge**, and their willingness to undertake pro-environmental actions, so this study focuses on some *specific* issues. Using **survey methods to produce quantitative data about** students' beliefs **concerning** the usefulness of specific actions and their willingness to adopt them, novel indices have been constructed that indicate the potential of education to increase students' willingness to undertake those actions. The findings imply that altering a student's belief about certain issues will have little effect on their willingness to act. This can be because most students, even those with only a weak belief in the efficacy, are prepared to take action anyway. Conversely, it can be because a majority, including those convinced about the efficacy, is not prepared to take **action**. **Education** about such actions, where there is only a weak link between believed effectiveness and willingness to act, may be ineffective in terms of changing practice, because other **factors such as social norms and situational influences** dominate. For such actions other strategies may be required. For another set of actions, however, the benefits of education in changing practice seemed more positive; increasing recycling, reducing the use of artificial fertilisers and planting more trees are examples.

INTRODUCTION

“The literature on public understanding of climate change indicates widespread awareness of the issue and a general concern, but limited behavioural response”
(Lorenzoni, Nicholson-Cole & Whitmarsh, 2007)

Twenty years ago the scientific evidence for 'global warming'¹ was considered by some to be contentious (Stevenson, 1987; Boyes & Stanisstreet, 1993). Today, however, the weight of objective evidence has persuaded the majority of authoritative sources that the increase in global warming is a real phenomenon, caused by human-sourced greenhouse gases (IPCC, 1997), and that this is an increasing threat to the world's environmental integrity, social well-being (IPCC, 2001; 2007), economic stability (Stern, 2007) and political security (Solana, 2008). In view of these persuasive predictions, it is increasingly important to design and apply effective measures for reducing the emission of greenhouse gases, the primary drivers of global warming. In part, this will depend on central government policies. The UK government, amongst others, set ambitious targets to reduce by 12.5% (relative to 1990 levels) the levels of the major greenhouse gases by 2010, with a reduction by 20% for carbon dioxide in particular. Furthermore, the political goal is to reduce carbon dioxide by 60% by 2050 (DTI, 2003). Unfortunately, since these targets were set it has become apparent that the 20% reduction in carbon dioxide will not be achieved, throwing doubt on the attainability of the 2050 target of a 60% reduction (DEFRA, 2006).

In a complementary manner, it is estimated that about half of UK energy is used directly by individuals, for domestic use and personal transport. In these sectors, however, energy consumption is increasing (DEFRA, 2008a). What is needed, then, are mechanisms to persuade individuals to reduce their carbon contribution by limiting their energy use, because many individual-level actions can accumulate to produce environmentally significant impacts (Jensen and Schnack, 2006). Although there is disagreement about whether environmental education should

¹ In reality, the addition of anthropogenic pollutants to the atmosphere results in an exacerbation of the natural 'greenhouse effect' leading to 'global warming', the major effect of which is an alteration in the world's climate – 'climate change'. In this paper we have elected to use the term 'global warming' because it describes the primary consequence of this process.

1 encourage pro-environmental action or whether it should focus solely on knowledge and attitudes
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3
4 (Heimlich & Ardoin, 2008), it could be argued that, in view of the urgent call to reduce global
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6 warming, one of the aims of environmental education should be to engender in learners a
7
8 preparedness to act in more environmentally sustainable ways (Mentzer & McEwen, 1999; Jurin &
9
10 Fortner, 2002). Early models for encouraging environmental behaviour became known as
11
12 'information deficit' models (Burgess, Harrison & Filius, 1998). These were based on the
13
14 assumption that if people understood more about the environment and the actions that would cause,
15
16 or avoid, environmental degradation, they would behave in a rational manner and adopt
17
18 environmentally sympathetic practices. In other words, it was believed that there was a relatively
19
20 direct and positive relationship between a person's cognitive base about environmental problems
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22 and his or her willingness to act in such a way as to reduce these problems. Other models suggested
23
24 a less direct link, in which action is influenced by both an intention to act and situational factors
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26 (Hines, Hungerford and Tomera, 1986-7). Some studies have shown that knowledge and behaviour
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28 are indeed related (Yencken, 2000). In many other cases, however, it seems that the relationship
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30 between knowledge and action is not robust (Rajecki, 1982; Hungerford & Volk, 1990; Posch,
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32 1993), and it is acknowledged that there is what has come to be known as a 'gap' between cognition
33
34 and action (Kollmus & Agyeman, 2002). In part, this 'gap' is due to the fact that behaviour is
35
36 influenced by a plethora of other factors, not just knowledge; other beliefs, social pressures,
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38 physical facilitators and inhibitors can synergistically influence whether or not a particular action is
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40 pursued (Corraliza & Berenguer, 2000). Similarly, descriptive and injunctive social norms,
41
42 standards by which actions are perceived as normally being undertaken, or as being approved or
43
44 disapproved of, can influence whether or not a person acts in an environmentally sympathetic
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46 fashion (Cialdini, Reno & Kallgren, 1990). Perhaps most relevant to the present study is the finding
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48 that situational influences such as a person's belief in their own self-efficacy also partly determine
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50 the extent to which he or she acts in a pro-environmental manner (Devine-Wright, Devine-Wright
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52 & Flemming, 2004; Laskova, 2007). Despite these complications, many of these other factors are
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1 themselves influenced by the cognitive base of the individual concerned, and thus potentially
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3 affected by education.
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9 A further issue that has emerged as researchers have attempted to generate models of the incentives
10 and disincentives to pro-environmental behaviour is that there are limitations in studying links
11 between *general* environmental attitudes and potential behaviour patterns (Fishbein & Ajzen, 1975;
12 Ajzen & Fishbein, 1980; Dietz, Stern & Guagnano, 1998; Stern, 1992). Given this complexity, and
13 a pressing need for a reduction in the emission of anthropogenic greenhouse gases, we have
14 attempted to explore the role that education about the usefulness of *specific* pro-environmental
15 actions might play in eliciting changes in the practices of individuals. We have designed an
16 instrument that questions respondents about their willingness to undertake *specific* pro-
17 environmental behaviours and, separately, their beliefs about the possible benefits of these
18 particular behaviours in the context of one environmental problem - global warming. Three
19 research questions have been addressed. Firstly, the degrees to which students report being willing
20 to undertake a variety of specific pro-environmental actions have been ascertained. Secondly, the
21 extents to which students believe these particular actions would be effective in reducing global
22 warming have been investigated. Thirdly, the relationship between these two parameters, students'
23 reported willingness to undertake specific actions and their beliefs about the usefulness of the same
24 actions, has been explored. In addition, measures were sought of students' degree of concern about
25 global warming, and the extent to which they thought that it was a real phenomenon. The overall
26 aim was to determine the extent to which increasing students' understanding about the efficacy of
27 specific actions might **persuade** individuals to increase their willingness to undertake those actions,
28 so that education for changes in practice might be targeted for greatest efficacy.
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58 METHODS

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1 This study employed a novel questionnaire to probe the views of secondary students. The study
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3 was initiated in the UK, but has since **been** extended to Australia, the USA and a number of
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5 countries in mainland Europe; here we report the findings of the UK study.
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10 **Design of the questionnaire**

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12 Throughout the questionnaire, the term 'global warming' was employed, although in the instructions
13
14 to students the term 'climate change' was included in parentheses. In individual items, however, the
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16 term 'global warming' alone was used because it was felt to be most closely linked to the primary
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18 cause of this environmental problem, and the focus of this study was to explore students'
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20 willingness to undertake actions which might contribute to potential solutions.
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27 The questionnaire consisted of a coversheet, two main sections and a short final section. The
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29 coversheet asked respondents to record their grade and gender. **Each of the** two main sections of
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31 the questionnaire contained 20 items, 16 of which were about actions that would contribute to the
32
33 amelioration of global warming, **and four of which were distracters that** were more idiosyncratic in
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35 nature. **The latter were derived from** ideas that had been raised by students themselves in earlier
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37 research (Boyes & Stanisstreet, 1993), **and were included** so that respondents would not feel
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39 **obliged** to respond positively to all questions (Oppenheim, 1992; Parmenter and Wardle, 2000).
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43 The results from these four items will not be considered in this paper. **The other 16 actions were**
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45 **selected to provide a reasonably comprehensive coverage of the things that could, to varying**
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47 **degrees, reduce global warming.** Most of the ideas in these items related to carbon dioxide
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49 emissions from energy use and wastage, although two were concerned with other greenhouse gases,
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51 methane and nitrogen oxides. Four of the 16 items concerned indirect actions, such as supporting
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53 increased environmental taxation or legislation. **The section at the end of** the questionnaire
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55 **contained items** designed to probe the level of students' concern about global warming, the extent
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60 of their perceived knowledge about global warming, the degree to which they considered

1 themselves to be environmentally ‘friendly’, and whether or not they believed that global warming
2 was a real phenomenon that was already happening. These questions, and the available responses,
3 are shown in **Figure 1**.
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10 **We now consider the two main sections of the questionnaire.** The focus of the first of **these** was the
11 degree to which students would be willing to undertake a particular action, in the words of the
12 coversheet of the questionnaire, “for the sake of the environment and the future of the Earth”; no
13 mention was made of global warming at this stage. Each item took the form of a conditional clause
14 indicating the personal cost or inconvenience of the action, followed by a simplified description of
15 the action. The wording of the items can be seen in the right hand column of **Figure 2**, and the
16 available responses to these items, which ranged from “I would definitely do it” to “I would
17 probably not do it”, and the ways in which they were scored, are shown in the right side of Figure 3.
18 The scored responses produced by the items in this section of the questionnaire were designated
19 students’ *Degree of Willingness to Act*.
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37 **The items** in the second main section of the questionnaire concerned the same pro-environmental
38 actions as those in the first main section, although the order was different so that the pairing of the
39 questions was not immediately apparent to the respondents. Here, however, the focus of the
40 questioning was on the extent to which respondents believed that the actions were useful in
41 alleviating global warming. The wording of these items can be seen in the left column of **Figure 2**,
42 and the available responses, which ranged from “quite a lot” to “nothing at all really”, and the ways
43 in which they were scored, are shown in the left side of Figure 3. The scored responses were
44 designated students’ *Believed Usefulness of Action*.
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58 **Figure 2** also illustrates the pairing of the items and the themes within the questionnaire. **In**
59 **addition to** the items **being paired, the** available responses in the two main sections of the
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1 questionnaire were designed to 'match', in semantic terms. Figure 3 illustrates this, where the two
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3 response scales are shown in apposition. If, for example, a student believed that a particular action
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5 would help by 'quite a lot', this was matched in the other section of the questionnaire to the
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7 response that they would 'definitely' be willing to do it; each of these responses received a score of
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9 1. Conversely, if a student believed that an action would reduce global warming 'by nothing at all',
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11 this is matched to the action section response that they would 'probably not' do it, and both
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13 responses received a score of zero. The intermediate responses were also designed to correspond in
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15 a similar way, semantically and by score.
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23 The final wording of the paired questionnaire items and matched response scales came about from a
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25 series of discussions with a group of researchers and teachers. The questionnaire was trialled with
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27 134 students (age 14 years), and the only modification entailed the removal of the word 'insulation'
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29 and the rephrasing of the pair of questions concerned.
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34 **Construction of the indices**

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36 From the responses to the two main sections of the questionnaire, the *Degree of Willingness to Act*
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38 and *Believed Usefulness of Action*, a number of derived indices were produced that have been used
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40 to explore the connections between them. Although the two response scales are ordinal and
41
42 although they measure different things, it was felt that because of their semantic matching (Figure
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44 3), some mathematical manipulation of the data is acceptable; this is explored below.
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51 *Potential Effectiveness of Education*

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53 The indices we wish to focus on here relate to the extent to which increasing the understanding
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55 about the efficacy of a particular action through specific environmental education might persuade
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57 individuals within a cohort to undertake that action. To obtain these for a particular action, student
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59 measures of the *Degree of Willingness to Act* were plotted against their value of the *Believed*
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1 *Usefulness of Action*, and the trend line was fitted. This produced a graph of the type exemplified
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3 in Figure 4. The semantic matching of the responses means that linear regression is less sensitive to
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5 the errors involved in using ordinal scales. The slope of such a trend line indicates the extent to
6
7 which the willingness of students to undertake an action might be said to be dependent upon their
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9 belief in the usefulness of that action. The gradient, therefore, provides a measure of the extent to
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11 which willingness to undertake an action might be increased by persuading students of the
12
13 environmental effectiveness of that action; we have called this gradient, in the present context, the
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15 *Potential Effectiveness of Education*. Once the gradient of the line has been determined for a pair of
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17 questions, two other derived indices can be calculated from the intercepts. The intercept when the
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19 *Believed Usefulness of Action* is zero represents the likely action of those students who believed that
20
21 such an action would be ineffective in reducing global warming; we term this the *Natural*
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23 *Willingness to Act*, and Figure 4 is annotated to show this. In a complementary fashion, the
24
25 distance marked *Natural Reluctance to Act* in Figure 4 is a measure of the extent to which students
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27 will not take action, even though the *Believed Usefulness of Action* is at its maximum. These three
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29 indices may be useful in comparing the potential effect of education about different specific pro-
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31 environmental actions in terms of changing practice.
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41 Comparing the values of the *Potential Effectiveness of Education* for different actions gives an
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43 indication of those actions for which education about their **usefulness** might lead to an increased
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45 willingness **to act**, and other actions where education will probably be less effective in this role. On
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47 a population basis, however, there is another measurement that will influence the efficacy of
48
49 education to this end, namely the proportion of the population who are not already reporting an
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51 intention to take action. Thus, education might be most productive in terms of **changing practices** if
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53 directed at those actions that relatively few of the population are already willing to undertake. A
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55 final index was therefore calculated, the *Potential Usefulness of Education*, by multiplying the
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1 *Potential Effectiveness of Education* by the proportion of students in who would ‘probably not’ or
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4 only ‘perhaps’ undertake the action.
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8 **RESULTS**

9
10 In all, 961 students in Grades 6 (11-12 years old) to 10 (15-16 years old) (UK National Curriculum
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12 Year Groups 7 through 11) from four state Community Comprehensive schools in the North West
13
14 of England completed the questionnaire. Of this sample, 18% were in Grade 6, 23% were in Grade
15
16 of England completed the questionnaire. Of this sample, 18% were in Grade 6, 23% were in Grade
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18 7, 25% were in Grade 8, 17% were in Grade 9, and 17% were in Grade 10. Males comprised 52%
19
20 of the cohort, females 48%; males and females were evenly distributed over the years. The
21
22 responses to the final four questions provided some background information about the beliefs and
23
24 views of the students. Some 61% of the students thought or were sure that global warming was
25
26 happening, with half of this figure (31%) being sure of this. About half of the students expressed
27
28 concern about global warming, with 16% reporting being ‘very worried’ and a further 33%
29
30 reporting being ‘quite worried’. Few students, about 14%, thought that they were well informed
31
32 (knew ‘a lot’) about global warming, although a further 39% considered they knew ‘something’
33
34 about it. Nearly half of the cohort (45%) thought of themselves as being either ‘very’ or at least
35
36 ‘quite’ environmentally friendly. Thus, many of this group of students believed that global
37
38 warming is a real phenomenon, few thought that they were especially well informed about it, and
39
40 about half were concerned about its consequences.
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49 **In the descriptions that follow, overall results for the complete cohort are reported first. Following**
50 **this, statistically significant differences between the responses of male and female students and**
51 **between students of different grades are described.**
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58 ***Students’ Degree of Willingness to Act***

1 The findings concerning students' *Degree of Willingness to Act* for different pro-environmental
2 actions are given in the first column of Figure 5 and illustrated graphically in Figure 6. In Figure 6,
3 the items are arranged in descending order according to the combined percentages of students who
4 would 'definitely' or 'almost certainly' undertake the action; in the descriptions below, these same
5 percentages are reported. The direct action to which most students were amenable (68%) was to
6 switch off un-used electrical appliances. The prospect of installing home insulation was acceptable
7 to about half of the students (49%), as were the ideas of recycling materials (48%) and paying more
8 for energy-efficient domestic appliances (44%). Over a third of the cohort (39%) were willing to
9 pay for more tree-planting, although fewer (28%) would accept the increased price premium for
10 food grown without artificial fertilisers, and even fewer (21%) would be prepared to reduce their
11 consumption of meat. In terms of personal transport, only about a fifth of the students (20%) would
12 consider getting a smaller car and a similar proportion (19%) would accept reducing car use by
13 using public rather than private transport. Rather few of the students (15%) would accept buying
14 fewer fashion items. In terms of energy production, **very** few students (10%) felt that using nuclear
15 power was **acceptable, perhaps because other environmental issues are associated with nuclear**
16 **energy. In addition, and perhaps surprisingly,** relatively few **respondents** (23%) would consider
17 paying more for renewable energy sources. Most of the indirect actions were also unpopular. Only
18 about a quarter of the students would be prepared to undertake more education about environmental
19 issues (23%) or allow their vote to be influenced by support for new environmental legislation
20 (21%), international agreements (21%) and, for even fewer, increased environmental taxation
21 (16%). Thus, students appeared willing to undertake different environmental behaviours to varying
22 extents. There was a strong association between most of the 16 *Degree of Willingness to Act* items
23 and the question in the third section of the questionnaire about the extent to which students were
24 worried about global **warming; this** will be discussed later.

Students' *Believed Usefulness of Action*

1 Items in the second main section of the questionnaire explored students' beliefs about the
2
3 usefulness of the various actions in reducing global warming, their *Believed Usefulness of Action*,
4
5 and the data from the responses are given in the second column of Figure 5 and illustrated
6
7 graphically in Figure 7. In Figure 7, the items are arranged in descending order according to the
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9 combined percentages of students who thought that the action would reduce global warming by
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11 'quite a lot' or by 'a fair amount'. In the descriptions that follow, these same percentages are
12
13 reported. Students apparently made a link between global warming and personal transport; two
14
15 actions thought by many of the students to contribute to a reduction in global warming were to
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17 reduce car use (68%) and drive smaller cars (50%). Energy production also seemed to be linked
18
19 with global warming in students' minds, since many believed that production of energy from
20
21 renewable sources (64%) and from nuclear sources (47%) could play a role in reducing global
22
23 warming. Perhaps linked to this, another relatively popular idea was energy conservation by
24
25 switching off unused electrical items (51%). Surprisingly, rather fewer students realised that
26
27 installing home insulation (39%) or the use of energy-efficient domestic appliances (37%) could
28
29 reduce global warming. Tree planting was also thought to contribute to decreasing global warming
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31 by more than half of the students (54%), and almost as many (47%) appreciated the role that
32
33 increased recycling could play. Rather fewer of the students (35%) realised that reducing the use of
34
35 artificial fertilisers and decreasing meat consumption (16%) could lessen global warming, perhaps
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37 because the mechanisms involved gases other than carbon dioxide, the latter being perhaps the most
38
39 well-known greenhouse gas. **Relatively few** students (28%) **realised** that buying fewer new items
40
41 could help to reduce global warming; **this may be because fewer students appreciated the carbon**
42
43 **cost of manufacturing and distributing new consumer goods.** Of what we have termed the 'indirect
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45 actions', those related to international agreements were thought to be the most effective (59%), with
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47 education (49%), legislation (43%) and taxation (37%) being thought less so. Thus, students
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49 believed that the various environmentally-friendly actions that had been suggested in the
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51 questionnaire would be differentially effective in reducing global warming.
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Relationship between the *Degree of Willingness to Act* and *Believed Usefulness of Action*

As explained above, a number of indices can be obtained from the responses to the two main sections of the questionnaire, where the scored items were called the *Degree of Willingness to Act* and the *Believed Usefulness of Action*. Some of these will now be discussed.

The *Potential Effectiveness of Education* provides an indication of the extent to which increasing understanding about particular actions through specific environmental education might persuade individuals to undertake those actions. This relationship was quantified by linear regression, and the results are illustrated schematically in Figure 4; the values of the indices from the regression are summarised in the last four columns of Figure 5. The first of these, the slope of the regression line constructed when the *Degree of Willingness to Act* and the *Believed Usefulness of Action* for pairs of actions are plotted, has been designated the *Potential Effectiveness of Education*; a high value of this index represents a steep relationship between the extent to which students believe an action to be effective and their willingness to undertake that action. In such cases, persuading students of the efficacy of the action should result in more students purporting to take that action. Where the relationship is shallower, indicated by a lower value of the *Potential Effectiveness of Education*, education about the action is less likely to result in more students from this cohort adopting it. The other two indices, the two vertical dimensions marked in Figure 4, provide indicators of the extent to which students will undertake the action anyway, without believing in its effectiveness (*Natural Willingness to Act*), and of the extent to which students will avoid the action even if they believe it is highly effective (*Natural Reluctance to Act*); they each take a value between zero and one.

Figure 5 shows that for some actions the value of the slope of the line, the *Potential Effectiveness of Education*, was low, suggesting that there was little change in the willingness to undertake an action for different beliefs in the effectiveness of that action. For example, this was true for the action of

1 switching off unused electrical items (0.14). In this case, the slope of the line was shallow because
2
3 the *Natural Willingness to Act* was relatively high (0.63); students were prepared to take this action
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5 in any case. Here, it is likely that other motivators, such as parental exhortations to reduce
6
7 electricity bills, coupled with a relatively low level of inconvenience, meant that students would be
8
9 taking this action anyway. The value of the *Potential Effectiveness of Education* was also fairly low
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11 for some other actions such as adopting more nuclear power (0.15), reducing car use (0.18),
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13 avoiding buying new fashion items (0.15) or purchasing smaller cars (0.17). In these cases,
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15 however, the slope of the line was shallow because the *Natural Reluctance to Act* tended to be quite
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17 high; even if students believed these actions to be effective in reducing global warming, they
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19 seemed unwilling to undertake them. For issues such as these it is probable that other disincentives,
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21 such as major inconvenience, substantial changes in lifestyle or environmental and health concerns,
22
23 would prevent students taking these actions. In yet other cases there was a steeper association
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25 between a belief in the effectiveness of an action and a willingness to undertake it. Increasing the
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27 amount of material that is recycled (0.34), reducing the use of artificial fertilisers (0.27) and tree
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29 planting fell into this category (0.26). For these, the *Natural Willingness to Act* and the *Natural*
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31 *Reluctance to Act* were both relatively low, and so the slope of the line was fairly steep. For these
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33 specific actions, then, although many other factors impinge upon behaviour, the data indicate that
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35 educating students about the effectiveness of the action might well result in more of the students
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37 adopting the action. In summary, there are some pro-environmental actions that will probably not
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39 be induced by convincing students of their efficacy, and there are others that probably will.

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51 There is another factor that will impinge upon the degree to which environmental education might
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53 be effective on a population level. In terms of behaviour change, the overall effectiveness of such
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55 education will be maximised when directed at those actions that a high proportion of the population
56
57 are not already undertaking. In an attempt to give some quantitative comparison to the various
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59 actions raised in the questionnaire, a final index, the *Potential Usefulness of Education*, was
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1 constructed by multiplying the *Potential Effectiveness of Education* by the proportion of students
2 who would 'probably not' or only 'perhaps' undertake the action; these data are shown in the final
3 column of Figure 5. This multiplication produces much smaller numbers, but the bigger of these
4 indicate that teaching about the effects of reducing meat consumption (0.14), lowering the use of
5 artificial fertilisers (0.12), decreasing car use (0.11) and increasing the proportion of energy
6 generated from renewable sources (0.11) should be useful areas on which to concentrate teaching.
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18 **Differences between subsets of students**

19 Differences between various groupings of students were investigated in a number of ways.
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21 ANCOVA was used for the basic scores on the 32 items when exploring, simultaneously,
22 differences between the responses of male and female students, and students in different grades.
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25 ANCOVA can be used not only to analyse the effect of several categorical independent variables on
26 a dependent variable (ANOVA) but can include one or more continuous variables which may
27 predict the dependent variable. In this case grade was used as a more or less continuous variable.
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30 For the derived indices, gradient and intercept were compared for any two groups using the standard
31 technique of dummy variable creation and fitting a multiple linear regression model against the
32 independent variable, the comparison variable (dichotomous) and the derived variable. Differences
33 revealed by any of these tests are noted below. When discussing these differences, the percentage
34 of the top two categories will be reported for the main questions (defined as in the first two columns
35 of Figure 5), whereas the derived indices will simply have their values compared (explained in the
36 later columns of Figure 5).
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53 *Differences between male and female students*

54 In this section, the first figures in brackets will be those for the males, followed by those for the
55 females. For the *Degree of Willingness to Act* items, more females than males were prepared to
56 take action on some issues; this included switching off unused electrical items (65%, 71%, $p < 0.05$),
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1 reducing car use (15%, 23%, $p<0.05$) and eating less meat (15%, 27%, $p<0.001$). In the case of
2
3 items to determine the *Believed Usefulness of Action*, three issues showed that females had a greater
4
5 belief in using energy-efficient domestic white goods (33%, 40%, $p<0.01$), reducing the purchase of
6
7 new fashion items (26%, 31%, $p<0.05$) and taking into account a politician's willingness to legislate
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9 on the environment when voting (38%, 48%, $p<0.01$).
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15 Measures of the *Potential Effectiveness of Education*, showed only one difference between the
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17 genders and that was for the question relating to international agreements (0.15, 0.33, $p<0.01$),
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19 where females appeared more likely to have their behaviour influenced by their understanding or
20
21 belief. For two issues there were significant differences in the *Natural Willingness to Act*; for
22
23 eating less meat females showed a greater inherent compliance (0.22, 0.31, $p<0.001$), but they
24
25 seemed less naturally willing to vote in accordance with politicians' views on international
26
27 environmental agreements (0.29, 0.15, $p<0.01$).
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34 *Differences between students in different grades*

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36 Differences between students in different grades are reported below only if ANCOVA revealed
37
38 statistically significant differences giving a trend across the grades. In the descriptions that follow,
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40 the percentage figures quoted are for the top two categories of response across Grades 6, 7, 8, 9 and
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42 10. Within the 16 *Degree of Willingness to Act* items, there were 6 significant and reasonably
43
44 consistent trends downwards across the grades. These were: switching off unwanted appliances
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46 (81%, 65%, 63%, 69%, 66%, $p<0.01$), purchasing foods cultivated without artificial fertilisers
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48 (34%, 35%, 18%, 30%, 24%, $p<0.001$), eating less meat (28%, 28%, 14%, 16%, 19%, $p<0.001$),
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50 buying more efficient appliances (56%, 46%, 36%, 45%, 40%, $p<0.001$) and voting for politicians
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52 in light of their policies on 'green' legislation (34%, 24%, 14%, 18%, 17%, $p<0.001$) and their
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54 support for international environmental agreements (36%, 21%, 15%, 20%, 18%, $p<0.001$).
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1 In the other main section of the questionnaire, the *Believed Usefulness of Action*, there were also a
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3 number of differences that for the most part showed a decrease over the grades. So, fewer of the
4
5 older students believed that global warming would be reduced (by 'quite a lot' or by 'a fair
6
7 amount') by adopting the use of smaller cars (57%, 55%, 52%, 51%, 33%, $p<0.001$), insulating
8
9 homes (44%, 45%, 42%, 39%, 21%, $p<0.001$), switching off un-used electrical items (61%, 57%,
10
11 48%, 48%, 39%, $p<0.001$), recycling more (54%, 60%, 47%, 37%, 33%, $p<0.001$), helping to
12
13 reduce the use of artificial fertilisers (35%, 46%, 37%, 29%, 22%, $p<0.001$), buying fewer fashion
14
15 items (35%, 33%, 27%, 25%, 21%, $p<0.001$), reducing car use (76%, 70%, 65%, 71%, 58%,
16
17 $p<0.001$), eating less meat (19%, 21%, 16%, 8%, 10%, $p<0.001$) or using energy-efficient domestic
18
19 appliances (47%, 42%, 31, 39%, 25%, $p<0.001$). Confidence in the effectiveness of most of the
20
21 indirect actions also declined over the grades. Thus, fewer of the older students saw the benefit,
22
23 with regard to global warming, of voting in accordance with promises on environmental legislation
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25 (53%, 46%, 38%, 45%, 36%, $p<0.01$) and taxation (47%, 38%, 34%, 38%, 27%, $p<0.001$), and
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27 international agreements (72%, 60%, 55%, 60%, 51%, $p<0.001$).

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37 There were a number of differences across the grades in the *Potential Effectiveness of Education*, as
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39 tested using two groups of students (top two and bottom two grades) and the standard technique
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41 described earlier. Generally, the analysis showed increases in the *Potential Effectiveness of*
42
43 *Education* across the grades; this included the actions of planting trees (0.19, 0.16, 0.21, 0.28, 0.50,
44
45 $p<0.05$) and increasing adoption of renewable energy (0.16, 0.23, 0.09, 0.24, 0.38, $p<0.05$).

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48 Although it is known that the knowledge-behaviour link is weak (Kollmus & Agyeman, 2002), it
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50 would appear from these findings that it is stronger for the older students, and would suggest
51
52 perhaps that **teaching about** the **efficacy** of these specific actions might be more effective **with** older
53
54 school students **than with their** younger **counterparts**. This trend was also evident in two of the
55
56 indirect actions, related to supporting international agreements (0.16, 0.20, 0.11, 0.19, 0.43, $p<0.05$)
57
58 and being prepared to undergo more environmental education (0.19, 0.10, 0.18, 0.25, 0.36, $p<0.05$).

1 However, it was also noticed that for these, and only these issues, the *Natural Willingness to Act*
2 started high and decreased across the grades, as the *Potential Effectiveness of Education* increased.
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6 The conclusion would seem to be that adolescents' views retain a degree of flexibility about these
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Differences between more and less concerned students

Finally, the relationship between the extent of students' concern about global warming and their willingness to act in various pro-environmental manners was investigated. Students were grouped according to their responses to a question in the final section of the questionnaire about how worried they are about global warming. Those who indicated that they were 'very' or 'quite' worried were considered to be 'more concerned' (n=452); those who responded that they were 'a little bit worried' or 'not worried at all' were considered to be 'less concerned' (n=460).

Rather than examine how these two groups responded to the *Degree of Willingness to Act variables*, which inevitably contain information about students with different degrees of *Believed Usefulness of Action*, we elected to focus on the extent to which being more or less worried might affect *students' inherent willingness to take action, their Natural Willingness to Act*. When the 16 regressions were performed for *the two groups of students*, and the indices compared using the dummy variable technique mentioned earlier, it became apparent that the values for the *Natural Willingness to Act* indices were consistently higher for the more concerned students than for those who were less concerned; this was true for all actions other than the increased adoption of nuclear power. Figure 8 shows the details for all the differences measured, where one may recall that the *Natural Willingness to Act* mapped on to *a scale with five values*, from zero ('probably not') to one ('almost certainly').

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4 In contrast to these differences, only two of the values of *Potential Effectiveness of Education*
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6 showed statistically significant differences between the two groups, and these differences were
7
8 relatively small. It seems clear from Figure 8 that, regardless of the degree of worry about global
9
10 warming, the sense in which action might be influenced by understanding or belief is fairly stable
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12 (though different for each issue). On the other hand, the *Natural Willingness to Act*, the likely
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14 action even when it is believed to be ineffective, is significantly greater for almost all issues for
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16 those who are more concerned about global warming. **Research on students' views about air**
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18 **pollution suggest that worry can have** a considerable influence on **the** stated willingness to take
19
20 certain environmental actions, **particularly in some cultures** (Boyes, Stanisstreet, Myers, Skamp &
21
22 Yeung, 2007). **The results of the present study further indicate that** worry about global warming
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24 and its consequences **is indeed likely to precipitate action, independent of whether or not it is**
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26 **thought to be helpful.**
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34 **DISCUSSION**

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36 **Research of this nature inevitably has some limitations. For example, the fact that we wished to**
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38 **encompass in this study a reasonably comprehensive range of actions that could, in reality,**
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40 **contribute to a reduction in global warming, inevitably led to a number of consequences. Firstly,**
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42 **this meant that some of these actions were out of the current locus of control of secondary students,**
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44 **who will assume the capacity to take them only later in life. For example, students in this age group**
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46 **will not be able to vote yet about environmental taxation or legislation, or be directly able to**
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48 **purchase energy-efficient consumer durables, although their views may have some influence on**
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50 **parental decisions. Furthermore, whether or not students are able to undertake a particular action**
51
52 **may have some influence on their stated intention to take it. Secondly, the selected actions varied**
53
54 **in terms of the directness of their link to a reduction in global warming. Use of smaller cars, for**
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56 **example, has a fairly obvious link to a reduction in carbon dioxide emission, whereas the link**
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1 between purchasing fewer consumer goods and reducing global warming is more circuitous and
2
3 requires an awareness of the production of greenhouse gases in manufacture and distribution.
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6 Thirdly, some of the issues represented in the questionnaire, such as the extended use of nuclear
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8 power, have counter-balancing environmental arguments, whereas others do not. For all of the
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10 actions, one can argue that any response of an individual indicating that they intend to act will not
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12 necessarily mean that they will do so (Downing & Ballantyne, 2007), although it is unlikely that an
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14 individual who states an intention not to take an action will then take it. Finally, although gaining
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16 any absolute measure of attitudes or intentions is problematic (Reid, 2006), the instrument devised
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18 does enable attitudes and intentions to a series of pro-environmental actions to be compared.
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25 Approximately two thirds of the students in this study believed that global warming is a real
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27 phenomenon, paralleling the high general awareness of global warming in the adult population
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29 (MORI, 2004). Furthermore, about half of the respondents expressed concern about the
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31 consequences of global warming, again similar to the adult population (PEW Research Centre,
32
33 2009), suggesting that consciousness of, and concern about, global warming are beginning to
34
35 develop early. Perhaps because of anxiety about the issue, UK adults in general appear to support,
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37 in principle at least, both individual and political action to reduce global warming (BBC, 2007);
38
39 about half of the UK population believe that modifying individuals' practices would be effective.
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41 In a complementary manner, a proportion of the adult population in general would support the
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43 introduction of further environmental legislation, partly because this is seen as fairer, but also
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45 because it means that pro-environmental behaviour does not rely only on an individuals'
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47 willingness to act (Darier & Schule, 1999).
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56 In the context of these general attitudes, the findings of the present study indicate that among UK
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58 secondary students there is a differential willingness to undertake different pro-environmental
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60 actions - what we have termed the *Degree of Willingness to Act*. Among the more direct actions,

1 for example, many students report a willingness to switch off unused electrical items in the home,
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3
4 whereas far fewer are prepared to alter their practices concerning personal transport by using public
5
6 rather than private transport, or by accepting the use of smaller, more energy-efficient private
7
8 vehicles, unless they are particularly worried about global warming. The differential willingness to
9
10 undertake diverse pro-environmental actions is similar to that reported for adults, who are more
11
12 prepared to increase recycling or to take action to conserve energy in domestic situations, but less
13
14 willing to modify their travel habits (Shackley, McLachlan & Gough, 2004; Kasemir *et al*, 2003;
15
16 O'Connor, Bord & Fisher, 1999). Each of the pro-environmental actions raised in this study has
17
18 associated incentives and disincentives for young people, the nature and extent of which will differ
19
20 between different actions. These motivators and inhibitors stem from a plethora of sources,
21
22 including beliefs, social pressures (Cialdini, Reno & Kallgren, 1990), social background (Pruneau
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24 *et al*, 2007), characteristics of the physical context (Corraliza & Berenguer, 2000) and a person's
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action competence (Jensen & Schnack, 2006).

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This range of motivators and inhibitors means that the likelihood of undertaking any particular pro-
environmental action is the result of an interaction between a general feeling of benefiting the
environment, coupled with more concrete personal incentives, disincentives and concerns.
Switching off un-used electrical items, for example, causes only minor inconvenience so carries few
such inhibitors. In addition, it may carry an incentive in that it aligns with parental exhortations to
'save electricity' for financial reasons. Use of public transport, on the other hand, may be perceived
as carrying a major inconvenience and could be associated with a negative social image amongst
school students' peer groups, with social norms acting as a disincentive (Cialdini, Reno & Kallgren,
1990). For indirect actions such as the influencing of voting patterns, rather few of the students
seemed willing to consider increased environmental taxation, legislation or education or, perhaps
surprisingly, even international agreements. Whilst it is unclear what voting priorities young people
may have, a part of their general unwillingness to consider such issues may be because there is a

1 tendency for them to distrust politicians (Smith, Stanisstreet & Boyes, 2005) and other authority
2
3 figures (Stern, 2008). Such mistrust has major implications for a population that approves in
4
5 principle of the introduction of pro-environmental actions by central government, but seems less
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7 willing to take this into account when voting.
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13 The findings of the present study also indicate that students consider that different actions may have
14
15 different levels of usefulness in reducing global warming, a measurement we termed the *Believed*
16
17 *Usefulness of Action*. For example, reducing car use, generating electricity from renewable sources
18
19 and switching off un-used electrical items were thought to contribute to reducing global warming.
20
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22 In addition, tree planting was seen as useful in this context. The prime effect of all of these actions
23
24 relate to atmospheric carbon dioxide, either by decreasing carbon dioxide emissions or, in the case
25
26 of tree planting, by increasing the rate of removal of carbon dioxide from the atmosphere.
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30 **Decreasing** the use of artificial fertilisers or **reducing meat production** was thought by students to be
31
32 less effective. In these cases the greenhouse gases involved are nitrogen oxides and methane,
33
34 respectively. It may be that the efficacy of such pro-environmental actions in terms of global
35
36 warming may be less well appreciated because the contribution of these two gases to global
37
38 warming is less well known than that of carbon dioxide (Boyes & Stanisstreet, 1993, 2001), the role
39
40 of which has been more recently re-enforced by phrases such as ‘carbon footprint’, ‘carbon
41
42 dependency’ and ‘carbon trading’. Students were also not strongly aware of the link between
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44 consumption of new ‘fashion’ items and global warming, perhaps because the energy consumed in
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46 their manufacture and transport to the point of purchase does not come immediately to the minds of
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48 young people.
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56 By combining the data obtained from the two main sections of the questionnaire, the *Degree of*
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58 *Willingness to Act* and the *Believed Usefulness of Action*, it was possible to derive a series of novel
59
60 indices to gain insight into the probable advantage, in terms of changing students’ practices, of

1 persuading young adults of the efficacy of different pro-environmental actions in ameliorating
2
3 global warming. In particular, the *Potential Effectiveness of Education* is a measure, in the context
4
5 of the present study, of the association between belief in the effectiveness of an action and the
6
7 willingness to undertake it. Certain actions had rather low values for the *Potential Effectiveness of*
8
9 *Education*, indicating that education might be less effective for such actions in terms of behaviour
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11 change. There are two reasons why the *Potential Effectiveness of Education* might be low. In some
12
13 cases, such as switching off un-used electrical items, this was because students showed a high
14
15 *Natural Willingness to Act* - they would perform such actions irrespective of a belief or not in their
16
17 merit. In other cases a low *Potential Effectiveness of Education* was associated with a high *Natural*
18
19 *Reluctance to Act*. Here, even a relatively strong belief in the efficacy of an action did not promote
20
21 its uptake, presumably because there were other disincentives in place; the nature of such
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23 disincentives would, of course, vary between different actions. For example, adoption of nuclear
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25 power may show a high *Natural Reluctance to Act* because of fears about environmental or health
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27 impacts of nuclear power. Change in transport habits, such as the use of smaller cars or substitution
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29 of public for private transport, could be somewhat intractable because environmental sensitivity
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31 would be out-weighed in decision-making by preferences about lifestyle or personal convenience,
32
33 an example of a physical inhibitor acting as a disincentive (Corraliza & Berenguiar, 2000). In
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35 addition, students were resistant to reducing their purchase of new 'fashion' items, perhaps because
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37 consumption of this sort is perceived as a natural characteristic of **their life**-style. In such cases,
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39 where the *Potential Effectiveness of Education* is low, education alone might be of only limited
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41 benefit in terms of altering students' **behaviour**, although it might be a useful component in a series
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43 of measures. For example, introduction of potentially unpopular environmental legislation might be
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45 made more acceptable if there is a general understanding of why it is necessary.
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58 In the case of other pro-environmental actions, there was a stronger relationship between the extent
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60 to which an action was believed to be effective in reducing global warming and a willingness to

1 undertake it; in other words, the *Potential Effectiveness of Education* was higher. Increasing
2 recycling, reducing the use of synthetic fertiliser, tree planting, installing home insulation and using
3 energy-efficient domestic appliances were examples of these actions. The first of these might be
4 especially relevant because this action is within the locus of control of individual young people.
5
6 Indeed, it has been shown that in the case of health education (Wilcox *et al*, 1981: Croucher *et al*,
7 1985), young people may influence the practices of the family in which they live, even though the
8 effect may be weak.
9

10 With virtually all of the issues, the rate at which intended action increased with belief about that
11 action did not depend on how worried the students were about global warming. On the other hand,
12 the extent to which the more worried students were prepared to take action even when they did not
13 believe it to be effective, was considerably greater; that is, the *Natural Willingness to Act* was
14 greater in the more concerned individuals. One possible explanation is that the more concerned
15 students make an assessment that, even though they perceive the action as having little or no effect,
16 it is worth taking 'just in case', because they worry about the outcome of inaction being so
17 devastating. An alternative explanation is that the willingness to take action and the concern about
18 the consequences of global warming may each be a reflection of a 'constellation' of underlying
19 attitudes (Heimlich & Ardoin, 2008), which includes students' perception of themselves as being
20 pro-environmental; almost half of the students in the present study declared themselves to be
21 'environmentally friendly'. The one issue for which there was no difference between the declared
22 intentions of worried and unconcerned students was the idea of being willing to pay more for
23 electricity if it were produced by nuclear power. Perhaps, in the minds even of those students who
24 are concerned about global warming, the risks associated with the proliferation of nuclear energy
25 are more significant than the consequences of global warming.
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1 In terms of persuading people to alter their behaviour, not all of those who are at present unwilling
2 to undertake actions will be amenable to changing their practices. The adult population can be
3 considered to consist of various groups with different characteristic behaviours and attitudes
4 (DEFRA, 2008b). Furthermore, research in the USA has suggested that society may be considered
5 to consist of six 'segments', from the 'Alarmed' who are sure that global warming is happening and
6 are worried about it, to the 'Dismissive' who consider that global warming is not happening and so
7 regard changes in behaviour as unnecessary (Maibach, Roser-Renouf & Leiserowitz, 2009).
8
9 Members of some of these segments are more amenable to change than others. A further index, the
10 *Potential Usefulness of Education*, attempted to take account of the size of the potential education
11 audience, that is, the proportion of students who did not already intend to undertake such actions.
12
13 Actions with a high *Potential Usefulness of Education* were those for which intended behaviour
14 appeared to be strongly influenced by a belief in their effectiveness (that is, the *Potential*
15 *Effectiveness of Education* was high), and which a relatively high proportion of students are at
16 present unwilling to undertake. Using this index, certain specific actions emerge as useful targets
17 for education; a reduction in meat consumption (and therefore production) and a willingness to pay
18 more for produce grown without the use of artificial fertilisers, together with a decrease in car use
19 and production of energy from renewable sources were such actions. Thus, the *Potential*
20 *Usefulness of Education* enables us to target actions which are not at present accepted by a large
21 proportion of the population. In a complementary manner, however, continuing environmental
22 education directed towards those who are already prepared to take action is also necessary in order
23 to reinforce and maintain their existing pro-environmental behaviour, particularly when this has
24 been engendered through social marketing (Heimlich & Ardoin, 2008).
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56 The present study reveals that for different actions there is a different degree of association between
57 a belief in the efficacy of an action and a willingness to undertake it; this variation is one reason
58 why environmental education in general might be less than fully effective in terms of behaviour
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1 **change.** Even in the case of specific actions, it is apparent that for some actions education to
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3 persuade learners of their usefulness in terms of a major environmental problem has little potential
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5 on its own to be effective in terms of modifying young people's practices.
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10 **Our research suggests** that where there were differences between the responses of male and female
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12 students, females tended to be more sensitive to the benefits of certain pro-environmental actions,
13
14 and more willing to undertake other pro-environmental actions. This is congruent with the
15
16 observation that females tend to score more highly than males on instruments that measure of
17
18 environmental attitudes (Burger *et al*, 1998; Taskin, 2009). The results also indicate that the degree
19
20 of association between belief in the effectiveness of an action and a willingness to undertake it
21
22 differs across different age groups of students. It appears, in contrast to our intuition, that older
23
24 secondary students might respond more to teaching than their younger counterparts in terms of
25
26 behaviour change. Perhaps a potential hazard, then, of initiating education about pro-environmental
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28 actions too early might be that of over-exposure; the possibility is that by the time that students
29
30 reach their most receptive stage they may be in a state of environmental 'fatigue', in the same way
31
32 that donors to charity are thought, eventually, to suffer 'compassion fatigue' (Gallup, 2009; Ker,
33
34 2009). In addition to **the** heterogeneity that could be linked to **overt factors** such as gender and year
35
36 group, it appears that there is **also** an association between the level of concern among students about
37
38 global warming, and their willingness to undertake pro-environmental actions. Education
39
40 strategists and practitioners should be aware, therefore, of this further heterogeneity within the
41
42 student population; like adults (Lorenzini, Nicholson-Cole & Whitmarsh, 2007; DEFRA, 2008b),
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44 students will not be uniform in their behavioural responsiveness to environmental education even
45
46 about specific **actions.**
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58 **The** discrepancies between belief and willingness to act for different actions **revealed in this study**
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60 originate in the variety of other, sometimes non-environmental, incentives and disincentives

1 associated with the various actions. It would be interesting, in further research, to investigate the
2
3 detail of those things that restrain or encourage individual actions, remembering that a wide variety
4
5 of factors are likely to be involved, and that these will differ for each action under consideration.
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10 **ACKNOWLEDGEMENTS**

11 **We wish to thank the referees for suggesting important improvements to our original manuscript.**
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Figure 1 Wording and available responses for the final four items of questionnaire

Items	Available responses
How worried are you about what Global Warming might do to the environment?	I am very worried I am quite worried I am a little bit worried I am not worried at all
How much do you think you know about Global Warming?	I know a lot about global warming I know something about global warming I know a little about global warming I know almost nothing about global warming
How 'environmentally friendly' do you think you are? (How much do you think you 'take care of' the environment by the things you do?)	I am very environmentally friendly I am quite environmentally friendly I am a bit environmentally friendly I am not at all environmentally friendly
Do you think that Global Warming is really happening now?	I am sure global warming is happening I think global warming is happening I don't know whether global warming is happening or not I am think global warming is not happening I am sure global warming is not happening

Figure 2 Wording of the questionnaire items. The main items of the questionnaire displayed so that the ‘pairing’ of the items can be seen.

Themes	Items about the <i>Believed Usefulness of Action</i>	Items about the <i>Degree of Willingness to Act</i>
<i>Direct actions</i>		
Transport (use)	If people didn't use their cars so much, global warming would be reduced	Even if it took me longer and was more inconvenient, I would try to use buses and trains instead of a car
Transport (type)	If people had smaller cars that used less petrol or diesel, global warming would be reduced	Even if it was not as fast or luxurious, I would try to get a car that uses less petrol or diesel
Power generation (renewable)	If more of our energy was produced from the wind, waves and sun, global warming would be reduced	Providing more of our energy was produced from the wind and waves and sun, I would be willing to pay more for electricity
Power generation (nuclear)	If more of our energy was produced from nuclear power stations, global warming would be reduced	Providing more of our energy was produced from nuclear power stations, I would be willing to pay more for electricity
The home (electricity use)	If people used less electricity in their homes, global warming would be reduced	To save electricity, I would switch things off at home when I didn't need them
The home (insulation)	If people got their homes insulated better, global warming would be reduced	Even though it cost me money, I would get extra insulation for my home
The home (consumer durables)	If people got things for their homes (like fridges and washing machines) that used less energy, global warming would be reduced	Even if it cost me more, I would buy things for my home (like fridges and washing machines) that use less energy
The home (consumables)	If people were prepared to buy fewer new things and make do with the old ones, global warming would be reduced	Even if it meant that I didn't always have the latest 'gear' or fashion, I would be prepared to buy new things less often
Environmentally-friendly (trees)	If more trees were planted in the world, global warming would be reduced	Even if I had to pay more taxes, I think there should be more trees planted in the world
Environmentally-friendly (recycle)	If people recycled things more, global warming would be reduced	Even if it was more trouble for me, I would recycle things rather than just throw them away
Food (Reducing meat)	If people eat less meat, global warming would be reduced	Even if I really liked meat, I would eat fewer meals with meat in them
Food (Reducing artificial fertilizers)	If farmers stopped using artificial fertilisers with nitrogen in them, global warming would be reduced	Even if it was more expensive, I would buy food grown without the use of artificial fertilisers
<i>Indirect actions</i>		
Environmental legislation	If politicians made the right kind of new laws, global warming would be reduced	I would vote for a politician who said they would bring in laws to reduce global warming, even though it would stop me doing some of the things I enjoy
Environmental taxation	If politicians made people pay more tax and spent the money on the right kind of things, global warming would be reduced	I would vote for a politician who said they would increase taxes to pay for reducing global warming, even though it meant me having less money to spend
Environmental education	If people were taught more about it, global warming would be reduced	I would like to learn more about global warming, even though it would mean extra work for me
Environmental International cooperation	If there could be more agreement between different countries about not putting certain gases into the air, global warming would be reduced	Even though it might mean some inconvenience to me (like changing my job), I would vote for a politician who said they would sign agreements with other countries on global warming

The items of the questionnaire are displayed so that the ‘pairing’ of the items can be seen. In the actual questionnaire, the items were in random order, and paired items were in different orders in the two main sections.

Figure 3 Wording of the permissible responses to the two sets of items.

<i>Believed Usefulness of Action</i> If I thought an action would help global warming by...	Score	<i>Degree of Willingness to Act</i> then I would...	Score
by quite a lot	1.00	definitely do it	1.00
by a fair amount	0.75	almost certainly do it	0.75
by a small but useful amount	0.50	probably do it	0.50
by a very small amount - hardly noticeable	0.25	perhaps do it	0.25
by nothing at all really	0.00	probably not do it	0.00

The wording of the permissible responses is displayed 'matched'. This 'matching' suggests the minimum action ('then I would') that might reasonably be expected for a given belief about the usefulness of that action. The figures show the scores assigned to the different responses; these enabled various coefficients to be constructed.

Figure 4 Annotated graph to show relationship between the *Degree of Willingness to Act* and the *Believed Usefulness of Action*

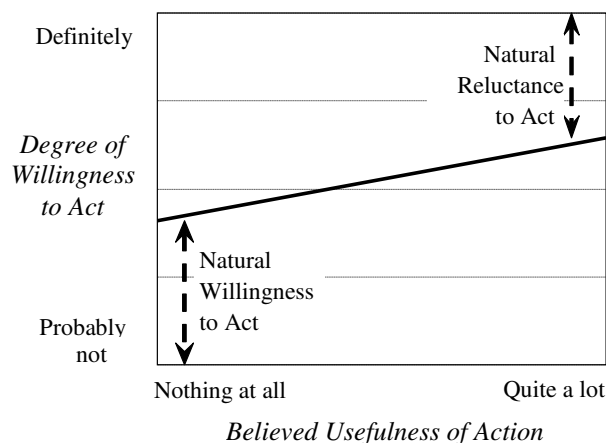
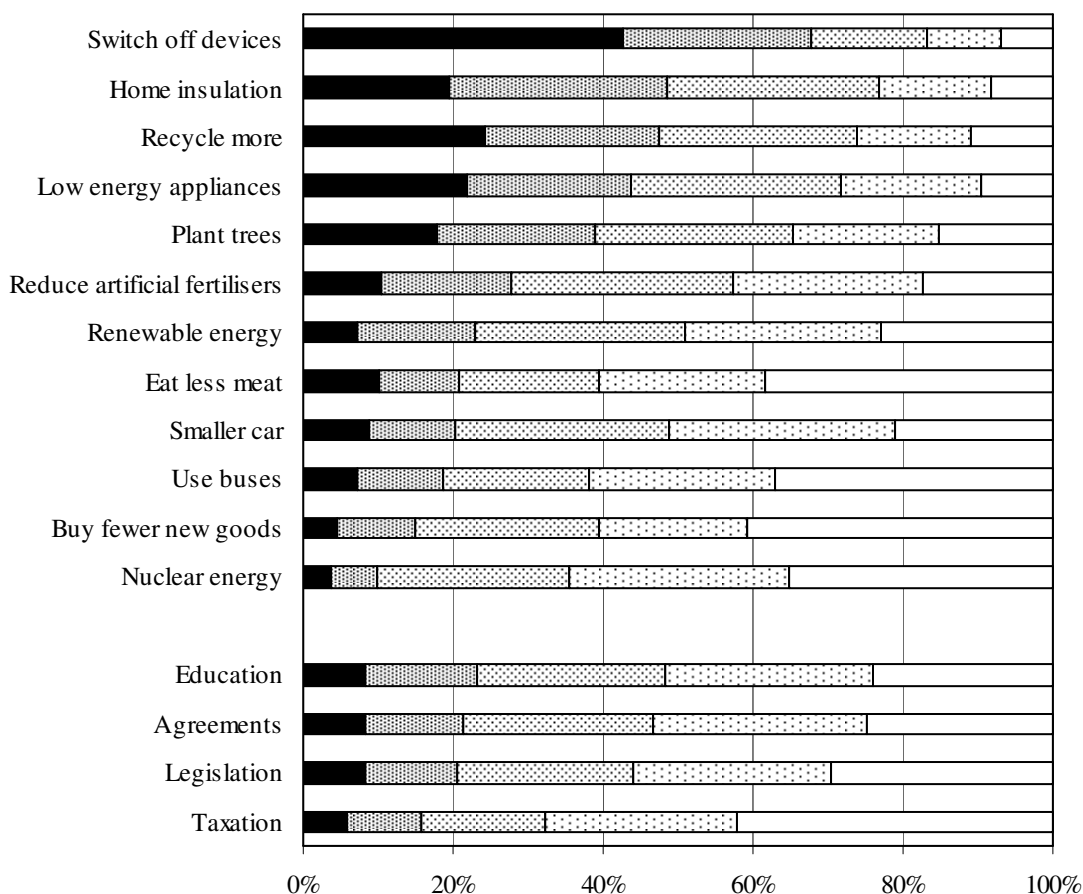


Figure 5 Secondary Students' willingness to undertake various pro-environmental actions, their beliefs about the usefulness of such actions and the relationships between these two measurements.

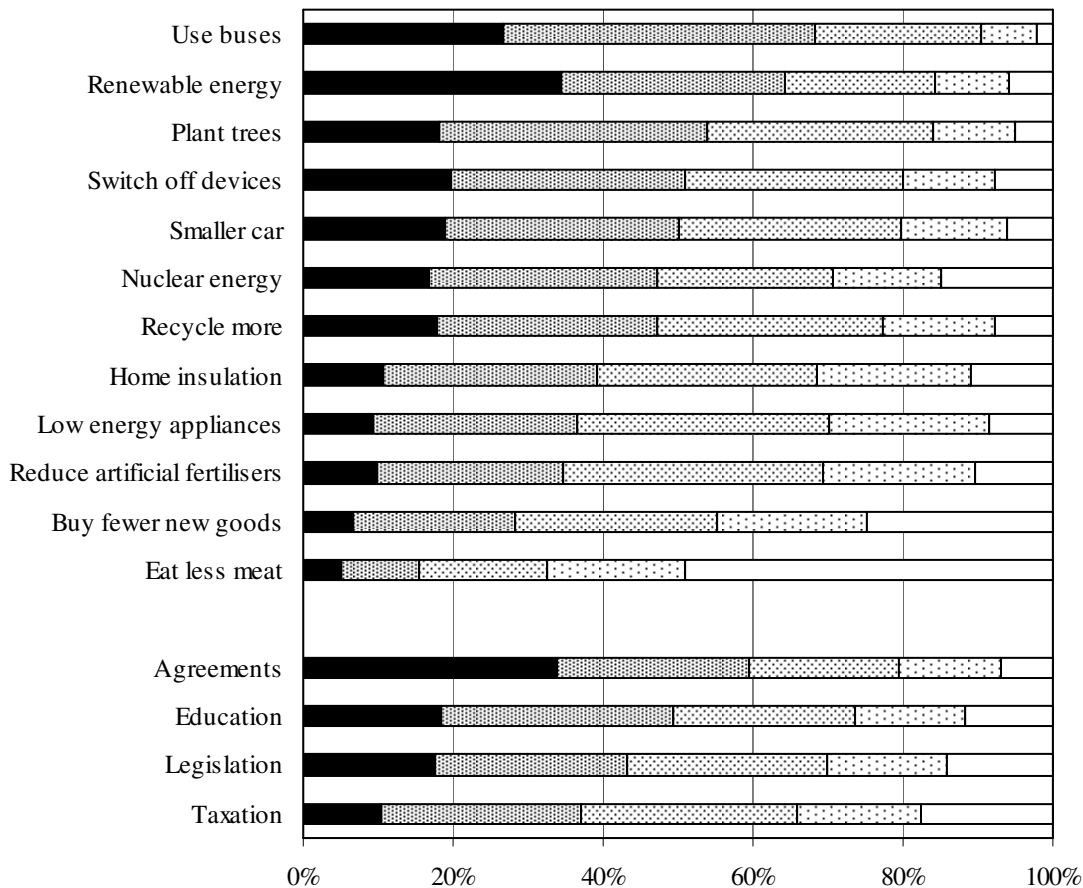
	<i>Degree of Willingness to Act</i>	<i>Believed Usefulness of Action</i>	<i>Potential Effectiveness of Education</i>	<i>Natural Willingness to Act</i>	<i>Natural Reluctance to Act</i>	<i>Potential Usefulness of Education</i>
	(% 'definitely' + 'almost certainly')	(% 'quite a lot' + 'a fair amount')	(Slope of <i>Degree of Willingness to Act</i> plotted vv <i>Believed Usefulness of Action</i>)	(Intercept when <i>Believed Usefulness of Action</i> is at minimum)	(Measurement between unity and the intercept when <i>Believed Usefulness of Action</i> is at maximum)	(<i>Potential Effectiveness of Education</i> x proportion of 'perhaps do it' and 'probably not do it')
<i>Direct actions</i>						
Smaller cars	20	50	0.17	0.29	0.54	0.09
Nuclear energy	10	47	0.15	0.20	0.64	0.10
Home insulation	49	39	0.25	0.46	0.28	0.06
Switch off unused devices	68	51	0.14	0.63	0.23	0.02
Plant trees	39	54	0.26	0.36	0.38	0.09
Recycle more	48	47	0.34	0.39	0.27	0.09
Reduce artificial fertilisers	28	35	0.27	0.31	0.42	0.12
Buy fewer new goods	15	28	0.15	0.23	0.62	0.09
Renewable energy	23	64	0.23	0.24	0.54	0.11
Use buses	19	68	0.18	0.19	0.63	0.11
Eat less meat	21	16	0.23	0.27	0.50	0.14
Low energy appliances	44	37	0.25	0.44	0.31	0.07
<i>Indirect actions</i>						
Legislation	21	43	0.23	0.24	0.54	0.13
Taxation	16	37	0.25	0.16	0.59	0.17
Agreements	21	59	0.24	0.23	0.54	0.13
Education	23	49	0.22	0.27	0.52	0.11

Figure 6 Secondary students' *Degree of Willingness to Act* to undertake different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who would 'definitely' undertake the action; the next, slightly lighter bar those who would 'almost certainly' undertake the action; the next, lighter bar, those who would 'probably' undertake the action; the next bar those who would 'perhaps' take the action; and the right hand, white bar, those who 'probably not' undertake the action. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who would 'definitely' and 'almost certainly' take the action.

Figure 7 Secondary students' *Believed Usefulness of Action* of different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who responded that the action would reduce global warming by 'quite a lot'; the next, slightly lighter bar those who believe it would reduce global warming by 'a fair amount'; the next, lighter bar, those who believe it would reduce global warming by a 'small but useful amount'; the next bar those who believe it would reduce global warming by 'a very small, hardly noticeable, amount'; and the right hand, white bar, those who believe the action would reduce global warming by 'nothing at all'. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who responded that the action would reduce global warming by 'quite a lot' and by 'a fair amount'.

Figure 8 Comparison of derived indices, *Natural Willingness to Act* and *Potential Effectiveness of Education* for two groups of students, those who are more or less concerned about global warming. The indices and categories are defined in the text.

Issue	<i>Natural Willingness to Act</i>			<i>Potential Effectiveness of Education</i>		
	More Concerned	Less Concerned	Sig	More Concerned	Less Concerned	Sig
<i>Direct actions</i>						
Smaller cars	.40	.25	**	.11	.12	
Nuclear energy	.22	.21		.18	.10	
Home insulation	.54	.44	*	.20	.23	
Switch off unused devices	.75	.60	**	.05	.09	
Plant trees	.50	.30	***	.18	.22	
Recycle more	.51	.36	**	.28	.28	
Reduce artificial fertilisers	.41	.28	**	.23	.20	
Buy fewer new goods	.32	.19	***	.10	.13	
Renewable energy	.38	.18	***	.14	.21	
Use buses	.37	.15	**	.07	.11	
Eat less meat	.38	.20	***	.11	.28	*
Low energy appliances	.54	.41	**	.18	.22	
<i>Indirect actions</i>						
Legislation	.35	.21	***	.20	.10	
Taxation	.25	.13	**	.25	.11	*
Agreements	.32	.19	**	.22	.16	
Education	.42	.21	***	.13	.15	

*** p<0.001

** p<0.01

* p<0.05

Environmental education for behaviour change: which actions should be targeted?

ABSTRACT

One aim of environmental education is to enable people to make informed decisions about their environmental behaviour; this is particularly significant with environmental problems that are believed to be both major and imminent, such as climate change resulting from global warming. Previous research suggests no strong link between a person's general environmental attitudes and knowledge, and his or her willingness to undertake pro-environmental actions, so this study focuses on some *specific* issues. Using survey methods to produce quantitative data about students' beliefs concerning the usefulness of specific actions and their willingness to adopt them, novel indices have been constructed that indicate the potential of education to increase students' willingness to undertake those actions. The findings imply that altering a student's belief about certain issues will have little effect on their willingness to act. This can be because most students, even those with only a weak belief in the efficacy, are prepared to take action anyway. Conversely, it can be because a majority, including those convinced about the efficacy, is not prepared to take action. Education about such actions, where there is only a weak link between believed effectiveness and willingness to act, may be ineffective in terms of changing practice, because other factors such as social norms and situational influences dominate. For such actions other strategies may be required. For another set of actions, however, the benefits of education in changing practice seemed more positive; increasing recycling, reducing the use of artificial fertilisers and planting more trees are examples.

INTRODUCTION

“The literature on public understanding of climate change indicates widespread awareness of the issue and a general concern, but limited behavioural response”

(Lorenzoni, Nicholson-Cole & Whitmarsh, 2007)

Twenty years ago the scientific evidence for 'global warming'¹ was considered by some to be contentious (Stevenson, 1987; Boyes & Stanisstreet, 1993). Today, however, the weight of objective evidence has persuaded the majority of authoritative sources that the increase in global warming is a real phenomenon, caused by human-sourced greenhouse gases (IPCC, 1997), and that this is an increasing threat to the world's environmental integrity, social well-being (IPCC, 2001; 2007), economic stability (Stern, 2007) and political security (Solana, 2008). In view of these persuasive predictions, it is increasingly important to design and apply effective measures for reducing the emission of greenhouse gases, the primary drivers of global warming. In part, this will depend on central government policies. The UK government, amongst others, set ambitious targets to reduce by 12.5% (relative to 1990 levels) the levels of the major greenhouse gases by 2010, with a reduction by 20% for carbon dioxide in particular. Furthermore, the political goal is to reduce carbon dioxide by 60% by 2050 (DTI, 2003). Unfortunately, since these targets were set it has become apparent that the 20% reduction in carbon dioxide will not be achieved, throwing doubt on the attainability of the 2050 target of a 60% reduction (DEFRA, 2006).

In a complementary manner, it is estimated that about half of UK energy is used directly by individuals, for domestic use and personal transport. In these sectors, however, energy consumption is increasing (DEFRA, 2008a). What is needed, then, are mechanisms to persuade individuals to reduce their carbon contribution by limiting their energy use, because many individual-level actions can accumulate to produce environmentally significant impacts (Jensen and Schnack, 2006). Although there is disagreement about whether environmental education should

¹ In reality, the addition of anthropogenic pollutants to the atmosphere results in an exacerbation of the natural 'greenhouse effect' leading to 'global warming', the major effect of which is an alteration in the world's climate – 'climate change'. In this paper we have elected to use the term 'global warming' because it describes the primary consequence of this process.

1 encourage pro-environmental action or whether it should focus solely on knowledge and attitudes
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4 (Heimlich & Ardoin, 2008), it could be argued that, in view of the urgent call to reduce global
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6 warming, one of the aims of environmental education should be to engender in learners a
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8 preparedness to act in more environmentally sustainable ways (Mentzer & McEwen, 1999; Jurin &
9
10 Fortner, 2002). Early models for encouraging environmental behaviour became known as
11
12 'information deficit' models (Burgess, Harrison & Filius, 1998). These were based on the
13
14 assumption that if people understood more about the environment and the actions that would cause,
15
16 or avoid, environmental degradation, they would behave in a rational manner and adopt
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18 environmentally sympathetic practices. In other words, it was believed that there was a relatively
19
20 direct and positive relationship between a person's cognitive base about environmental problems
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22 and his or her willingness to act in such a way as to reduce these problems. Other models suggested
23
24 a less direct link, in which action is influenced by both an intention to act and situational factors
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26 (Hines, Hungerford and Tomera, 1986-7). Some studies have shown that knowledge and behaviour
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28 are indeed related (Yencken, 2000). In many other cases, however, it seems that the relationship
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30 between knowledge and action is not robust (Rajecki, 1982; Hungerford & Volk, 1990; Posch,
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32 1993), and it is acknowledged that there is what has come to be known as a 'gap' between cognition
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34 and action (Kollmus & Agyeman, 2002). In part, this 'gap' is due to the fact that behaviour is
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36 influenced by a plethora of other factors, not just knowledge; other beliefs, social pressures,
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38 physical facilitators and inhibitors can synergistically influence whether or not a particular action is
39
40 pursued (Corraliza & Berenguer, 2000). Similarly, descriptive and injunctive social norms,
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42 standards by which actions are perceived as normally being undertaken, or as being approved or
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44 disapproved of, can influence whether or not a person acts in an environmentally sympathetic
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46 fashion (Cialdini, Reno & Kallgren, 1990). Perhaps most relevant to the present study is the finding
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48 that situational influences such as a person's belief in their own self-efficacy also partly determine
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50 the extent to which he or she acts in a pro-environmental manner (Devine-Wright, Devine-Wright
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52 & Flemming, 2004; Laskova, 2007). Despite these complications, many of these other factors are
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1 themselves influenced by the cognitive base of the individual concerned, and thus potentially
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3 affected by education.
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9 A further issue that has emerged as researchers have attempted to generate models of the incentives
10 and disincentives to pro-environmental behaviour is that there are limitations in studying links
11 between *general* environmental attitudes and potential behaviour patterns (Fishbein & Ajzen, 1975;
12 Ajzen & Fishbein, 1980; Dietz, Stern & Guagnano, 1998; Stern, 1992). Given this complexity, and
13 a pressing need for a reduction in the emission of anthropogenic greenhouse gases, we have
14 attempted to explore the role that education about the usefulness of *specific* pro-environmental
15 actions might play in eliciting changes in the practices of individuals. We have designed an
16 instrument that questions respondents about their willingness to undertake *specific* pro-
17 environmental behaviours and, separately, their beliefs about the possible benefits of these
18 particular behaviours in the context of one environmental problem - global warming. Three
19 research questions have been addressed. Firstly, the degrees to which students report being willing
20 to undertake a variety of specific pro-environmental actions have been ascertained. Secondly, the
21 extents to which students believe these particular actions would be effective in reducing global
22 warming have been investigated. Thirdly, the relationship between these two parameters, students'
23 reported willingness to undertake specific actions and their beliefs about the usefulness of the same
24 actions, has been explored. In addition, measures were sought of students' degree of concern about
25 global warming, and the extent to which they thought that it was a real phenomenon. The overall
26 aim was to determine the extent to which increasing students' understanding about the efficacy of
27 specific actions might persuade individuals to increase their willingness to undertake those actions,
28 so that education for changes in practice might be targeted for greatest efficacy.
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58 METHODS

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1 This study employed a novel questionnaire to probe the views of secondary students. The study
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3 was initiated in the UK, but has since been extended to Australia, the USA and a number of
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5 countries in mainland Europe; here we report the findings of the UK study.
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10 **Design of the questionnaire**

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12 The questionnaire consisted of a coversheet, two main sections and a short final section. The
13
14 coversheet asked respondents to record their grade and gender. Each of the two main sections of
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16 the questionnaire contained 20 items, 16 of which were about actions that would contribute to the
17
18 amelioration of global warming, and four of which were distracters that were more idiosyncratic in
19
20 nature. The latter were derived from ideas that had been raised by students themselves in earlier
21
22 research (Boyes & Stanisstreet, 1993), and were included so that respondents would not feel
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24 obliged to respond positively to all questions (Oppenheim, 1992; Parmenter and Wardle, 2000).
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26 The results from these four items will not be considered in this paper. The other 16 actions were
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28 selected to provide a reasonably comprehensive coverage of the things that could, to varying
29
30 degrees, reduce global warming. **Although this was not an exhaustive list, the actions chosen were**
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32 **considered to be representative and are generally accepted as important (US EPA, 2010).** Most of
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34 the ideas in these items related to carbon dioxide emissions from energy use and wastage, although
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36 two were concerned with other greenhouse gases, methane and nitrogen oxides. Four of the 16
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38 items concerned indirect actions, such as supporting increased environmental taxation or legislation.
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40 The section at the end of the questionnaire contained items designed to probe the level of students'
41
42 concern about global warming, the extent of their perceived knowledge about global warming, the
43
44 degree to which they considered themselves to be environmentally 'friendly', and whether or not
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46 they believed that global warming was a real phenomenon that was already happening. **These final**
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48 **four** questions, and the available responses, are shown in Figure 1.
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1 We now consider the two main sections of the questionnaire. Because the aim of the questionnaire
2 was to explore, in a quantitative manner, possible links between belief in the efficacy of specific
3 behaviours and a willingness to undertake those same behaviours, both the structure of the
4 questionnaire, and the wording of the items and responses in these two sections had to be
5 constructed *de novo*. The focus of the first main section was the degree to which students would be
6 willing to undertake a particular action, in the words of the coversheet of the questionnaire, “for the
7 sake of the environment and the future of the Earth”; no mention was made of global warming at
8 this stage. Each item took the form of a conditional clause indicating the personal cost or
9 inconvenience of the action, followed by a simplified description of the action. The wording of the
10 items can be seen in the right hand column of Figure 2, and the available responses to these items,
11 which ranged from “I would definitely do it” to “I would probably not do it”, and the ways in which
12 they were scored, are shown in the right side of Figure 3. The scored responses produced by the
13 items in this section of the questionnaire were designated students’ *Degree of Willingness to Act*.

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34 The items in the second main section of the questionnaire concerned the same pro-environmental
35 actions as those in the first main section, although the order was different so that the pairing of the
36 questions was not immediately apparent to the respondents. Here, however, the focus of the
37 questioning was on the extent to which respondents believed that the actions were useful in
38 alleviating global warming. The wording of these items can be seen in the left column of Figure 2,
39 and the available responses, which ranged from “quite a lot” to “nothing at all really”, and the ways
40 in which they were scored, are shown in the left side of Figure 3. The scored responses were
41 designated students’ *Believed Usefulness of Action*.

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56 Figure 2 also illustrates the pairing of the items and the themes within the questionnaire. In
57 addition to the items being paired, the available responses in the two main sections of the
58 questionnaire were designed to ‘match’, in semantic terms. Figure 3 illustrates this, where the two
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1 response scales are shown in apposition. If, for example, a student believed that a particular action
2 would help by 'quite a lot', this was matched in the other section of the questionnaire to the
3 response that they would 'definitely' be willing to do it; each of these responses received a score of
4 1. Conversely, if a student believed that an action would reduce global warming 'by nothing at all',
5 this is matched to the action section response that they would 'probably not' do it, and both
6 responses received a score of zero. The intermediate responses were also designed to correspond in
7 a similar way, semantically and by score.
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20 The final wording of the paired questionnaire items and matched response scales came about from a
21 series of discussions with a group of researchers and teachers. Throughout the questionnaire, the
22 term 'global warming' was employed, although in the instructions to students the term 'climate
23 change' was included in parentheses. In individual items, however, the term 'global warming' alone
24 was used because it was felt to be most closely linked to the primary cause of this environmental
25 problem, and the focus of this study was to explore students' willingness to undertake actions
26 which might contribute to potential solutions.
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39 The questionnaire was trialled with 134 students (age 14 years). The students completed the
40 questionnaire in normal classroom situations in the presence of their usual class teacher, who then
41 elicited feedback from them. Following discussions between the authors, the teacher and a wider
42 research group, the only modification deemed necessary was the rephrasing and clarification of the
43 pair of questions concerning home insulation.
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53 Construction of the indices

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55 From the responses to the two main sections of the questionnaire, the *Degree of Willingness to Act*
56 and *Believed Usefulness of Action*, a number of derived indices were produced that have been used
57 to explore the connections between them. Although the two response scales are ordinal and
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1 although they measure different things, it was felt that because of their semantic matching (Figure
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3 3), some mathematical manipulation of the data is acceptable; this is explored below.
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8 *Potential Effectiveness of Education*

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10 The indices we wish to focus on here relate to the extent to which increasing the understanding
11 about the efficacy of a particular action through specific environmental education might persuade
12 individuals within a cohort to undertake that action. To obtain the indices for a particular action,
13 student measures of the *Degree of Willingness to Act* were plotted against their value of the
14 *Believed Usefulness of Action*, and the trend line was fitted. This produced a graph of the type
15 exemplified in Figure 4. The semantic matching of the responses means that linear regression is
16 less sensitive to the errors involved in using ordinal scales. The slope of such a trend line indicates
17 the extent to which the willingness of students to undertake an action might be said to be dependent
18 upon their belief in the usefulness of that action. The gradient, therefore, provides a measure of the
19 extent to which willingness to undertake an action might be increased by persuading students of the
20 environmental effectiveness of that action; we have called this gradient, in the present context, the
21 *Potential Effectiveness of Education*. Once the gradient of the line has been determined for a pair of
22 questions, two other derived indices can be calculated from the intercepts. The intercept when the
23 *Believed Usefulness of Action* is zero represents the likely action of those students who believed that
24 such an action would be ineffective in reducing global warming; we term this the *Natural*
25 *Willingness to Act*, and Figure 4 is annotated to show this. In a complementary fashion, the
26 distance marked *Natural Reluctance to Act* in Figure 4 is a measure of the extent to which students
27 will not take action, even though the *Believed Usefulness of Action* is at its maximum. These three
28 indices may be useful in comparing the potential effect of education about different specific pro-
29 environmental actions in terms of changing practice.
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1 Comparing the values of the *Potential Effectiveness of Education* for different actions gives an
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3 indication of those actions for which education about their usefulness might lead to an increased
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5 willingness to act, and other actions where education will probably be less effective in this role. On
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7 a population basis, however, there is another measurement that will influence the efficacy of
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9 education to this end, namely the proportion of the population who are not already reporting an
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11 intention to take action. Thus, education might be most productive in terms of changing practices if
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13 directed at those actions that relatively few of the population are already willing to undertake. A
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15 final index was therefore calculated, the *Potential Usefulness of Education*, by multiplying the
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17 *Potential Effectiveness of Education* by the proportion of students in who would 'probably not' or
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19 only 'perhaps' undertake the action.
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27 RESULTS

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29 In all, 961 students in Grades 6 (11-12 years old) to 10 (15-16 years old) (UK National Curriculum
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31 Year Groups 7 through 11) from four state Community Comprehensive schools in the North West
32
33 of England completed the questionnaire. Of this sample, 18% were in Grade 6, 23% were in Grade
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35 7, 25% were in Grade 8, 17% were in Grade 9, and 17% were in Grade 10. Males comprised 52%
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37 of the cohort, females 48%; males and females were evenly distributed over the years. The
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39 responses to the final four questions provided some background information about the beliefs and
40
41 views of the students. Some 61% of the students thought or were sure that global warming was
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43 happening, with half of this figure (31%) being sure of this. About half of the students expressed
44
45 concern about global warming, with 16% reporting being 'very worried' and a further 33%
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47 reporting being 'quite worried'. Few students, about 14%, thought that they were well informed
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49 (knew 'a lot') about global warming, although a further 39% considered they knew 'something'
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51 about it. Nearly half of the cohort (45%) thought of themselves as being either 'very' or at least
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53 'quite' environmentally friendly. Thus, many of this group of students believed that global
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1 warming is a real phenomenon, few thought that they were especially well informed about it, and
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3 about half were concerned about its consequences.
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9 In the descriptions that follow, overall results for the complete cohort are reported first. Following
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11 this, statistically significant differences between the responses of male and female students and
12
13 between students of different grades are described.
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16 17 18 **Students' Degree of Willingness to Act**

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20 The findings concerning students' *Degree of Willingness to Act* for different pro-environmental
21
22 actions are given in the first column of Figure 5 and illustrated graphically in Figure 6. In Figure 6,
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24 the items are arranged in descending order according to the combined percentages of students who
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26 would 'definitely' or 'almost certainly' undertake the action; in the descriptions below, these same
27
28 percentages are reported. The direct action to which most students were amenable (68%) was to
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30 switch off un-used electrical appliances. The prospect of installing home insulation was acceptable
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32 to about half of the students (49%), as were the ideas of recycling materials (48%) and paying more
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34 for energy-efficient domestic appliances (44%). Over a third of the cohort (39%) were willing to
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36 pay for more tree-planting, although fewer (28%) would accept the increased price premium for
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38 food grown without artificial fertilisers, and even fewer (21%) would be prepared to reduce their
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40 consumption of meat. In terms of personal transport, only about a fifth of the students (20%) would
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42 consider getting a smaller car and a similar proportion (19%) would accept reducing car use by
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44 using public rather than private transport. Rather few of the students (15%) would accept buying
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46 fewer fashion items. In terms of energy production, very few students (10%) felt that using nuclear
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48 power was acceptable, perhaps because other environmental issues are associated with nuclear
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50 energy. In addition, and perhaps surprisingly, relatively few respondents (23%) would consider
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52 paying more for renewable energy sources. Most of the indirect actions were also unpopular. Only
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54 about a quarter of the students would be prepared to undertake more education about environmental
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1 issues (23%) or allow their vote to be influenced by support for new environmental legislation
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3 (21%), international agreements (21%) and, for even fewer, increased environmental taxation
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5 (16%). Thus, students appeared willing to undertake different environmental behaviours to varying
6
7 extents. There was a strong association between most of the 16 *Degree of Willingness to Act* items
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9 and the question in the third section of the questionnaire about the extent to which students were
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11 worried about global warming; this will be discussed later.
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18 **Students' *Believed Usefulness of Action***

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20 Items in the second main section of the questionnaire explored students' beliefs about the
21
22 usefulness of the various actions in reducing global warming, their *Believed Usefulness of Action*,
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24 and the data from the responses are given in the second column of Figure 5 and illustrated
25
26 graphically in Figure 7. In Figure 7, the items are arranged in descending order according to the
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28 combined percentages of students who thought that the action would reduce global warming by
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30 'quite a lot' or by 'a fair amount'. In the descriptions that follow, these same percentages are
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32 reported. Students apparently made a link between global warming and personal transport; two
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34 actions thought by many of the students to contribute to a reduction in global warming were to
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36 reduce car use (68%) and drive smaller cars (50%). Energy production also seemed to be linked
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38 with global warming in students' minds, since many believed that production of energy from
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40 renewable sources (64%) and from nuclear sources (47%) could play a role in reducing global
41
42 warming. Perhaps linked to this, another relatively popular idea was energy conservation by
43
44 switching off unused electrical items (51%). Surprisingly, rather fewer students realised that
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46 installing home insulation (39%) or the use of energy-efficient domestic appliances (37%) could
47
48 reduce global warming. Tree planting was also thought to contribute to decreasing global warming
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50 by more than half of the students (54%), and almost as many (47%) appreciated the role that
51
52 increased recycling could play. Rather fewer of the students (35%) realised that reducing the use of
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54 artificial fertilisers and decreasing meat consumption (16%) could lessen global warming, perhaps
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1 because the mechanisms involved gases other than carbon dioxide, the latter being perhaps the most
2 well-known greenhouse gas. Relatively few students (28%) realised that buying fewer new items
3 could help to reduce global warming; this may be because fewer students appreciated the carbon
4 cost of manufacturing and distributing new consumer goods. Of what we have termed the 'indirect
5 actions', those related to international agreements were thought to be the most effective (59%), with
6 education (49%), legislation (43%) and taxation (37%) being thought less so. Thus, students
7 believed that the various environmentally-friendly actions that had been suggested in the
8 questionnaire would be differentially effective in reducing global warming.
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23 **Relationship between the *Degree of Willingness to Act* and *Believed Usefulness of Action***

24 As explained above, a number of indices can be obtained from the responses to the two main
25 sections of the questionnaire, where the scored items were called the *Degree of Willingness to Act*
26 and the *Believed Usefulness of Action*. Some of these will now be discussed.
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34 The *Potential Effectiveness of Education* provides an indication of the extent to which increasing
35 understanding about particular actions through specific environmental education might persuade
36 individuals to undertake those actions. This relationship was quantified by linear regression, and
37 the results are illustrated schematically in Figure 4; the values of the indices from the regression are
38 summarised in the last four columns of Figure 5. The first of these, the slope of the regression line
39 constructed when the *Degree of Willingness to Act* and the *Believed Usefulness of Action* for pairs
40 of actions are plotted, has been designated the *Potential Effectiveness of Education*; a high value of
41 this index represents a steep relationship between the extent to which students believe an action to
42 be effective and their willingness to undertake that action. In such cases, persuading students of the
43 efficacy of the action should result in more students purporting to take that action. Where the
44 relationship is shallower, indicated by a lower value of the *Potential Effectiveness of Education*,
45 education about the action is less likely to result in more students from this cohort adopting it.
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1 There are two other two indices shown on the vertical axes in Figure 4. The first, the *Natural*
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3 *Willingness to Act*, provides an indication of the extent to which students will undertake the action
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5 even when they believe it to be ineffective. The second, the *Natural Reluctance to Act*, shows the
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7 extent to which students will avoid the action even if they believe it is highly effective. Each of
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9 these indices can take a value between zero and one.
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15 Figure 5 shows that for some actions the value of the slope of the line, the *Potential Effectiveness of*
16 *Education*, was low, suggesting that there was little change in the willingness to undertake an action
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18 for different beliefs in the effectiveness of that action. For example, this was true for the action of
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20 switching off unused electrical items (0.14). In this case, the slope of the line was shallow because
21
22 the *Natural Willingness to Act* was relatively high (0.63); students were prepared to take this action
23
24 in any case. Here, it is likely that other motivators, such as parental exhortations to reduce
25
26 electricity bills, coupled with a relatively low level of inconvenience, meant that students would be
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28 taking this action anyway. The value of the *Potential Effectiveness of Education* was also fairly low
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30 for some other actions such as adopting more nuclear power (0.15), reducing car use (0.18),
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32 avoiding buying new fashion items (0.15) or purchasing smaller cars (0.17). In these cases,
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34 however, the slope of the line was shallow because the *Natural Reluctance to Act* tended to be quite
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36 high; even if students believed these actions to be effective in reducing global warming, they
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38 seemed unwilling to undertake them. For issues such as these it is probable that other disincentives,
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40 such as major inconvenience, substantial changes in lifestyle or environmental and health concerns,
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42 would prevent students taking these actions. In yet other cases there was a steeper association
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44 between a belief in the effectiveness of an action and a willingness to undertake it. Increasing the
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46 amount of material that is recycled (0.34), reducing the use of artificial fertilisers (0.27) and tree
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48 planting fell into this category (0.26). For these, the *Natural Willingness to Act* and the *Natural*
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50 *Reluctance to Act* were both relatively low, and so the slope of the line was fairly steep. For these
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52 specific actions, then, although many other factors affect behaviour, the data indicate that educating
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1 students about the effectiveness of the action might well result in more of the students adopting the
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3 action. In summary, there are some pro-environmental actions that will probably not be induced by
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5 convincing students of their efficacy, and there are others that probably will.
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10 There is another factor that will impinge upon the degree to which environmental education might
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12 be effective on a population level. In terms of behaviour change, the overall effectiveness of such
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14 education will be maximised when directed at those actions that a high proportion of the population
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16 are not already undertaking. In an attempt to give some quantitative comparison to the various
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18 actions raised in the questionnaire, a final index, the *Potential Usefulness of Education*, was
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20 constructed by multiplying the *Potential Effectiveness of Education* by the proportion of students
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22 who would 'probably not' or only 'perhaps' undertake the action; these data are shown in the final
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24 column of Figure 5. This multiplication produces much smaller numbers, but the bigger of these
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26 indicate that teaching about the effects of reducing meat consumption (0.14), lowering the use of
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28 artificial fertilisers (0.12), decreasing car use (0.11) and increasing the proportion of energy
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30 generated from renewable sources (0.11) should be useful areas on which to concentrate teaching.
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39 **Differences between subsets of students**

40 Differences between various groupings of students were investigated in a number of ways.

41 ANCOVA was used for the basic scores on the 32 items when exploring, simultaneously,
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43 differences between the responses of male and female students, and students in different grades.

44 ANCOVA can be used not only to analyse the effect of several categorical independent variables on
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46 a dependent variable (ANOVA) but can include one or more continuous variables which may
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48 predict the dependent variable. In this case grade was used as a more or less continuous variable.

49 For the derived indices, gradient and intercept were compared for any two groups using the standard
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51 technique of dummy variable creation and fitting a multiple linear regression model against the
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53 independent variable, the comparison variable (dichotomous) and the derived variable. Differences
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1 revealed by any of these tests are noted below. When discussing these differences, the percentage
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3 of the top two categories will be reported for the main questions (defined as in the first two columns
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5 of Figure 5), whereas the derived indices will simply have their values compared (explained in the
6
7 later columns of Figure 5).
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10 11 12 13 *Differences between male and female students*

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15 In this section, the first figures in brackets will be those for the males, followed by those for the
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17 females. For the *Degree of Willingness to Act* items, more females than males were prepared to
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19 take action on some issues; this included switching off unused electrical items (65%, 71%, $p<0.05$),
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21 reducing car use (15%, 23%, $p<0.05$) and eating less meat (15%, 27%, $p<0.001$). In the case of
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23 items to determine the *Believed Usefulness of Action*, three issues showed that females had a greater
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25 belief in using energy-efficient domestic white goods (33%, 40%, $p<0.01$), reducing the purchase of
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27 new fashion items (26%, 31%, $p<0.05$) and taking into account a politician's willingness to legislate
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29 on the environment when voting (38%, 48%, $p<0.01$).
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36 Measures of the *Potential Effectiveness of Education*, showed only one difference between the
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38 genders and that was for the question relating to international agreements (0.15, 0.33, $p<0.01$),
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40 where females appeared more likely to have their behaviour influenced by their understanding or
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42 belief. For two issues there were significant differences in the *Natural Willingness to Act*; for
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44 eating less meat females showed a greater inherent compliance (0.22, 0.31, $p<0.001$), but they
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46 seemed less naturally willing to vote in accordance with politicians' views on international
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48 environmental agreements (0.29, 0.15, $p<0.01$).
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55 56 *Differences between students in different grades*

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58 Differences between students in different grades are reported below only if ANCOVA revealed
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60 statistically significant differences giving a trend across the grades. In the descriptions that follow,

1 the percentage figures quoted are for the top two categories of response across Grades 6, 7, 8, 9 and
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4 10. Within the 16 *Degree of Willingness to Act* items, there were 6 significant and reasonably
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6 consistent trends downwards across the grades. These were: switching off unwanted appliances
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8 (81%, 65%, 63%, 69%, 66%, $p<0.01$), purchasing foods cultivated without artificial fertilisers
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10 (34%, 35%, 18%, 30%, 24%, $p<0.001$), eating less meat (28%, 28%, 14%, 16%, 19%, $p<0.001$),
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12 buying more efficient appliances (56%, 46%, 36%, 45%, 40%, $p<0.001$) and voting for politicians
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14 in light of their policies on 'green' legislation (34%, 24%, 14%, 18%, 17%, $p<0.001$) and their
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16 support for international environmental agreements (36%, 21%, 15%, 20%, 18%, $p<0.001$).
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23 In the other main section of the questionnaire, the *Believed Usefulness of Action*, there were also a
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25 number of differences that for the most part showed a decrease over the grades. So, fewer of the
26
27 older students believed that global warming would be reduced (by 'quite a lot' or by 'a fair
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29 amount') by adopting the use of smaller cars (57%, 55%, 52%, 51%, 33%, $p<0.001$), insulating
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31 homes (44%, 45%, 42%, 39%, 21%, $p<0.001$), switching off un-used electrical items (61%, 57%,
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33 48%, 48%, 39%, $p<0.001$), recycling more (54%, 60%, 47%, 37%, 33%, $p<0.001$), helping to
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35 reduce the use of artificial fertilisers (35%, 46%, 37%, 29%, 22%, $p<0.001$), buying fewer fashion
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37 items (35%, 33%, 27%, 25%, 21%, $p<0.001$), reducing car use (76%, 70%, 65%, 71%, 58%,
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39 $p<0.001$), eating less meat (19%, 21%, 16%, 8%, 10%, $p<0.001$) or using energy-efficient domestic
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41 appliances (47%, 42%, 31, 39%, 25%, $p<0.001$). Confidence in the effectiveness of most of the
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43 indirect actions also declined over the grades. Thus, fewer of the older students saw the benefit,
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45 with regard to global warming, of voting in accordance with promises on environmental legislation
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47 (53%, 46%, 38%, 45%, 36%, $p<0.01$) and taxation (47%, 38%, 34%, 38%, 27%, $p<0.001$), and
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49 international agreements (72%, 60%, 55%, 60%, 51%, $p<0.001$).
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58 There were a number of differences across the grades in the *Potential Effectiveness of Education*, as
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60 tested using two groups of students (top two and bottom two grades) and the standard technique

1 described earlier. Generally, the analysis showed increases in the *Potential Effectiveness of*
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3 *Education* across the grades; this included the actions of planting trees (0.19, 0.16, 0.21, 0.28, 0.50,
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5 $p < 0.05$) and increasing adoption of renewable energy (0.16, 0.23, 0.09, 0.24, 0.38, $p < 0.05$).
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8 Although it is known that the knowledge-behaviour link is weak (Kollmus & Agyeman, 2002), it
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10 would appear from these findings that it is stronger for the older students, and would suggest
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12 perhaps that teaching about the efficacy of these specific actions might be more effective with older
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14 school students than with their younger counterparts. This trend was also evident in two of the
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16 indirect actions, related to supporting international agreements (0.16, 0.20, 0.11, 0.19, 0.43, $p < 0.05$)
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18 and being prepared to undergo more environmental education (0.19, 0.10, 0.18, 0.25, 0.36, $p < 0.05$).
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21 However, it was also noticed that for these, and only these issues, the *Natural Willingness to Act*
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23 started high and decreased across the grades, as the *Potential Effectiveness of Education* increased.
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26 The conclusion would seem to be that adolescents' views retain a degree of flexibility about these
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28 issues, with younger students being generally less discriminatory, and having a high willingness to
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30 act regardless of their belief in the efficacy of an action, whereas older students seem to show a
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32 response in their intended actions which is more in line with their understanding.
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39 *Differences between more and less concerned students*

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41 Finally, the relationship between the extent of students' concern about global warming and their
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43 willingness to act in various pro-environmental manners was investigated. Students were grouped
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45 according to their responses to a question in the final section of the questionnaire about how
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47 worried they are about global warming. Those who indicated that they were 'very' or 'quite'
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49 worried were considered to be 'more concerned' (n=452); those who responded that they were 'a
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51 little bit worried' or 'not worried at all' were considered to be 'less concerned' (n=460).
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58 Rather than examine how these two groups responded to the *Degree of Willingness to Act* variables,
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60 which inevitably contain information about students with different degrees of *Believed Usefulness*

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of Action, we elected to focus on the extent to which being more or less worried might affect students' inherent willingness to take action, their *Natural Willingness to Act*. When the 16 regressions were performed for the two groups of students, and the indices compared using the dummy variable technique mentioned earlier, it became apparent that the values for the *Natural Willingness to Act* indices were consistently higher for the more concerned students than for those who were less concerned; this was true for all actions other than the increased adoption of nuclear power. Figure 8 shows the details for all the differences measured, where one may recall that the *Natural Willingness to Act* mapped on to a scale with five values, from zero ('probably not') to one ('almost certainly').

In contrast to these differences, only two of the values of *Potential Effectiveness of Education* showed statistically significant differences between the two groups, and these differences were relatively small. It seems clear from Figure 8 that, regardless of the degree of worry about global warming, the sense in which action might be influenced by understanding or belief is fairly stable (though different for each issue). On the other hand, the *Natural Willingness to Act*, the likely action even when it is believed to be ineffective, is significantly greater for almost all issues for those who are more concerned about global warming. Research on students' views about air pollution suggest that worry can have a considerable influence on the stated willingness to take certain environmental actions, particularly in some cultures (Boyes, Stanisstreet, Myers, Skamp & Yeung, 2007). The results of the present study further indicate that worry about global warming and its consequences is indeed likely to precipitate action, independent of whether or not it is thought to be helpful.

DISCUSSION

Research of this nature inevitably has some limitations. For example, the fact that we wished to encompass in this study a reasonably comprehensive range of actions that could, in reality,

1 contribute to a reduction in global warming, inevitably led to a number of consequences. Firstly,
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3 this meant that some of these actions were out of the current locus of control of secondary students,
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5 who will assume the capacity to take them only later in life. For example, students in this age group
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7 will not be able to vote yet about environmental taxation or legislation, or be directly able to
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9 purchase energy-efficient consumer durables, although their views may have some influence on
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11 parental decisions. Furthermore, whether or not students are able to undertake a particular action
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13 may have some influence on their stated intention to take it. Secondly, the selected actions varied
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15 in terms of the directness of their link to a reduction in global warming. Use of smaller cars, for
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17 example, has a fairly obvious link to a reduction in carbon dioxide emission, whereas the link
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19 between purchasing fewer consumer goods and reducing global warming is more circuitous and
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21 requires an awareness of the production of greenhouse gases in manufacture and distribution.
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23 Thirdly, some of the issues represented in the questionnaire, such as the extended use of nuclear
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25 power, have counter-balancing environmental arguments, whereas others do not. For all of the
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27 actions, one can argue that any response of an individual indicating that they intend to act will not
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29 necessarily mean that they will do so (Downing & Ballantyne, 2007), although it is unlikely that an
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31 individual who states an intention not to take an action will then take it. Finally, although gaining
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33 any absolute measure of attitudes or intentions is problematic (Reid, 2006), the instrument devised
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35 does enable attitudes and intentions to a series of pro-environmental actions to be compared.
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46 Approximately two thirds of the students in this study believed that global warming is a real
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48 phenomenon, paralleling the high general awareness of global warming in the adult population
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50 (MORI, 2004). Furthermore, about half of the respondents expressed concern about the
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52 consequences of global warming, again similar to the adult population (PEW Research Centre,
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54 2009), suggesting that consciousness of, and concern about, global warming are beginning to
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56 develop early. Perhaps because of anxiety about the issue, UK adults in general appear to support,
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58 in principle at least, both individual and political action to reduce global warming (BBC, 2007);
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1 about half of the UK population believe that modifying individuals' practices would be effective.
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3 In a complementary manner, a proportion of the adult population in general would support the
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5 introduction of further environmental legislation, partly because this is seen as fairer, but also
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7 because it means that pro-environmental behaviour does not rely only on an individuals'
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9 willingness to act (Darier & Schule, 1999).
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16 In the context of these general attitudes, the findings of the present study indicate that among UK
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18 secondary students there is a differential willingness to undertake different pro-environmental
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20 actions - what we have termed the *Degree of Willingness to Act*. Among the more direct actions,
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22 for example, many students report a willingness to switch off unused electrical items in the home,
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24 whereas far fewer are prepared to alter their practices concerning personal transport by using public
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26 rather than private transport, or by accepting the use of smaller, more energy-efficient private
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28 vehicles, unless they are particularly worried about global warming. The differential willingness to
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30 undertake diverse pro-environmental actions is similar to that reported for adults, who are more
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32 prepared to increase recycling or to take action to conserve energy in domestic situations, but less
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34 willing to modify their travel habits (Shackley, McLachlan & Gough, 2004; Kasemir *et al*, 2003;
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36 O'Connor, Bord & Fisher, 1999). Each of the pro-environmental actions raised in this study has
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38 associated incentives and disincentives for young people, the nature and extent of which will differ
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40 between different actions. These motivators and inhibitors stem from a plethora of sources,
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42 including beliefs, social pressures (Cialdini, Reno & Kallgren, 1990), social background (Pruneau
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44 *et al*, 2007), characteristics of the physical context (Corraliza & Berenguer, 2000) and a person's
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46 action competence (Jensen & Schnack, 2006).
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56 This range of motivators and inhibitors means that the likelihood of undertaking any particular pro-
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58 environmental action is the result of an interaction between a general feeling of benefiting the
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60 environment, coupled with more concrete personal incentives, disincentives and concerns.

1 Switching off un-used electrical items, for example, causes only minor inconvenience so carries few
2 such inhibitors. In addition, it may carry an incentive in that it aligns with parental exhortations to
3 'save electricity' for financial reasons. Use of public transport, on the other hand, may be perceived
4 as carrying a major inconvenience and could be associated with a negative social image amongst
5 school students' peer groups, with social norms acting as a disincentive (Cialdini, Reno & Kallgren,
6 1990). For indirect actions such as the influencing of voting patterns, rather few of the students
7 seemed willing to consider increased environmental taxation, legislation or education or, perhaps
8 surprisingly, even international agreements. Whilst it is unclear what voting priorities young people
9 may have, a part of their general unwillingness to consider such issues may be because there is a
10 tendency for them to distrust politicians (Smith, Stanisstreet & Boyes, 2005) and other authority
11 figures (Stern, 2008). Such mistrust has major implications for a population that approves in
12 principle of the introduction of pro-environmental actions by central government, but seems less
13 willing to take this into account when voting.
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34 The findings of the present study also indicate that students consider that different actions may have
35 different levels of usefulness in reducing global warming, a measurement we termed the *Believed*
36 *Usefulness of Action*. For example, reducing car use, generating electricity from renewable sources
37 and switching off un-used electrical items were thought to contribute to reducing global warming.
38 In addition, tree planting was seen as useful in this context. The prime effect of all of these actions
39 relate to atmospheric carbon dioxide, either by decreasing carbon dioxide emissions or, in the case
40 of tree planting, by increasing the rate of removal of carbon dioxide from the atmosphere.
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51 Decreasing the use of artificial fertilisers or reducing meat production was thought by students to be
52 less effective. In these cases the greenhouse gases involved are nitrogen oxides and methane,
53 respectively. It may be that the efficacy of such pro-environmental actions in terms of global
54 warming may be less well appreciated because the contribution of these two gases to global
55 warming is less well known than that of carbon dioxide (Boyes & Stanisstreet, 1993, 2001), the role
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1 of which has been more recently re-enforced by phrases such as ‘carbon footprint’, ‘carbon
2 dependency’ and ‘carbon trading’. Students were also not strongly aware of the link between
3 consumption of new ‘fashion’ items and global warming, perhaps because the energy consumed in
4 their manufacture and transport to the point of purchase does not come immediately to the minds of
5 young people.
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15 By combining the data obtained from the two main sections of the questionnaire, the *Degree of*
16 *Willingness to Act* and the *Believed Usefulness of Action*, it was possible to derive a series of novel
17 indices to gain insight into the probable advantage, in terms of changing students’ practices, of
18 persuading young adults of the efficacy of different pro-environmental actions in ameliorating
19 global warming. In particular, the *Potential Effectiveness of Education* is a measure, in the context
20 of the present study, of the association between belief in the effectiveness of an action and the
21 willingness to undertake it. Certain actions had rather low values for the *Potential Effectiveness of*
22 *Education*, indicating that education might be less effective for such actions in terms of behaviour
23 change. There are two reasons why the *Potential Effectiveness of Education* might be low. In some
24 cases, such as switching off un-used electrical items, this was because students showed a high
25 *Natural Willingness to Act* - they would perform such actions irrespective of a belief or not in their
26 merit. In other cases a low *Potential Effectiveness of Education* was associated with a high *Natural*
27 *Reluctance to Act*. Here, even a relatively strong belief in the efficacy of an action did not promote
28 its uptake, presumably because there were other disincentives in place; the nature of such
29 disincentives would, of course, vary between different actions. For example, adoption of nuclear
30 power may show a high *Natural Reluctance to Act* because of fears about environmental or health
31 impacts of nuclear power. Change in transport habits, such as the use of smaller cars or substitution
32 of public for private transport, could be somewhat intractable because environmental sensitivity
33 would be out-weighed in decision-making by preferences about lifestyle or personal convenience,
34 an example of a physical inhibitor acting as a disincentive (Corraliza & Berenguiar, 2000). In
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1 addition, students were resistant to reducing their purchase of new 'fashion' items, perhaps because
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3 consumption of this sort is perceived as a natural characteristic of their life-style. In such cases,
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5 where the *Potential Effectiveness of Education* is low, education alone might be of only limited
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7 benefit in terms of altering students' behaviour, although it might be a useful component in a series
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9 of measures. For example, introduction of potentially unpopular environmental legislation might be
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11 made more acceptable if there is a general understanding of why it is necessary.
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18 In the case of other pro-environmental actions, there was a stronger relationship between the extent
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20 to which an action was believed to be effective in reducing global warming and a willingness to
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22 undertake it; in other words, the *Potential Effectiveness of Education* was higher. Increasing
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24 recycling, reducing the use of synthetic fertiliser, tree planting, installing home insulation and using
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26 energy-efficient domestic appliances were examples of these actions. The first of these might be
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28 especially relevant because this action is within the locus of control of individual young people.
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30 Indeed, it has been shown that in the case of health education (Wilcox *et al*, 1981; Croucher *et al*,
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32 1985), young people may influence the practices of the family in which they live, even though the
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34 effect may be weak.
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41 With virtually all of the issues, the rate at which intended action increased with belief about that
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43 action did not depend on how worried the students were about global warming. On the other hand,
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45 the extent to which the more worried students were prepared to take action even when they did not
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47 believe it to be effective, was considerably greater; that is, the *Natural Willingness to Act* was
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49 greater in the more concerned individuals. One possible explanation is that the more concerned
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51 students make an assessment that, even though they perceive the action as having little or no effect,
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53 it is worth taking 'just in case', because they worry about the outcome of inaction being so
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55 devastating. An alternative explanation is that the willingness to take action and the concern about
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57 the consequences of global warming may each be a reflection of a 'constellation' of underlying
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1 attitudes (Heimlich & Ardoin, 2008), which includes students' perception of themselves as being
2
3 pro-environmental; almost half of the students in the present study declared themselves to be
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5 'environmentally friendly'. The one issue for which there was no difference between the declared
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7 intentions of worried and unconcerned students was the idea of being willing to pay more for
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9 electricity if it were produced by nuclear power. Perhaps, in the minds even of those students who
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11 are concerned about global warming, the risks associated with the proliferation of nuclear energy
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13 are more significant than the consequences of global warming.
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20 In terms of persuading people to alter their behaviour, **only a few of those who are at present**
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22 **unwilling to undertake actions would** be amenable to changing their practices. The adult population
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24 can be considered to consist of various groups with different characteristic behaviours and attitudes
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26 (DEFRA, 2008b). Furthermore, research in the USA has suggested that society may be considered
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28 to consist of six 'segments', from the 'Alarmed' who are sure that global warming is happening and
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30 are worried about it, to the 'Dismissive' who consider that global warming is not happening and so
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32 regard changes in behaviour as unnecessary (Maibach, Roser-Renouf & Leiserowitz, 2009).
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36 Members of some of these segments are more amenable to change than others. A further index, the
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38 *Potential Usefulness of Education*, attempted to take account of the size of the potential education
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40 audience, that is, the proportion of students who did not already intend to undertake such actions.
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42 Actions with a high *Potential Usefulness of Education* were those for which intended behaviour
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44 appeared to be strongly influenced by a belief in their effectiveness (that is, the *Potential*
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46 *Effectiveness of Education* was high), and which a relatively high proportion of students are at
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48 present unwilling to undertake. Using this index, certain specific actions emerge as useful targets
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50 for education; a reduction in meat consumption (and therefore production) and a willingness to pay
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52 more for produce grown without the use of artificial fertilisers, together with a decrease in car use
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54 and production of energy from renewable sources were such actions. Thus, the *Potential*
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56 *Usefulness of Education* enables us to target actions which are not at present accepted by a large
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1 proportion of the population. In a complementary manner, however, continuing environmental
2 education directed towards those who are already prepared to take action is also necessary in order
3 to reinforce and maintain their existing pro-environmental behaviour, particularly when this has
4 been engendered through social marketing (Heimlich & Ardoin, 2008).
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10 The present study reveals that for different actions there is a different degree of association between
11 a belief in the efficacy of an action and a willingness to undertake it; this variation is one reason
12 why environmental education in *general* might be less than fully effective in terms of behaviour
13 change. Even in the case of specific actions, it is apparent that for some actions education to
14 persuade learners of their usefulness in terms of a major environmental problem has little potential
15 on its own to be effective in terms of modifying young people's practices.
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30 Our research suggests that where there were differences between the responses of male and female
31 students, females tended to be more sensitive to the benefits of certain pro-environmental actions,
32 and more willing to undertake other pro-environmental actions. This is congruent with the
33 observation that females tend to score more highly than males on instruments that measure of
34 environmental attitudes (Burger *et al*, 1998; Taskin, 2009). The results also indicate that the degree
35 of association between belief in the effectiveness of an action and a willingness to undertake it
36 differs across different age groups of students. It appears, in contrast to our intuition, that older
37 secondary students might respond more to teaching than their younger counterparts in terms of
38 behaviour change. Perhaps a potential hazard, then, of initiating education about pro-environmental
39 actions too early might be that of over-exposure; the possibility is that by the time that students
40 reach their most receptive stage they may be in a state of environmental 'fatigue', in the same way
41 that donors to charity are thought, eventually, to suffer 'compassion fatigue' (Gallup, 2009; Ker,
42 2009). In addition to the heterogeneity that could be linked to overt factors such as gender and year
43 group, it appears that there is also an association between the level of concern among students about
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1 global warming, and their willingness to undertake pro-environmental actions. Education
2 strategists and practitioners should be aware, therefore, of this further heterogeneity within the
3 student population; like adults (Lorenzini, Nicholson-Cole & Whitmarsh, 2007; DEFRA, 2008b),
4 students will not be uniform in their behavioural responsiveness to environmental education even
5 about specific actions.
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15 The discrepancies between belief and willingness to act for different actions revealed in this study
16 originate in the variety of other, sometimes non-environmental, incentives and disincentives
17 associated with the various actions. It would be interesting, in further research, to investigate the
18 detail of those things that restrain or encourage individual actions, remembering that a wide variety
19 of factors are likely to be involved, and that these will differ for each action under consideration.
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Figure 1 Wording and available responses for the final four items of questionnaire

Items	Available responses
How worried are you about what Global Warming might do to the environment?	I am very worried I am quite worried I am a little bit worried I am not worried at all
How much do you think you know about Global Warming?	I know a lot about global warming I know something about global warming I know a little about global warming I know almost nothing about global warming
How 'environmentally friendly' do you think you are? (How much do you think you 'take care of' the environment by the things you do?)	I am very environmentally friendly I am quite environmentally friendly I am a bit environmentally friendly I am not at all environmentally friendly
Do you think that Global Warming is really happening now?	I am sure global warming is happening I think global warming is happening I don't know whether global warming is happening or not I am think global warming is not happening I am sure global warming is not happening

Figure 2 Wording of the questionnaire items. The main items of the questionnaire displayed so that the ‘pairing’ of the items can be seen.

Themes	Items about the <i>Believed Usefulness of Action</i>	Items about the <i>Degree of Willingness to Act</i>
<i>Direct actions</i>		
Transport (use)	If people didn't use their cars so much, global warming would be reduced	Even if it took me longer and was more inconvenient, I would try to use buses and trains instead of a car
Transport (type)	If people had smaller cars that used less petrol or diesel, global warming would be reduced	Even if it was not as fast or luxurious, I would try to get a car that uses less petrol or diesel
Power generation (renewable)	If more of our energy was produced from the wind, waves and sun, global warming would be reduced	Providing more of our energy was produced from the wind and waves and sun, I would be willing to pay more for electricity
Power generation (nuclear)	If more of our energy was produced from nuclear power stations, global warming would be reduced	Providing more of our energy was produced from nuclear power stations, I would be willing to pay more for electricity
The home (electricity use)	If people used less electricity in their homes, global warming would be reduced	To save electricity, I would switch things off at home when I didn't need them
The home (insulation)	If people got their homes insulated better, global warming would be reduced	Even though it cost me money, I would get extra insulation for my home
The home (consumer durables)	If people got things for their homes (like fridges and washing machines) that used less energy, global warming would be reduced	Even if it cost me more, I would buy things for my home (like fridges and washing machines) that use less energy
The home (consumables)	If people were prepared to buy fewer new things and make do with the old ones, global warming would be reduced	Even if it meant that I didn't always have the latest 'gear' or fashion, I would be prepared to buy new things less often
Environmentally-friendly (trees)	If more trees were planted in the world, global warming would be reduced	Even if I had to pay more taxes, I think there should be more trees planted in the world
Environmentally-friendly (recycle)	If people recycled things more, global warming would be reduced	Even if it was more trouble for me, I would recycle things rather than just throw them away
Food (Reducing meat)	If people eat less meat, global warming would be reduced	Even if I really liked meat, I would eat fewer meals with meat in them
Food (Reducing artificial fertilizers)	If farmers stopped using artificial fertilisers with nitrogen in them, global warming would be reduced	Even if it was more expensive, I would buy food grown without the use of artificial fertilisers
<i>Indirect actions</i>		
Environmental legislation	If politicians made the right kind of new laws, global warming would be reduced	I would vote for a politician who said they would bring in laws to reduce global warming, even though it would stop me doing some of the things I enjoy
Environmental taxation	If politicians made people pay more tax and spent the money on the right kind of things, global warming would be reduced	I would vote for a politician who said they would increase taxes to pay for reducing global warming, even though it meant me having less money to spend
Environmental education	If people were taught more about it, global warming would be reduced	I would like to learn more about global warming, even though it would mean extra work for me
Environmental International cooperation	If there could be more agreement between different countries about not putting certain gases into the air, global warming would be reduced	Even though it might mean some inconvenience to me (like changing my job), I would vote for a politician who said they would sign agreements with other countries on global warming

The items of the questionnaire are displayed so that the ‘pairing’ of the items can be seen. In the actual questionnaire, the items were in random order, and paired items were in different orders in the two main sections.

Figure 3 Wording of the permissible responses to the two sets of items.

<i>Believed Usefulness of Action</i> If I thought an action would help global warming by...	Score	<i>Degree of Willingness to Act</i> then I would...	Score
by quite a lot	1.00	definitely do it	1.00
by a fair amount	0.75	almost certainly do it	0.75
by a small but useful amount	0.50	probably do it	0.50
by a very small amount - hardly noticeable	0.25	perhaps do it	0.25
by nothing at all really	0.00	probably not do it	0.00

The wording of the permissible responses is displayed 'matched'. This 'matching' suggests the minimum action ('then I would') that might reasonably be expected for a given belief about the usefulness of that action. The figures show the scores assigned to the different responses; these enabled various coefficients to be constructed.

Figure 4 Annotated graph to show relationship between the *Degree of Willingness to Act* and the *Believed Usefulness of Action*

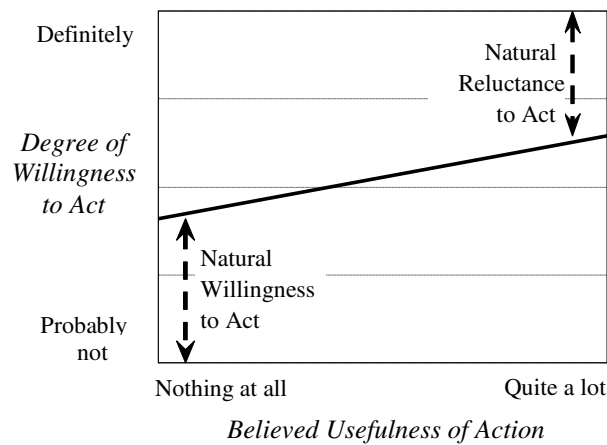
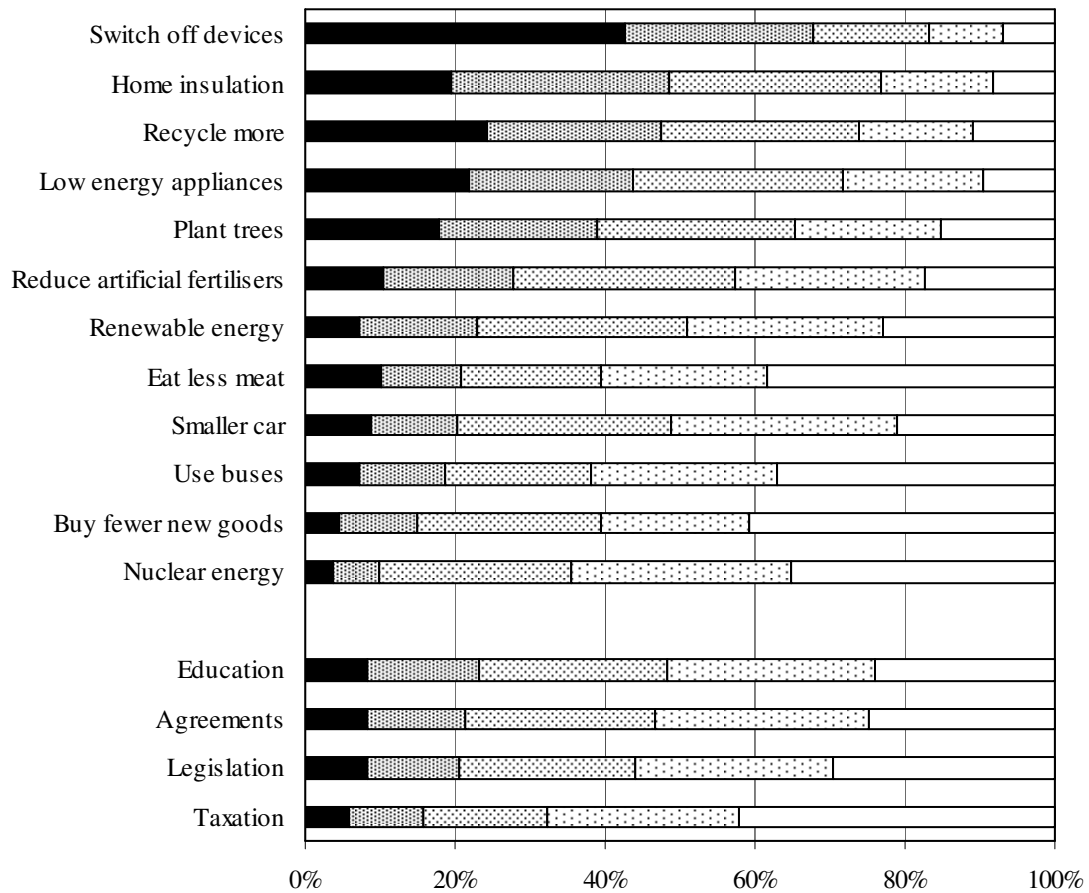


Figure 5 Secondary Students' willingness to undertake various pro-environmental actions, their beliefs about the usefulness of such actions and the relationships between these two measurements.

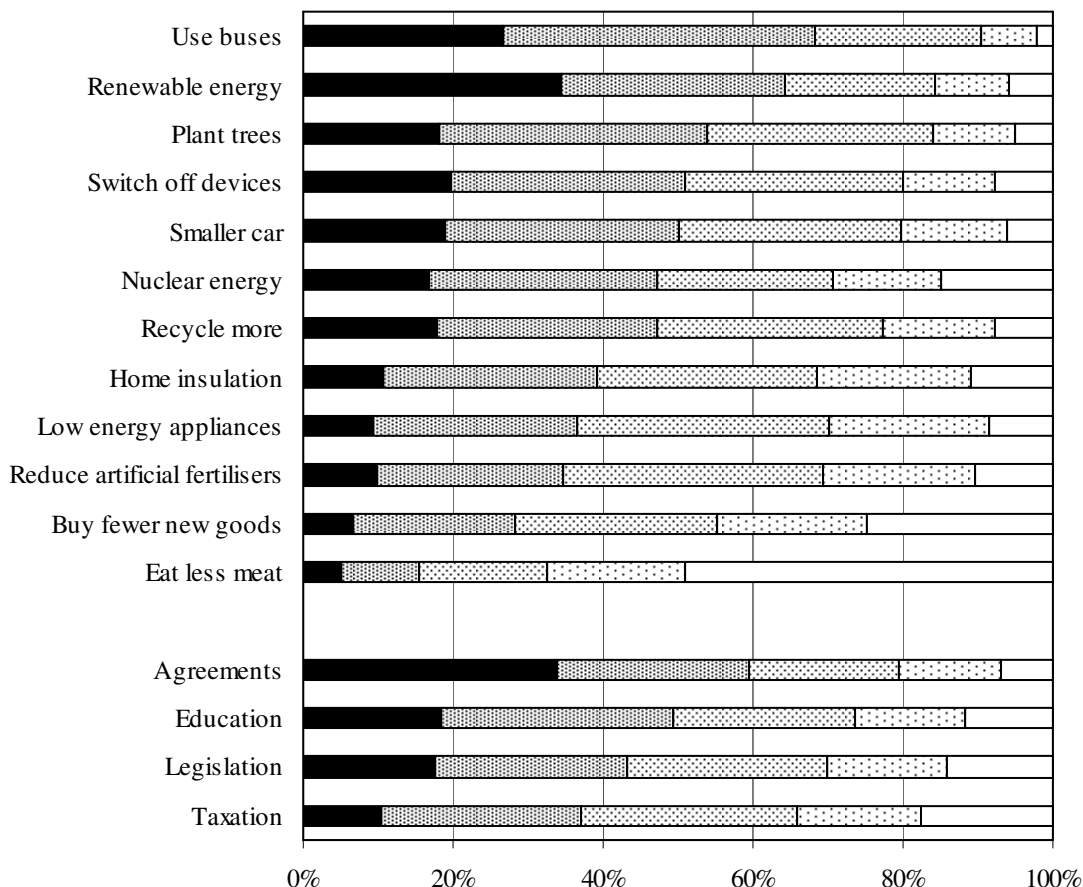
	<i>Degree of Willingness to Act</i>	<i>Believed Usefulness of Action</i>	<i>Potential Effectiveness of Education</i>	<i>Natural Willingness to Act</i>	<i>Natural Reluctance to Act</i>	<i>Potential Usefulness of Education</i>
	(% 'definitely' + 'almost certainly')	(% 'quite a lot' + 'a fair amount')	(Slope of <i>Degree of Willingness to Act</i> plotted vv <i>Believed Usefulness of Action</i>)	(Intercept when <i>Believed Usefulness of Action</i> is at minimum)	(Measurement between unity and the intercept when <i>Believed Usefulness of Action</i> is at maximum)	(<i>Potential Effectiveness of Education</i> x proportion of 'perhaps do it' and 'probably not do it')
<i>Direct actions</i>						
Smaller cars	20	50	0.17	0.29	0.54	0.09
Nuclear energy	10	47	0.15	0.20	0.64	0.10
Home insulation	49	39	0.25	0.46	0.28	0.06
Switch off unused devices	68	51	0.14	0.63	0.23	0.02
Plant trees	39	54	0.26	0.36	0.38	0.09
Recycle more	48	47	0.34	0.39	0.27	0.09
Reduce artificial fertilisers	28	35	0.27	0.31	0.42	0.12
Buy fewer new goods	15	28	0.15	0.23	0.62	0.09
Renewable energy	23	64	0.23	0.24	0.54	0.11
Use buses	19	68	0.18	0.19	0.63	0.11
Eat less meat	21	16	0.23	0.27	0.50	0.14
Low energy appliances	44	37	0.25	0.44	0.31	0.07
<i>Indirect actions</i>						
Legislation	21	43	0.23	0.24	0.54	0.13
Taxation	16	37	0.25	0.16	0.59	0.17
Agreements	21	59	0.24	0.23	0.54	0.13
Education	23	49	0.22	0.27	0.52	0.11

Figure 6 Secondary students' *Degree of Willingness to Act* to undertake different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who would 'definitely' undertake the action; the next, slightly lighter bar those who would 'almost certainly' undertake the action; the next, lighter bar, those who would 'probably' undertake the action; the next bar those who would 'perhaps' take the action; and the right hand, white bar, those who 'probably not' undertake the action. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who would 'definitely' and 'almost certainly' take the action.

Figure 7 Secondary students' *Believed Usefulness of Action* of different pro-environmental actions



For each action, the darkest bar, to the left hand side, represents the percentages of students who responded that the action would reduce global warming by 'quite a lot'; the next, slightly lighter bar those who believe it would reduce global warming by 'a fair amount'; the next, lighter bar, those who believe it would reduce global warming by a 'small but useful amount'; the next bar those who believe it would reduce global warming by 'a very small, hardly noticeable, amount'; and the right hand, white bar, those who believe the action would reduce global warming by 'nothing at all'. 'Direct' actions are in the upper section of the figure; 'indirect' actions are in the lower section. Within each section, actions are arranged in descending order of the combined percentages of students who responded that the action would reduce global warming by 'quite a lot' and by 'a fair amount'.

Figure 8 Comparison of derived indices, *Natural Willingness to Act* and *Potential Effectiveness of Education* for two groups of students, those who are more or less concerned about global warming. The indices and categories are defined in the text.

Issue	<i>Natural Willingness to Act</i>			<i>Potential Effectiveness of Education</i>		
	More Concerned	Less Concerned	Sig	More Concerned	Less Concerned	Sig
<i>Direct actions</i>						
Smaller cars	.40	.25	**	.11	.12	
Nuclear energy	.22	.21		.18	.10	
Home insulation	.54	.44	*	.20	.23	
Switch off unused devices	.75	.60	**	.05	.09	
Plant trees	.50	.30	***	.18	.22	
Recycle more	.51	.36	**	.28	.28	
Reduce artificial fertilisers	.41	.28	**	.23	.20	
Buy fewer new goods	.32	.19	***	.10	.13	
Renewable energy	.38	.18	***	.14	.21	
Use buses	.37	.15	**	.07	.11	
Eat less meat	.38	.20	***	.11	.28	*
Low energy appliances	.54	.41	**	.18	.22	
<i>Indirect actions</i>						
Legislation	.35	.21	***	.20	.10	
Taxation	.25	.13	**	.25	.11	*
Agreements	.32	.19	**	.22	.16	
Education	.42	.21	***	.13	.15	

*** p<0.001

** p<0.01

* p<0.05