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Research Report

Public understanding of climate change and support for mitigation

Research Series, No. 135

Provided in Cooperation with:

The Economic and Social Research Institute (ESRI), Dublin

Suggested Citation: Timmons, Shane; Lunn, Pete (2022) : Public understanding of climate change and support for mitigation, Research Series, No. 135, The Economic and Social Research Institute (ESRI), Dublin,
<https://doi.org/10.26504/rs135>

This Version is available at:

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RESEARCH
SERIES
NUMBER 135
January 2022

PUBLIC UNDERSTANDING OF CLIMATE CHANGE AND SUPPORT FOR MITIGATION

SHANE TIMMONS AND PETE LUNN



Public understanding of climate change and support for mitigation

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Pete Lunn

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**RESEARCH SERIES
NUMBER 135**

Economic and Social Research Institute

Allied Irish Banks

Available to download from www.esri.ie

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Whitaker Square, Sir John Rogerson's Quay, Dublin 2

<https://doi.org/10.26504/rs135>



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ACKNOWLEDGEMENTS

This research was conducted as part of a research programme on climate change funded by Allied Irish Banks (AIB). We thank Cameron Belton for his work during early stages of the project. We are also grateful to Kelly de Bruin, Clare Kelly and Karl Purcell for helpful comments on early drafts of the study materials, and to an ESRI seminar audience for helpful feedback. We also thank two anonymous reviewers and Helen Russell for helpful comments on an initial draft of this report.

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EXECUTIVE SUMMARY

In this study, a large, representative sample of the Irish population undertook a multiple-choice quiz about climate change. The 10-minute quiz was designed to engage participants and to measure their understanding, not of facts and figures, but of the scientific relationships behind climate change – of what causes what, and how. The study was conducted in mid-October 2021.

As well as revealing how well the population understands climate change, the central focus of the study was the relationship between understanding and willingness to act. To investigate this, the study contained an experiment that tested whether exposing people to the answers to the quiz questions altered their attitudes to climate policy and individual behaviour. Half the sample was randomly assigned to see the answers to the quiz questions, while the other half was not. We then measured support for climate mitigation policy (in particular, a carbon tax) and judgements of individual behaviour. In this way, we conducted an experimental test of whether engaging with accurate scientific information about climate change has an impact on willingness to tackle it.

The study produced the following main findings:

- When people engage with accurate scientific information about climate change, it increases their support for a carbon tax. To a lesser extent, it also alters their judgments of appropriate behaviour and changes their stated intentions about their own behaviour.
- After exposure to scientific information, people become more likely to believe that the carbon tax can shift businesses and households towards more sustainable energy sources and that the price per tonne of carbon should be higher than its current level. However, there is no similar effect of giving people information on what the ring-fenced carbon tax revenue is used for.
- The effect of scientific information on support for climate mitigation policy is much greater than the effect on judgments and intentions regarding individual everyday behaviours. When it comes to this, a far stronger predictor is how worried the individual is about climate change.
- The majority (70 per cent) of adults are worried about climate change. It ranks third, after housing and healthcare, among the most pressing issues facing people in Ireland.
- Almost 90 per cent believe human activity is causing the Earth's atmosphere to warm and most can identify energy- and transport-related causes of emissions.

- One-in-three do not recognise the agriculture sector as a main contributor of greenhouse gases in Ireland. Over one-third are not aware that fertiliser and slurry release greenhouse gases and two-thirds are unaware that disturbing soil releases carbon.
- Most adults (84 per cent+) can identify most effects of climate change and are aware that many are increasing at an accelerated pace (e.g. rising sea levels). However, awareness that climate change can lead to increased spread of infectious disease is low (36 per cent).
- Understanding of the relative mitigative impact of different individual actions is poor. For example, most people underestimate the impact of eating less meat and overestimate the impact of buying local, organic or unpackaged food.
- The majority believe that achieving emissions targets will entail high investment and costs for households, but are divided over whether the benefits will be experienced in the short or long term.
- The majority (85 per cent) support the 'polluter pays' principle and identify the carbon tax as an application of it. Almost one-in-two adults believe the carbon tax should be higher (47 per cent), while almost one-third (31 per cent) believe it should be lower.
- People judge it to be less acceptable for companies to offset their emissions or move high-emitting processes abroad in order to avoid emissions charges than to invest in new processes, even if it means higher costs for consumers.

CHAPTER 1

Understanding of climate change and support for mitigation: Introduction and background

Climate change presents a major societal and economic threat. Tackling it requires significant investment and regulation (e.g. International Monetary Fund, 2021). Governments and high-emission industries are ultimately responsible for the transition to a low-carbon economy, but public buy-in will be essential. Day-to-day habits will need to change and policies that aim to shift reliance from high-carbon consumption will need support. However, some behaviours and policies that are widely regarded to be effective at reducing emissions, such as eating less meat and taxing carbon emissions, are controversial. A common assumption is that interventions that aim to educate the public about climate change are a useful way to motivate necessary change.

Experimental studies in psychology, however, show that people often interpret information in ways that support the outcome they want to believe, ignoring or downplaying evidence that supports conclusions they dislike (Kahan et al., 2017; Kunda, 1990). There is evidence that such ‘motivated reasoning’ affects support for climate mitigation policies, with individuals who are inclined to be sceptical about climate change interpreting climate science in ways that support the status quo (e.g. Hart and Nisbet, 2012; Morin-Chassé and Lachapelle, 2020; Sarewitz, 2011). Similarly, recent research from France shows that while knowledge about climate change is linked to support for carbon taxation, information interventions have little effect (Douenne and Fabre, forthcoming; 2020). Giving people better information about climate change may not necessarily encourage behaviour change and support for mitigation policies, if only those already motivated to tackle the issue find such information persuasive.

This study set out to provide the first measure of understanding of climate change among a representative sample of adults in Ireland and to test the link between comprehension and willingness to change. This link is of fundamental importance: if understanding is lacking and comprehension is linked to the acceptability of change, then improving the public’s understanding is a vital part of climate mitigation. If not, then, efforts will be better spent on other barriers to change.

1.1 MEASURING UNDERSTANDING

We had two specific aims. One was to assess comprehension of the fundamentals of climate change. For example, do people know the day-to-day causes of climate change, its effects and the most effective ways to reduce their impact on the

environment? Similar to previous research, we ask some questions that probe factual knowledge, such as why the earth's atmosphere is warming and the sources of greenhouse gases (e.g. Clarke, et al., 2012; Hamilton, 2012; Lombardi et al., 2013; Dos Santos, 2012). However, we avoided specific numeric facts, such as the projected change in temperature or exact percentage change in CO₂ concentration in the atmosphere (e.g. Degen et al., 2014; Fisher et al., 2019). Instead, we included questions about the relative contribution of different sectors of the economy, how Ireland compares to the rest of the world, the effects of climate change, the pace of change and the relative impact of mitigative actions. These questions target people's "gist" or bottom-line understanding of climate change. This kind of understanding, compared to knowledge of verbatim details, is a stronger predictor of people's judgements and decisions across multiple domains (Reyna and Brainerd, 1995; Reyna, 2008), but as far as we know has not previously been measured in the domain of climate change.

1.2 SUPPORT FOR CHANGE

The second aim was to assess how comprehension relates to willingness to make and support change, both in terms of support for controversial policies such as carbon taxation and perceptions of individual actions. For example, do people who know more about climate change hold stronger beliefs that carbon taxation will be effective? (We focused specifically on carbon taxation because, although it is widely regarded by economists as an effective way to reduce emissions, it tends to be more divisive than other policy recommendations, such as home retrofit subsidies.) Importantly, we also sought to test the causal link between climate comprehension and support for policy change. To do so, we experimentally tested whether providing more information about climate change leads to stronger support for carbon taxation and alters behavioural intentions (Lunn and Robertson, 2018). By selecting some respondents at random to see information about climate change and comparing their responses to respondents who did not see this information, we determined the effect that this information had on subsequent judgements.

In addition to information on climate change more broadly, we also sought to test experimentally whether informing the public about how Ireland's carbon tax revenue is actually used would affect support. Research in other countries shows that when the public are informed of specific uses of tax revenue (e.g. to fund green investment or rebates), support for carbon pricing increases (e.g. Amdur et al., 2014; Bachus et al., 2019; Bristow et al., 2010). However, most of this research is based on survey questions of simplified hypothetical scenarios.

1.3 SOCIO-DEMOGRAPHIC DIFFERENCES

Our approach also allowed us to gain insight into how much people in different socio-demographic subgroups know about climate change, and to identify economic and social factors that could disincentivise individuals from supporting the kind of change necessary for climate mitigation. It is well established in previous research that women tend to perceive greater risks from climate change and are more likely to support environmental policies than men (Brody et al., 2008; Finucane et al., 2000; O Connor et al., 1999), although men tend to do better on assessments of knowledge (e.g. Douenne and Fabre, 2020). The relationships between other socio-demographic characteristics and attitudes to climate change, however, are less straightforward. Some studies find, for example, that being younger and having higher income predict greater climate change concern and support for policy (Akerlof et al., 2013; O' Connor et al., 1999). Others suggest that these relationships are accounted for by differential educational attainment (Douenne and Fabre, 2020; Smith et al., 2017; Thalmann, 2004). Yet other studies find no relationship between age, income or educational attainment on climate attitudes and policy support (Brody et al., 2008; Kellstedt et al., 2008; Milfont, 2012; Sundblad et al., 2007; van der Linden, 2015). Differences between those living in urban and rural areas are similarly mixed (Berenguer et al., 2005; Huddart-Kennedy et al., 2009). Given these discrepancies and the need for research in an Irish context, we test for effects of gender, age, income (proxied by socio-economic group) and education, as well as employment status and location indicators (urban/rural and region). The study is the first of its kind in Ireland.

CHAPTER 2

Method

2.1 PARTICIPANTS

One thousand participants were recruited from a large online panel held by a leading market research and polling company.¹ Timmons et al. (2020) provide details on how recruitment from this panel compares to a probability sample. This method was particularly suited to this study, as our interest lay in broad patterns of responding to novel questions and the relative effect of an information intervention on support for change rather than point-estimates in the population. Socio-demographic characteristics of the sample are summarised in Appendix A. They approximate latest CSO figures well, with a modest underrepresentation of younger age groups. Importantly, as this study measured knowledge, the education profile of participants is closely similar to the Census figure. Note that, by design, any differential participation by socio-demographic group was unrelated to the specific focus of the study (i.e. climate change), as participants were unaware of the topic prior to participation.² Furthermore, we report results that control for socio-demographic characteristics, implying that the findings are not sensitive to any differences. Participants were paid €5 for undertaking the study, which took 25 minutes to complete on average. They also had the option to earn an additional €2 or donate it to charity (see below). In order to complete the study, participants had to correctly answer attention-check questions.

2.2 TIMING AND CONTEXT

Data were collected between 14 October and 20 October 2021. Hence the study was run after the Budget 2022 announcement on 12 October, in which the carbon tax was raised from €33.50 to €41 per tonne. Data were collected before the Climate Change Advisory Council's sectoral carbon budget was announced (26 October) and before the media coverage of COP26 (31 October – 12 November) became extensive.

2.3 MATERIALS AND DESIGN

The study was programmed using Gorilla Experiment Builder (Anwyl-Irvine et al., 2020) and was organised into stages.³ We first measured concern about climate change, as affect (e.g. worry) is often found to be highly predictive of climate-related opinions and behaviour (e.g. Bouman et al., 2020; van der Linden, 2015). We measured concern through an open-text question about the main issues facing

¹ RED-C Research & Marketing (www.redcresearch.ie).

² In addition, drop-outs during the quiz were low for an online study (n = 50) and were random across groups.

³ The study was pre-registered in line with best scientific practice (<https://osf.io/ahek2/>; Munafò et al., 2017).

people in Ireland and by asking participants to select the most important issue from a list of options. Participants answered before being informed of the main subject of the study, and hence were not primed to think about climate change. We then assessed worry about climate change through standard rating scales.

Next, participants completed a quiz about climate change. Questions were adapted from previous research, surveys and data from other reliable sources (e.g. EPA (www.epa.ie); Eurostat (ec.europa.eu/eurostat); Our World in Data (www.ourworldindata.org); Wynes et al., 2020). As noted above, we sought to target conceptual understanding of the information that is likely to be important for motivating climate mitigation, rather than knowledge of specific facts, as is more typically measured in academic surveys of climate change knowledge (e.g. details of the Paris Agreement; Hine et al., 2013; Lombardi et al., 2013). Questions addressed the causes of climate change, the relative influence of different sectors of the economy, how Ireland compares to other countries, the effects of climate change and evidence it is occurring, and the relative impact of various individual-level solutions (e.g. eating a plant-based diet vs. using re-usable shopping bags). Some questions were multiple choice and had one correct answer, whereas others had multiple correct answers and participants were informed to ‘select all that apply’. Questions could not be skipped and just one had a “don’t know” option (noted below). Instead, participants were told to give their best guess and were incentivised to answer correctly. They were able to opt-in to a raffle for one of five €100 virtual Mastercards, knowing that each correct answer would earn them an additional raffle entry. Almost all participants (95.5 per cent) entered the raffle. The quiz and answers were reviewed by independent experts before data were collected.

Half of the participants were randomised to see the answers to the quiz after attempting each set of questions. This approach allowed us both to assess comprehension in the full sample while also experimentally testing the influence that seeing the answers had on measures recorded later in the study.

The next stage was about tackling climate change. First, participants were asked their perception of the kind of investment that would be required to meet emissions targets (e.g. if they believed it would cost households money in the short term) and whether they agreed with the ‘polluter pays’ principle. Participants then read information about the carbon tax, including its aim and current cost (as of the 2022 Budget). Half the participants were randomised to see information about how the carbon tax is used in Ireland, to test whether information on the use of hypothecated⁴ carbon tax revenue affects support (Bachus et al., 2019). Hence the

⁴ A ‘hypothecated’ tax is one where the money raised is for a specific, defined purpose rather than adding to general Exchequer funding.

design for this stage of the study was a 2 (quiz answers, no answers) x 2 (revenue use information, no information) between-groups design, giving four groups with approximately a quarter of the sample in each. The stage then recorded two dependent variables. The first was participants' belief that carbon taxation can encourage businesses and households to shift towards more sustainable practices. This was designed to give an overall assessment of the perceived effectiveness of the tax, although it is possible that people might view it is more effective for one than the other. The second was a measure of what participants think the price per tonne of carbon should be.

The next stage recorded participants' judgements of others' behaviour and intentions for their own future behaviour. Participants were first asked how acceptable they thought it was for other people to engage in various environmentally harmful behaviours (e.g. putting waste food in the general waste bin instead of the compostable one). The behaviours related to food, transport, energy and general consumption and varied by their impact on the average person's carbon footprint (low, moderate or high; as estimated by Wynes and Nicholas, 2017; Wynes et al., 2020). The same questions were then reformulated into behavioural intention questions and participants were asked about the likelihood that they would engage with each in the future. These questions were personalised to the participant (e.g. only those who eat meat were asked whether they would eat less meat in future). Our aim was to test whether seeing the answers while completing the quiz affected participants' views about the behaviour of others and their own intentions.

Participants then saw short vignettes about hypothetical companies and how they might respond to changes in regulatory policy. Participants read about three companies based in Ireland and were told that a new policy to reduce carbon emissions meant that they needed to change some of their manufacturing processes to avoid large fines. They read that one company invested in new processes that reduced emissions but that this investment meant higher costs for their consumers. Another company moved its processes abroad to avoid the emissions being counted against Irish targets and thereby could keep costs for customers in Ireland the same. The final company purchased carbon offsets and passed the cost on to their customers. The order of the vignettes was randomised across participants. Participants rated how acceptable they judged the actions of each company, from 1 'not at all acceptable' to 7 'completely acceptable'.

The study concluded with questions about the participants' background characteristics. In the final question, participants were offered an additional €2 for completing the study or they could opt to donate that €2 to a carbon offset charity. This decision served as an additional outcome variable, measuring real behaviour. The study also included a short experimental test of the effects of framing on policy

support, to be reported separately. This short section was run after the main experimental component, meaning that the randomisation did not affect the experimental treatments or primary outcome measures reported here. All study materials are available on the study's OSF page.

CHAPTER 3

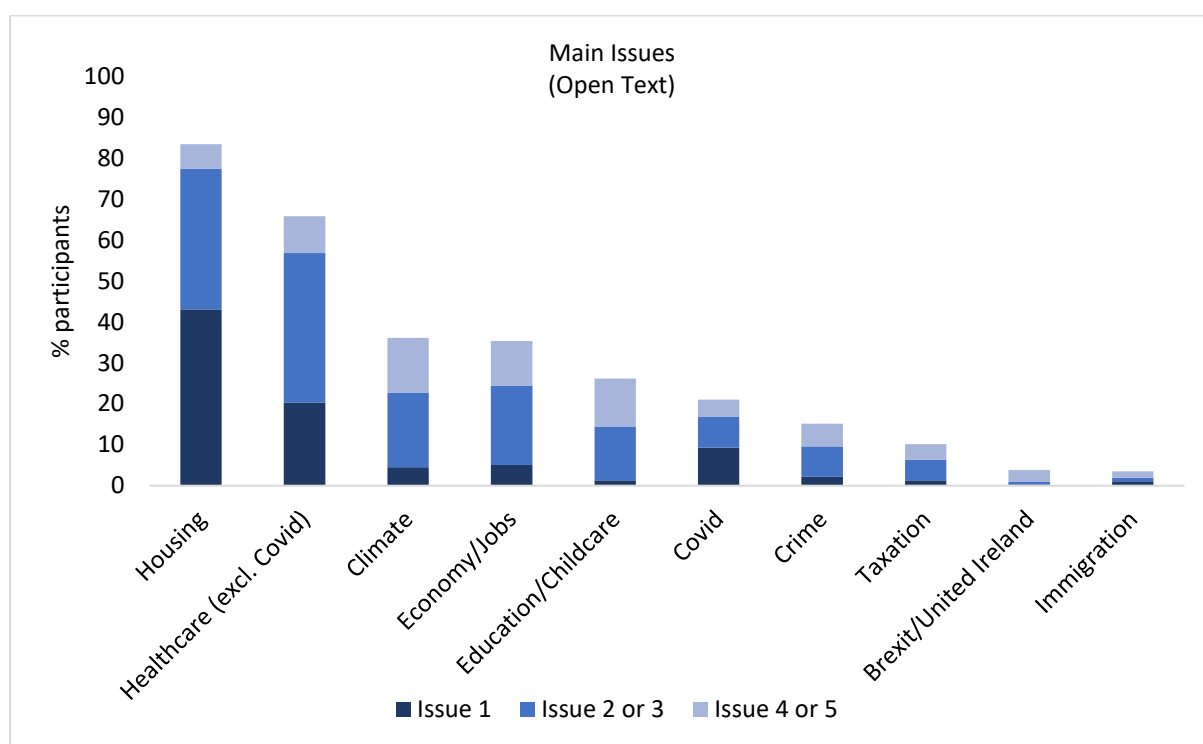
Results

This section proceeds as follows. First, we present findings from our measure of climate concern. Second, we summarise the descriptive results from responses to the quiz. Third, we describe our measures of carbon pricing support, including results from statistical models of the relationship between knowledge and support, the effects of engaging with climate science information on support and responses to the vignettes about hypothetical companies' response to emissions charges. Fourth, we present the results from the behavioural judgements of others and intentions for the future. Where differences between socio-demographic subgroups are noted, they are statistically significant.

3.1 CLIMATE CHANGE CONCERN

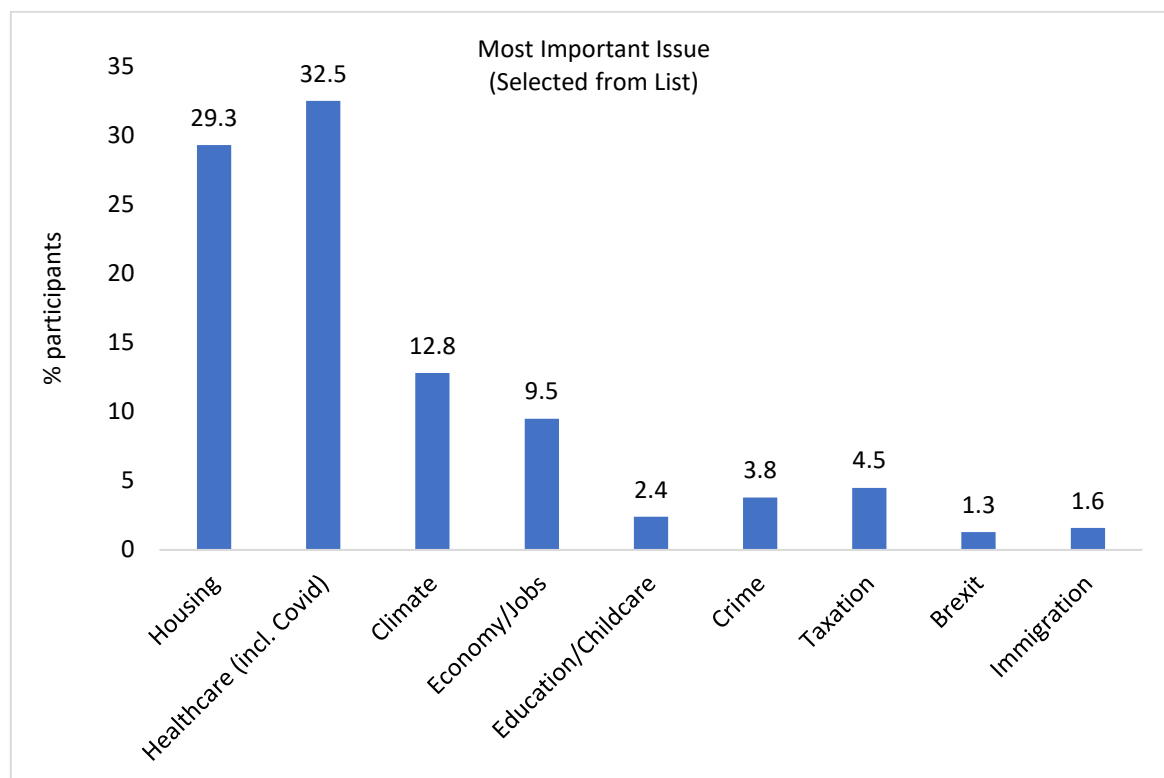
We measured concern about the climate in three ways. An open-text question and multiple choice question on the main issues facing people in Ireland were asked before participants were informed about the nature of the study. A question asking respondents to rate how worried they are about climate change was asked afterwards. Figure 3.1 shows that climate change was the third most frequently cited issue facing people in Ireland, mentioned by 37 per cent of the sample. This proportion is not statistically greater than the proportion who mentioned the economy or jobs ($Z = 0.75, p = .457$) but it is statistically greater than the next most cited issue (education/childcare; $Z = 5.19, p < .001$). However, far fewer people mentioned climate change than either of the two most common issues: housing and healthcare ($Z_{\text{Housing}} = 21.25, p < .001$; $Z_{\text{Health}} = 12.93, p < .001$). Climate change was also the third most selected issue when participants were asked to choose from a list of options (Figure 3.2), with one-in-eight selecting it as the most important issue facing people in Ireland. Again, housing and healthcare dominated as the issues participants prioritised, although for this question the difference between proportion of those who selected climate change and those who selected the economy is statistically significant ($Z = 2.34, p = .019$).

FIGURE 3.1 RESPONSES TO THE OPEN-TEXT QUESTION ABOUT THE MOST IMPORTANT ISSUES FACING PEOPLE IN IRELAND

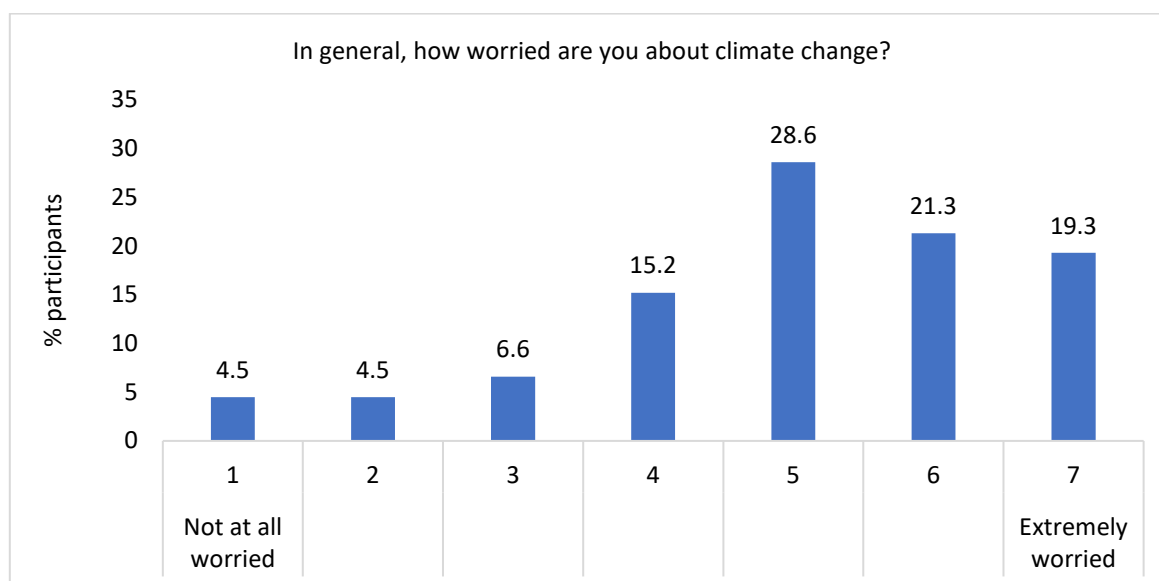


Source: Authors' analysis.

FIGURE 3.2 PERCENTAGE OF PARTICIPANTS WHO SELECTED EACH ISSUE AS THE MOST IMPORTANT WHEN PRESENTED WITH A LIST



Source: Authors' analysis.

FIGURE 3.3 DISTRIBUTION OF RESPONSES TO THE RATING SCALE QUESTION ABOUT WORRY

Source: Authors' analysis.

When asked specifically about climate change, participants reported being worried, giving an average score of 5 ($SD = 1.59$) on a 7-point scale from 'not at all worried' to 'extremely worried'. Figure 3.3 shows that over two-thirds of the public placed themselves above the mid-point of the scale. We tested for socio-demographic predictors of concern using logistic regression models for (i) having mentioned climate change in the open text question and (ii) having selected it as the main issue, and using an ordinal logistic regression model for worry (Appendix C). Participants from the highest socio-economic status (SES) group⁵ and those with higher educational attainment showed more concern. Respondents with children under the age of 18 showed lower concern. Men reported being significantly less worried than women.

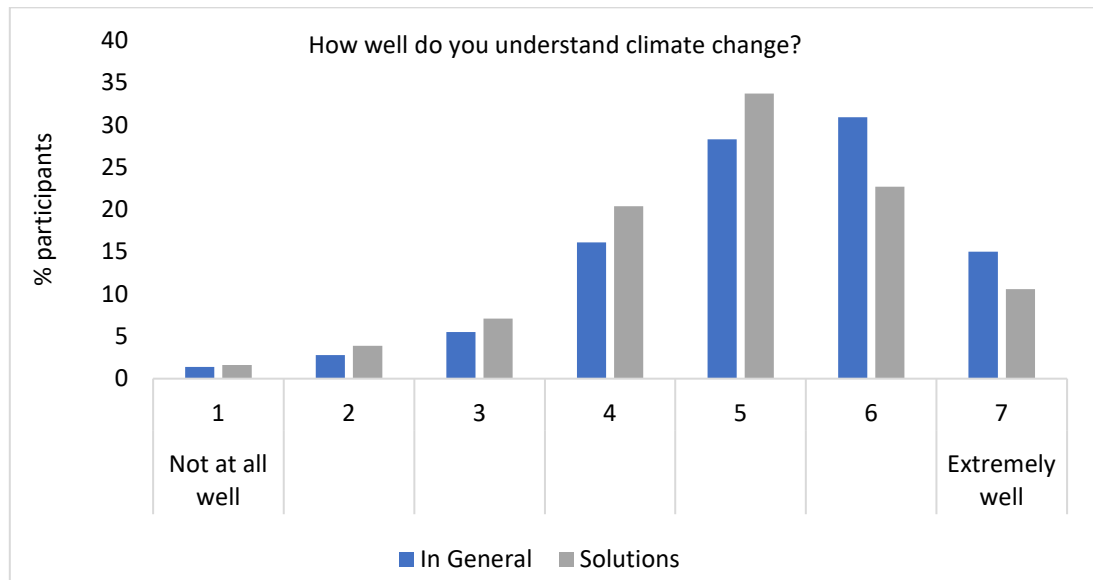
3.2 UNDERSTANDING OF CLIMATE CHANGE

Participants were confident in their level of understanding of climate change ($M = 5.2$, $SD = 1.3$) and, to a lesser extent, its solutions ($M = 4.9$, $SD = 1.3$; $t(999) = 8.75$, $p < .001$) (Figure 3.4). The correlation between worry and perceived understanding is statistically significant but perhaps weaker than might be expected if worry is thought to motivate information-seeking ($r = .33$, $p < .001$); only approximately 10 per cent of the variation in worry can be explained by perceived understanding. Figures 3.5a-3.14b show the responses to the questions in the quiz, summarised in this section, with the dark green bars indicating correct

⁵ SES groups are estimated by the occupation of the chief income earner in the participant's household. For analysis purposes, we group A (higher managerial/professional) and B (intermediate managerial/professional) together, C1 (supervisory/clerical/junior managerial) and C2 (skilled manual workers) together, and D (semi-skilled/unskilled manual) and E (casual workers/unemployed) together.

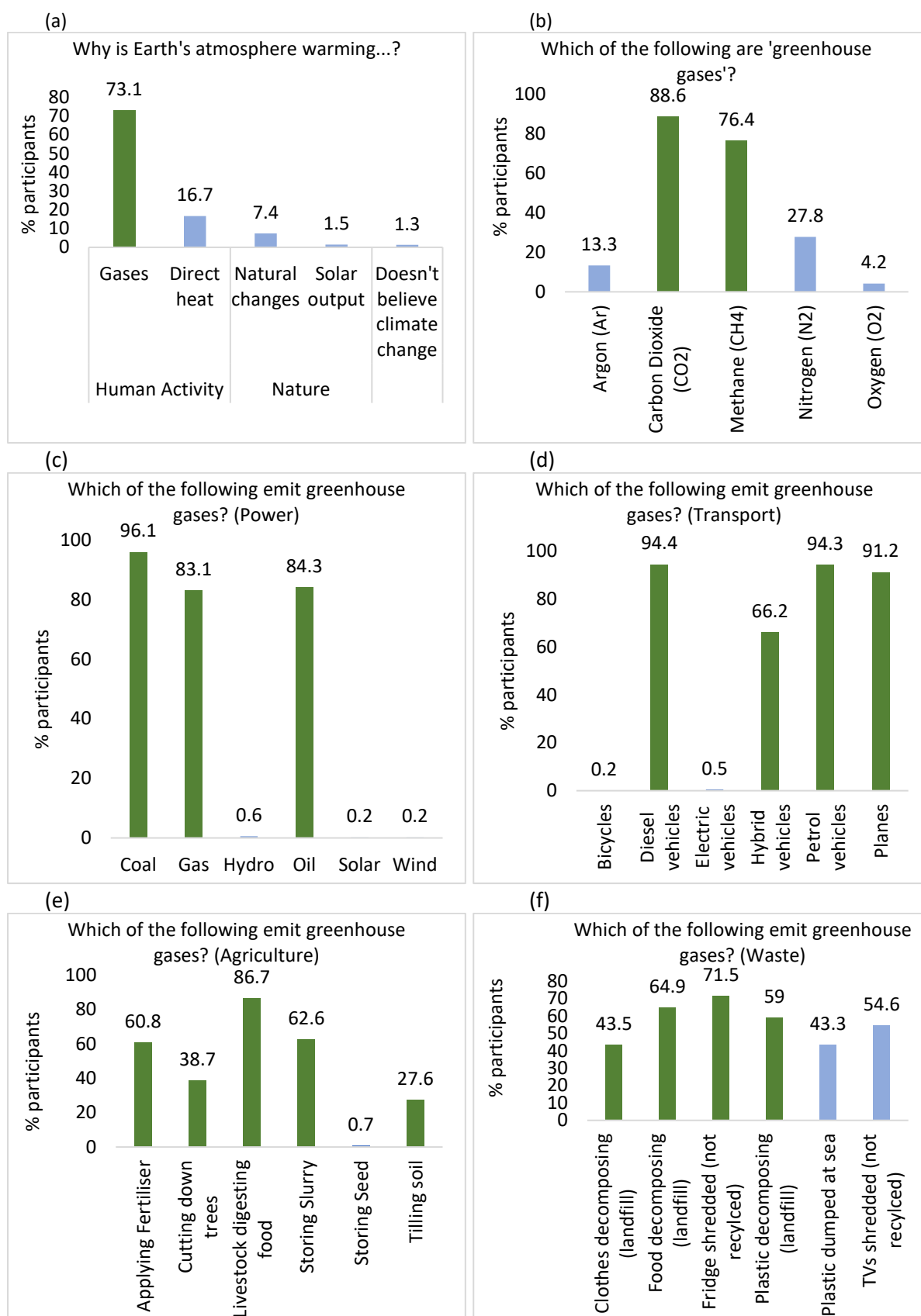
responses. Since one of our aims was to provide the first comprehensive assessment of climate change knowledge in Ireland, we present the results to each question.

FIGURE 3.4 DISTRIBUTION OF RESPONSES TO THE RATING SCALE QUESTIONS ABOUT PERCEIVED UNDERSTANDING



Source: Authors' analysis.

FIGURES 3.5A-F RESPONSES TO QUESTIONS ABOUT THE CAUSE OF CLIMATE CHANGE, GREENHOUSE GASES AND THE SOURCES OF GREENHOUSE GASES IN DIFFERENT SECTORS



Source: Authors' analysis.

Note: Figures 3.5b-f present 'Select All That Apply' questions. Correct answers are shown in the dark green bars.

When asked about why the Earth's atmosphere is warming, almost 90 per cent of respondents selected a response corresponding to human activity, although fewer were aware of the mechanism (i.e. that burning fossil fuels releases gases that trap heat; 73.1 per cent, Figure 3.5a).⁶ Most of the remainder believed that the Earth's atmosphere is warming because of natural causes, with just 1.3 per cent reporting that they do not believe the climate is changing. Almost all participants identified carbon dioxide as a greenhouse gas, although one-in-four failed to identify methane as one (Figure 3.5b).

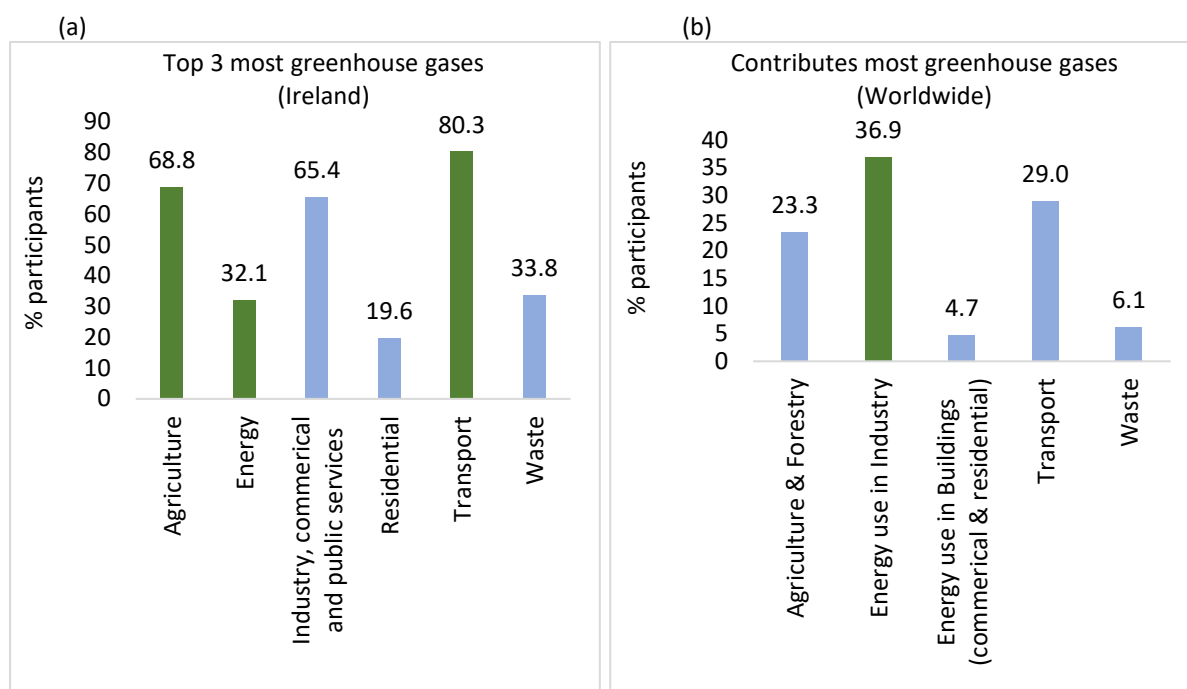
Turning to the sources of greenhouse gases, awareness of energy- and transport-related sources was high, particularly for coal, diesel and petrol cars and planes (Figures 3.5c and 3.5d). However, one-third of participants were not aware that hybrid vehicles emit greenhouse gases. Performance on the agriculture- and waste-related sources was weaker (Figures 3.5e and 3.5f). A majority were not aware that activity that disturbs soil (e.g. cutting down trees, ploughing) releases carbon into the atmosphere. More than one-third were not aware that fertiliser and slurry emit greenhouse gases. Similarly, more than one-third of participants were not aware that food waste in landfills emits greenhouse gases as it decomposes. Even fewer knew that as clothing and plastic decompose, they emit greenhouse gases.

Approximately one-in-three participants did not identify Agriculture as one of the main contributors of greenhouse gases in Ireland, despite it contributing more than any other sector (Figure 3.6a). Awareness of Transport as a contributor was more widespread, with 80 per cent of the sample selecting it. Least well known of the main sources is Energy; a majority did not place it in the top three. Despite few people believing that decomposing food, clothing and plastic emit greenhouse gases, one-third of respondents suspected that Waste is one of the largest sources of emissions. The Waste sector contributes just 3 per cent of emissions in Ireland (combined with F-gases used for refrigeration). When asked about worldwide emissions, the most commonly selected response was the correct one: Energy use in Industry (Figure 3.6b).

⁶ The five response categories were:

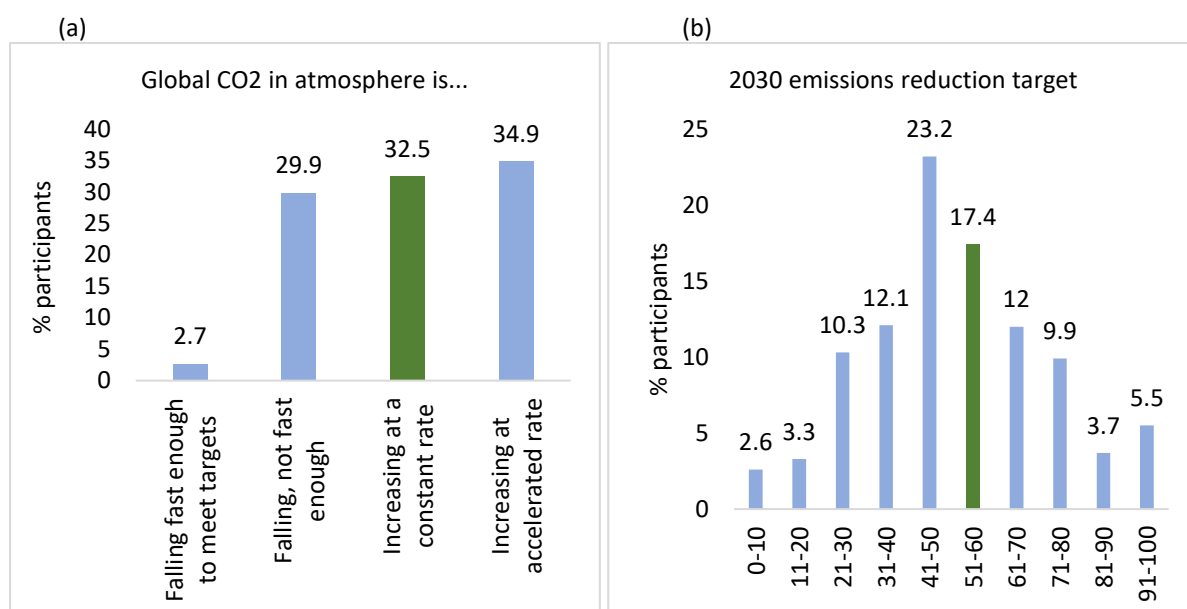
- Human activity (e.g. burning fossil fuels) generates heat energy which adds to the natural heat from the sun.
- Human activity (e.g. burning fossil fuels) releases gases. These gases trap the sun's heat in the Earth's atmosphere, preventing it from being released into space.
- Natural changes to the climate mean we often see long periods (100-200 years) of slight warming that are followed by long periods of slight cooling.
- Solar output (i.e. energy from the sun) has increased over the past 200 years meaning all layers of the atmosphere have warmed.
- I don't believe the Earth's atmosphere is warming more now than 200 years ago.

FIGURES 3.6A AND 3.6B RESPONSES TO QUESTIONS ABOUT SECTORAL CONTRIBUTIONS (A) IN IRELAND (SELECT-ALL-THAT-APPLY) AND (B) WORLDWIDE



Source: Authors' analysis.

FIGURES 3.7A AND 3.7B RESPONSES TO QUESTIONS ABOUT CURRENT EMISSIONS RATES AND IRELAND'S EMISSIONS TARGET

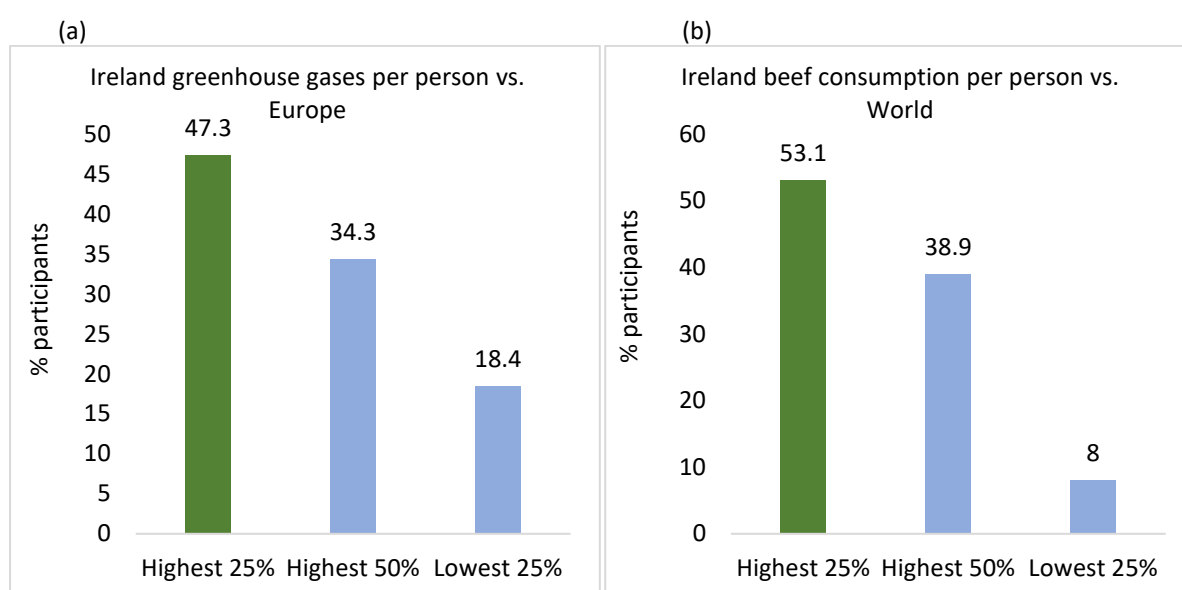


Source: Authors' analysis.

Participants were generally unsure about the rate at which carbon dioxide is being added to the atmosphere. One-in-three correctly selected that it is increasing at a constant rate, however a similar proportion thought the rate is falling (albeit not

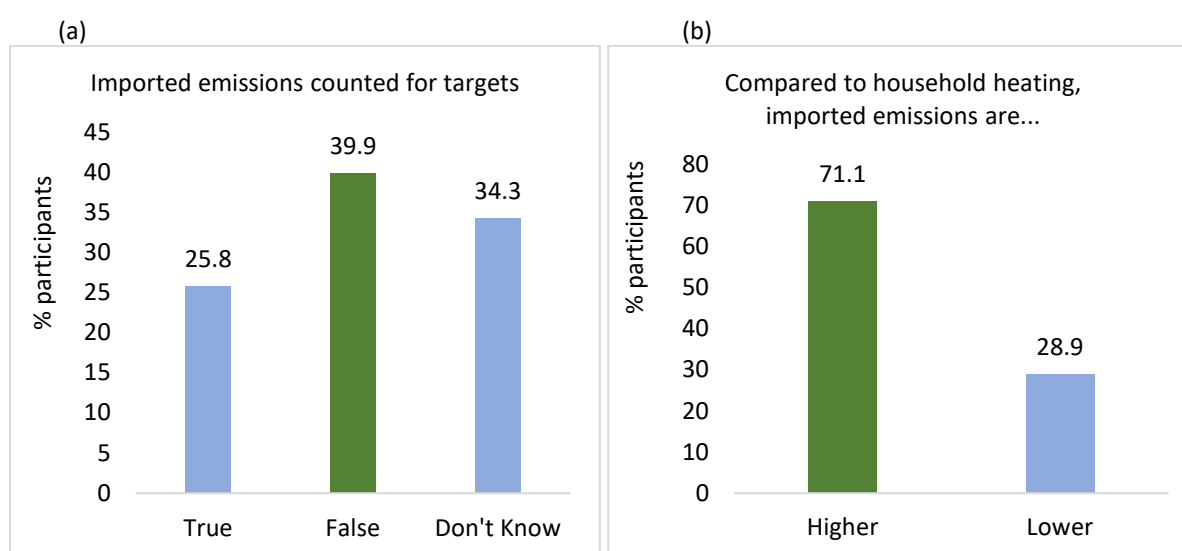
fast enough to meet targets) and thought that it is increasing at an accelerated rate (Figure 3.7a). The question assumed that participants could comprehend the difference between a “constant” and “accelerated” rate, although this may not have been true of all participants. There was uncertainty too about Ireland’s emissions reduction target by 2030 (51 per cent; Figure 3.7b). The sample was split either side of the correct figure, with large variation in responses.

FIGURES 3.8A AND 3.8B RESPONSES TO QUESTIONS ABOUT IRELAND’S GREENHOUSE GASES AND BEEF CONSUMPTION



Source: Authors’ analysis.

FIGURES 3.9A AND 3.9B RESPONSES TO QUESTIONS ABOUT EMISSIONS CALCULATIONS AND TRADE

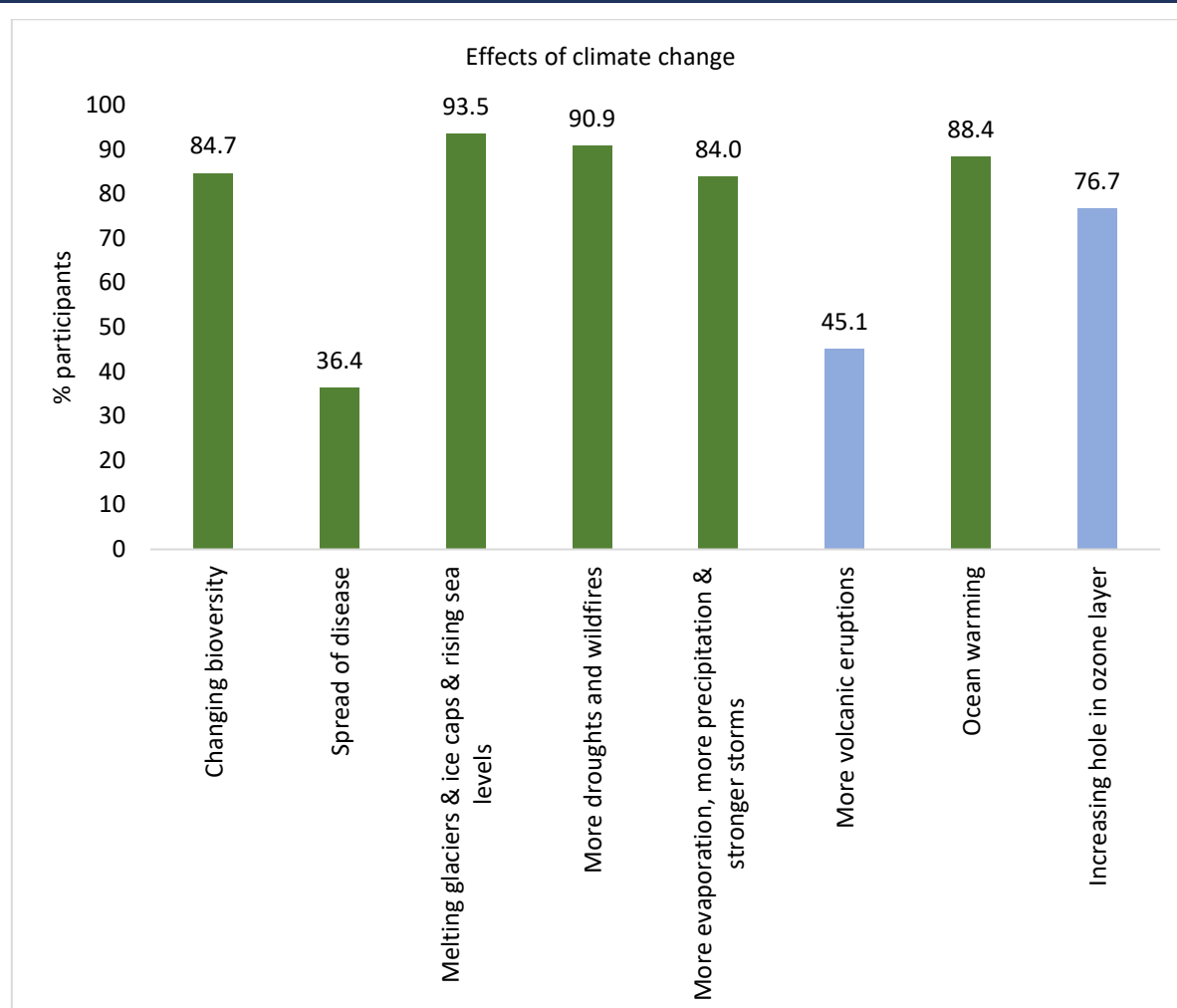


Source: Authors’ analysis.

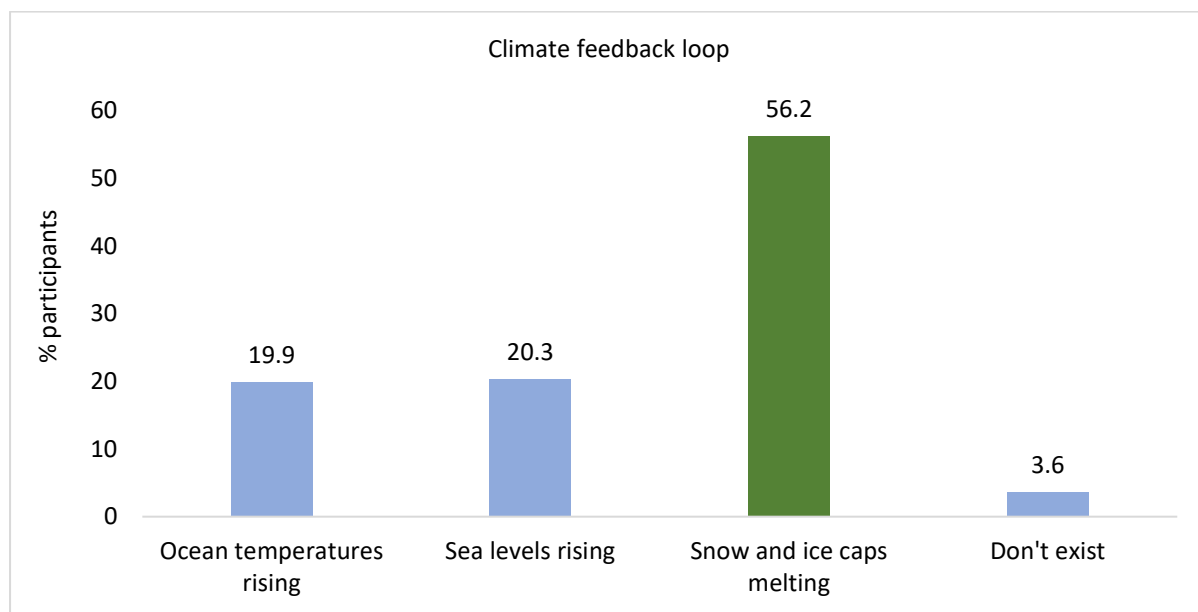
Note: “Imported emissions” was defined for respondents as emissions from the production of goods that are imported to Ireland (e.g. steel, clothes, electronics made abroad but sold here).

When asked about the per-person contribution of Ireland to climate change, the most commonly selected responses were that Ireland is in the highest 25 per cent in Europe for greenhouse gas emissions and highest 25 per cent in the world for beef consumption (Figures 3.8a and 3.8b). However almost one-in-five believed Ireland’s per-person emissions are among the lowest in Europe. There is a lack of awareness of how emissions are calculated; a majority were not aware that emissions from imports are not included (Figure 3.9a). Once informed of this, however, most people correctly suspected that these emissions are higher than those from household heating (Figure 3.9b).

FIGURE 3.10 RESPONSES TO THE (SELECT-ALL-THAT-APPLY) QUESTION ABOUT THE EFFECTS OF CLIMATE CHANGE



Source: Authors' analysis.

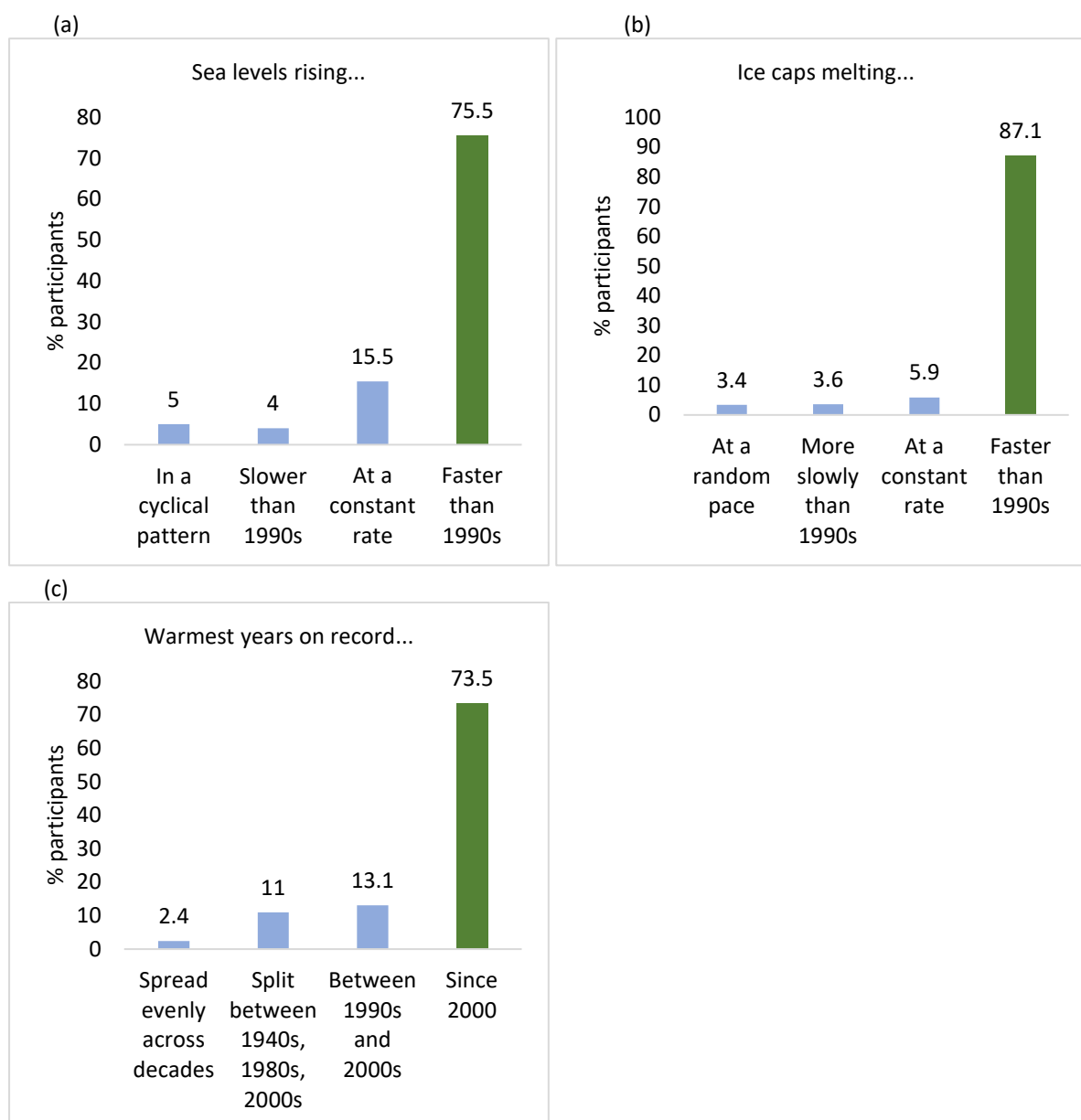
FIGURE 3.11 RESPONSES TO THE QUESTION ABOUT CLIMATE FEEDBACK LOOPS

Source: Authors' analysis.

The vast majority of people were aware of most of the effects of climate change, including melting ice caps, rising sea levels, more extreme weather events, ocean warming and changing biodiversity (Figure 3.10). However, just one-in-three knew that climate change contributes to the spread of infectious disease. Figure 3.11 shows that over half of people identified melting ice caps as part of a 'climate feedback loop' (i.e. an effect that can accelerate further change).⁷ Most people were also aware of evidence for climate change and that its main effects are worsening at an accelerated pace: a majority were aware that ice caps are melting and sea levels rising faster now than in the 1990s, and that most of the 20 warmest years on record have occurred since 2000 (Figures 3.12a-c).

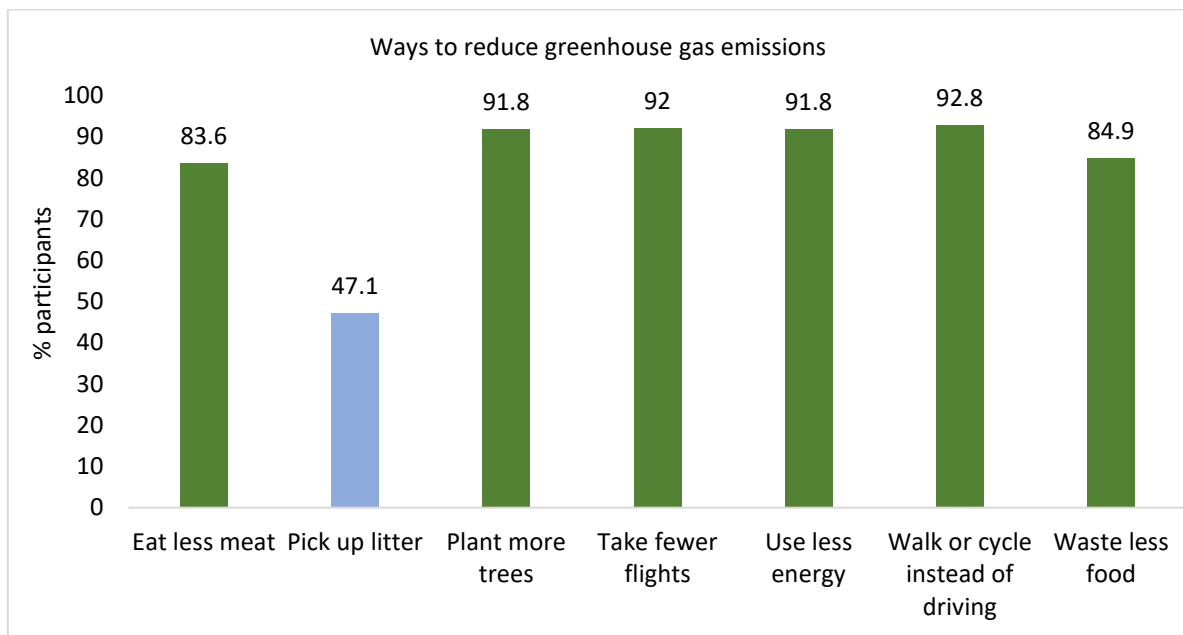
⁷ The question informed respondents that "some of the effect of climate change can in turn lead to even more climate change" and that "these are called 'climate feedback loops'." The response options were:

- Ocean temperatures rise > biodiversity changes > sea life begins to produce more heat > ocean temperatures rise further.
- Sea levels rise > more water evaporates > rainfall increases > sea levels rise further.
- Snow and ice caps melt > less radiation from the sun is reflected back into space > more heat is absorbed > more snow and ice caps melt.
- Climate feedback loops don't exist.

FIGURES 3.12A-C RESPONSES TO QUESTIONS ABOUT THE EVIDENCE FOR CLIMATE CHANGE

Source: Authors' analysis.

The final part of the quiz assessed awareness of the individual-level actions that can be taken to reduce environmental impact. Most participants correctly selected climate-friendly actions when presented with a simple list (Figure 3.13), however awareness of the relative impact of different actions was poor (Figure 3.14a). A majority incorrectly estimated the impact of most behaviours. Figure 3.14b shows that most of the sample overestimated the effect of low-impact actions, like buying only local, organic or unpackaged food, and underestimated the impact of plant-based diets (one of the highest-impact actions). Almost half underestimated the impact of long-distance flights. A majority incorrectly answered that switching from a conventional car to a hybrid one and recycling as much as possible are some of the most impactful actions the average person can take.

FIGURE 3.13 RESPONSES TO THE (SELECT-ALL-THAT-APPLY) QUESTION ABOUT INDIVIDUAL ACTIONS TO ADDRESS CLIMATE CHANGE

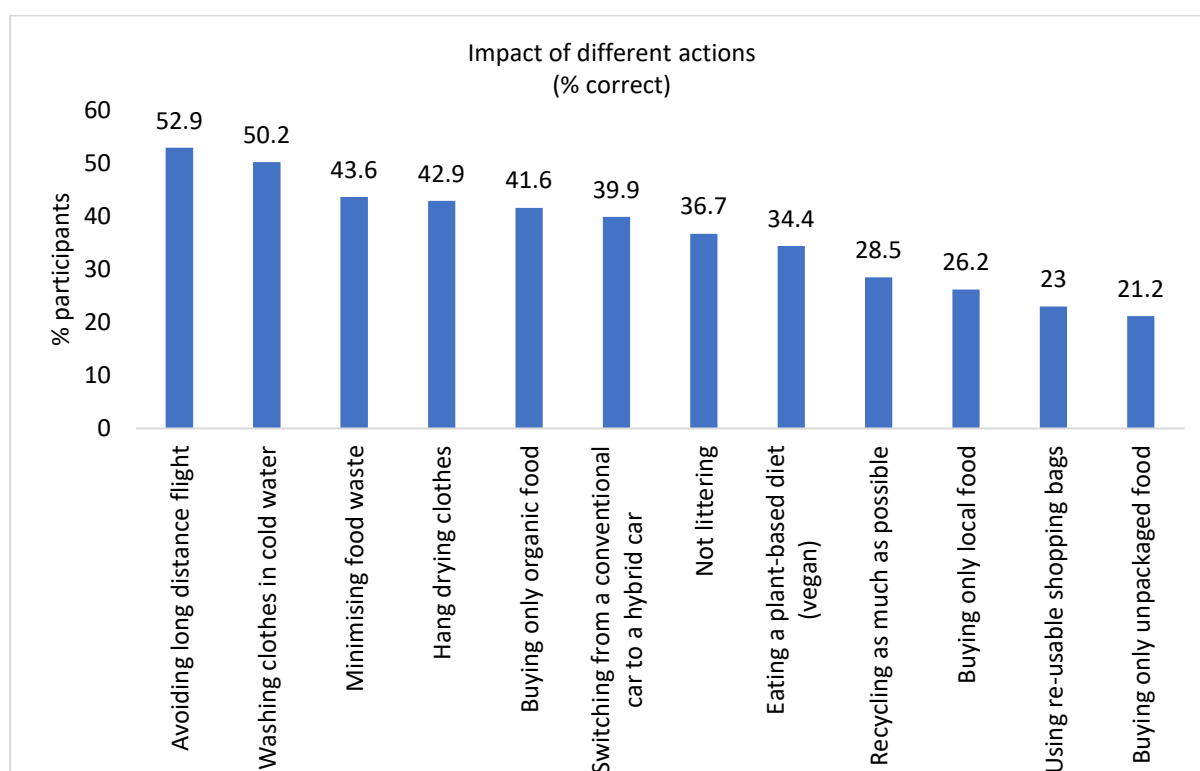
Source: Authors' analysis.

Responses to the quiz allowed us to investigate the link between concern about climate change and understanding. We scored responses on the quiz as outlined in the pre-registration (with select-all-that-apply questions earning more points than multiple choice questions, and questions with more options earning more points than questions with fewer).⁸ Participants who mentioned climate change as a main issue during the open text question scored significantly better than those who did not ($M = 17.6$ vs. 16.0 out of a possible 26.5 points; $t(998) = 9.44$, $p < .001$). Similarly, those who reported being more worried about climate change than average (a 6 or 7 out of 7) scored significantly better than those who were less worried ($M = 17.1$ vs. 16.2 , $t(998) = 4.78$, $p < .001$). Statistical models⁹ that used socio-demographic characteristics to predict quiz score show that men did better than women ($M = 16.9$, $SD = 2.7$; $M = 16.3$, $SD = 2.6$), those with higher educational attainment did better than those with lower ($M = 17.3$, $SD = 2.6$; $M = 16.1$, $SD = 2.7$), those in the highest social grade group did better than those in the lowest ($M = 17.3$, $SD = 2.5$; $M = 15.7$, $SD = 2.7$) and Irish respondents did better than non-Irish ones ($M = 16.6$, $SD = 2.7$; $M = 15.9$, $SD = 2.8$; Appendix B).

⁸ Binary choice multiple-choice questions were worth 0.25 points, with each additional response adding 0.25 points to the question's worth. Each response option to 'Select All That Apply' questions added 0.25 points. Slider scales were worth 1.5 points for an exact match, 1 point within 5 percentage-points of the correct answers, 0.75 points within 10 percentage-points and 0.25 points within 20 percentage-points.

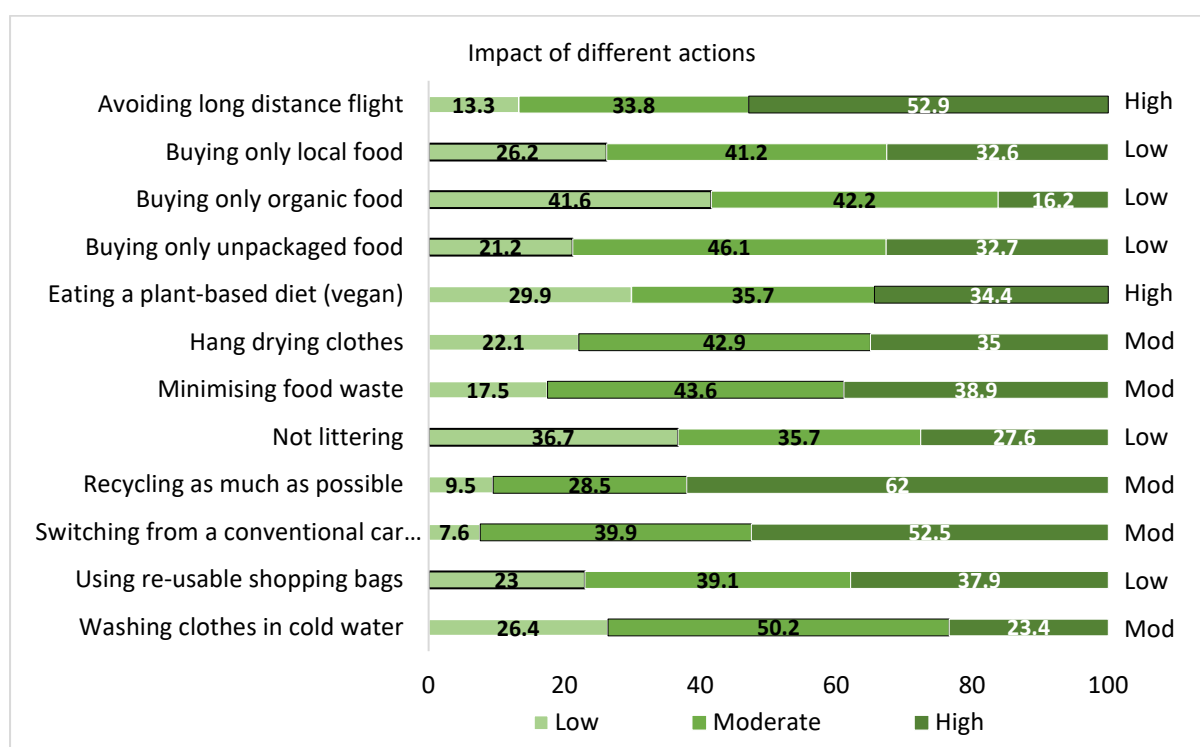
⁹ Results from all statistical models are the same when robustness checks (outlined in the pre-registration) are conducted. We report results from the full sample.

FIGURE 3.14A PERCENTAGE OF CORRECT RESPONSES ABOUT THE IMPACT OF DIFFERENT INDIVIDUAL ACTIONS



Source: Authors' analysis.

FIGURE 3.14B RESPONSES TO THE QUESTION ABOUT THE RELATIVE IMPACT OF DIFFERENT INDIVIDUAL ACTIONS



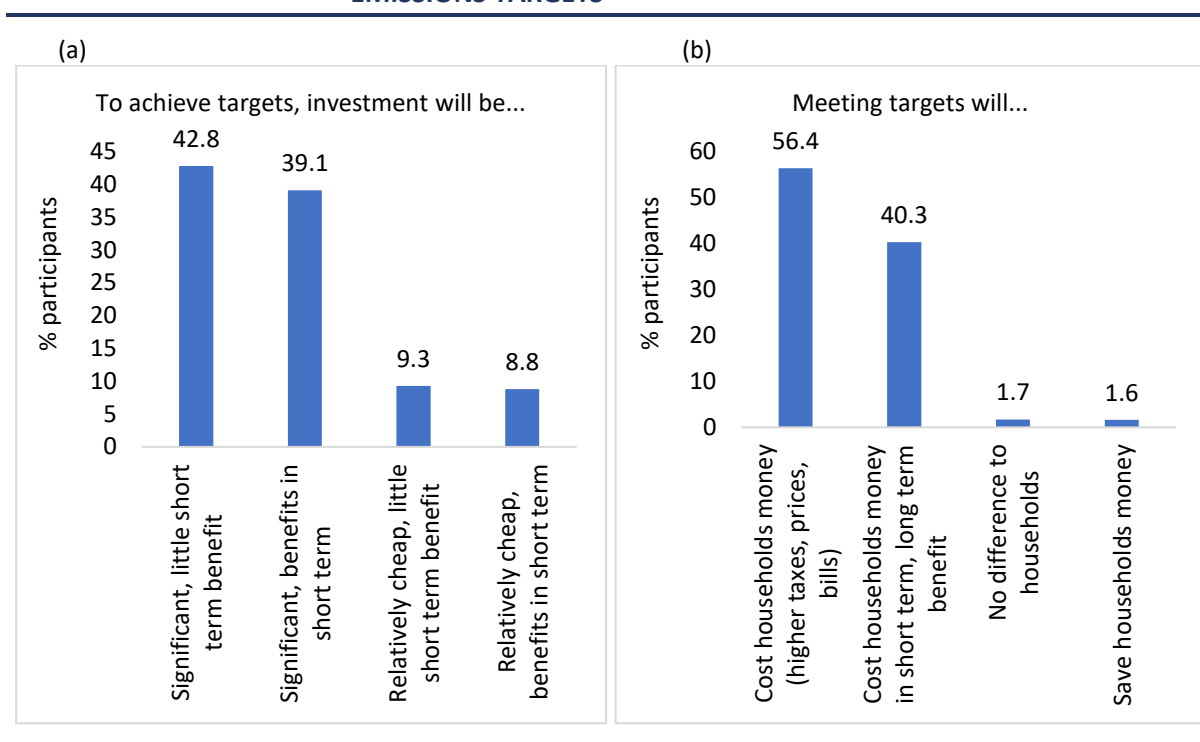
Source: Authors' analysis.

Note: Correct responses are outlined in black and noted on the right.

3.3 CARBON TAXATION AND POLICY

Participants reported that achieving emissions reduction targets will take substantial investment¹⁰ and is likely to cost households money (Figures 3.15a and 3.15b); few believed that investment can be done cheaply or that achieving targets will make no difference to household bills. However, there was disagreement about when the benefits of that investment are likely to be experienced. Almost as many participants predicted that the benefits will be experienced in the short term (39.1 per cent) as expected little short-term benefit (42.8 per cent).

FIGURES 3.15A AND 3.15B RESPONSES TO QUESTIONS ABOUT PERCEIVED COST OF MEETING EMISSIONS TARGETS

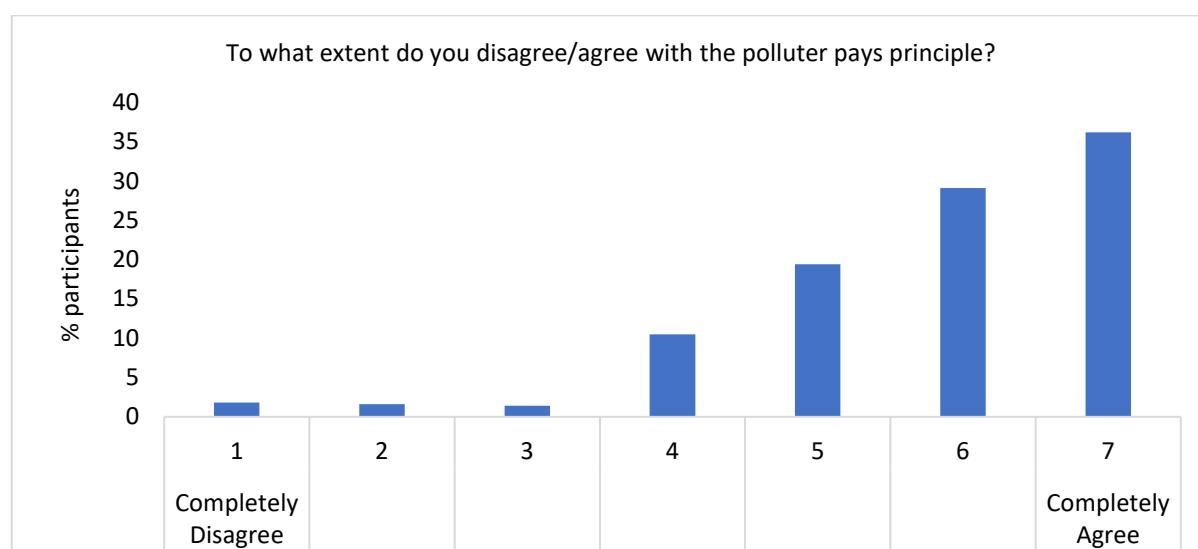


Source: Authors' analysis.

¹⁰ Response options were:

- Investment to achieve emissions targets will probably be significant (e.g. more than €10bn per year) and there may be little benefit for many years.
- Investment to achieve emissions targets will probably be significant (e.g. more than €10bn per year) but this will be balanced out by the benefits relatively soon.
- Investment to achieve emissions targets can be relatively cheap (e.g. less than €1bn) but there may be little benefit for many years.
- Investment to achieve emissions targets can be relatively cheap (e.g. less than €1bn) and this will be balanced out by the benefits relatively soon.

FIGURE 3.16 DISTRIBUTION OF RESPONSES TO THE RATING SCALE ABOUT THE ‘POLLUTER PAYS’ PRINCIPLE



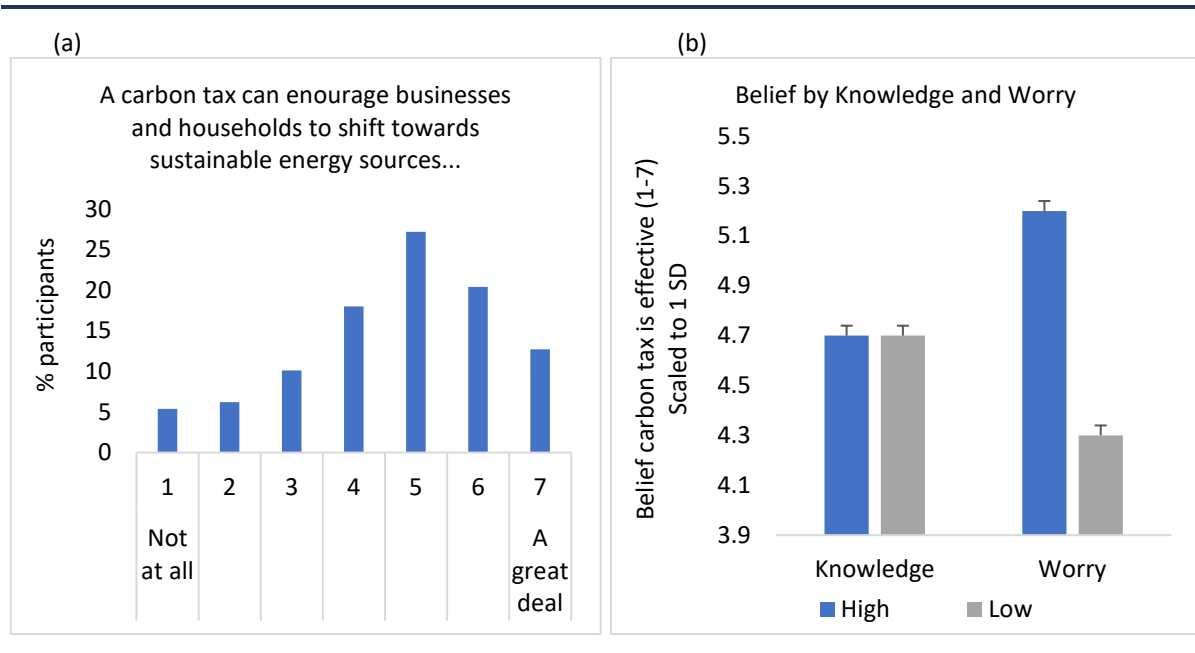
Source: Authors' analysis.

Most participants agreed with the 'polluter pays' principle, with almost 85 per cent of people giving a score above the midpoint of a scale from 1 'completely disagree' to 7 'completely agree' ($M = 5.8$, $SD = 1.3$; Figure 3.16). Those who scored above average on the quiz gave higher agreement ratings ($M = 5.9$ vs. 5.6 ; $t(998) = 3.52$, $p < .001$), implying a link between knowledge about climate change and policy support. Most people (85.7 per cent) could also identify the carbon tax as an application of the principle.¹¹

¹¹ The 'polluter pays' principle was explained to participants as stating that "those who pollute the environment should pay to cover the cost of the damage to human health or the environment." They were then asked to select examples of policies that follow the principle from the following list. We were interested solely in whether they identified carbon taxation as an application of the principle:

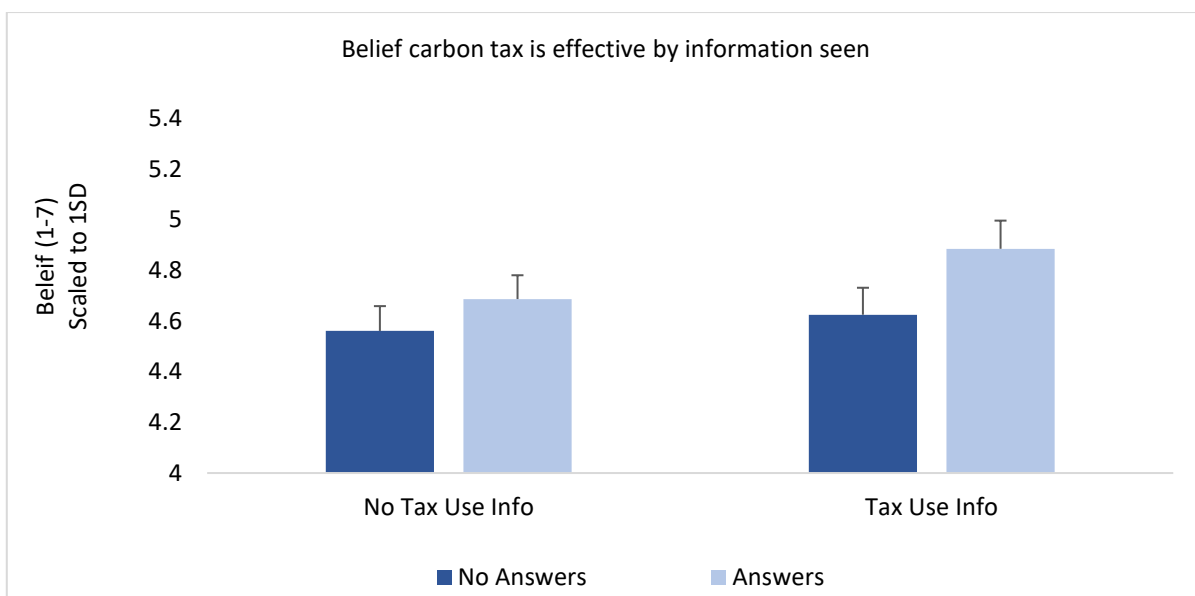
- 'Cap-and-trade' systems for emissions.
- Carbon tax (applied to fossil fuels incl. petrol/diesel).
- Emission standards that set maximum allowable discharge of emissions.
- Home retrofit grants to improve energy efficiency.
- Plastic bag levy.
- Subsidies for electric vehicles.

FIGURES 3.17A AND 3.17B DISTRIBUTION OF RESPONSES TO THE RATING SCALE ABOUT THE EFFECTIVENESS OF THE CARBON TAX AND AVERAGE SCORE BY KNOWLEDGE AND WORRY



Source: Authors' analysis.

FIGURE 3.18 AVERAGE BELIEF THAT THE CARBON TAX IS EFFECTIVE BY EXPERIMENTAL CONDITION



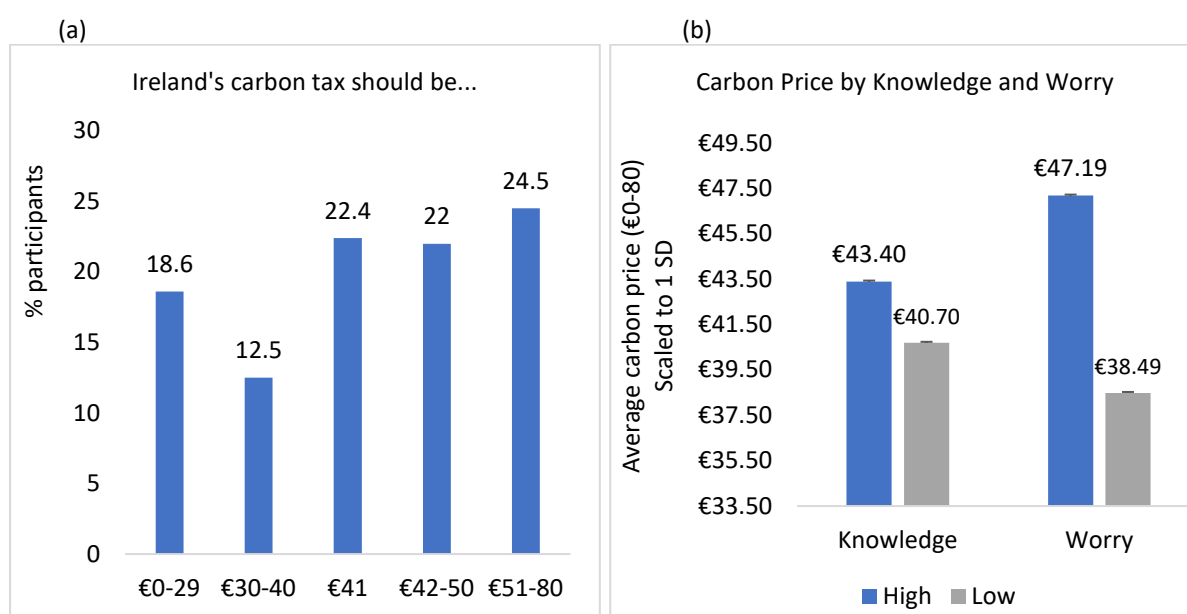
Source: Authors' analysis.

Note: Error bars are the standard error of the mean.

Opinions on whether carbon taxation can shift businesses and households towards sustainability, however, are somewhat divided, although a slight majority reported they believe it to be effective ($M = 4.7$, $SD = 1.6$; Figure 3.17a). Quiz score was not significantly related to belief in the carbon tax's efficacy. Worry was the strongest of all predictors ($p < .001$; Figure 3.17b). Almost half (47 per cent) of those highly worried about climate change reported believing the carbon tax is highly effective,

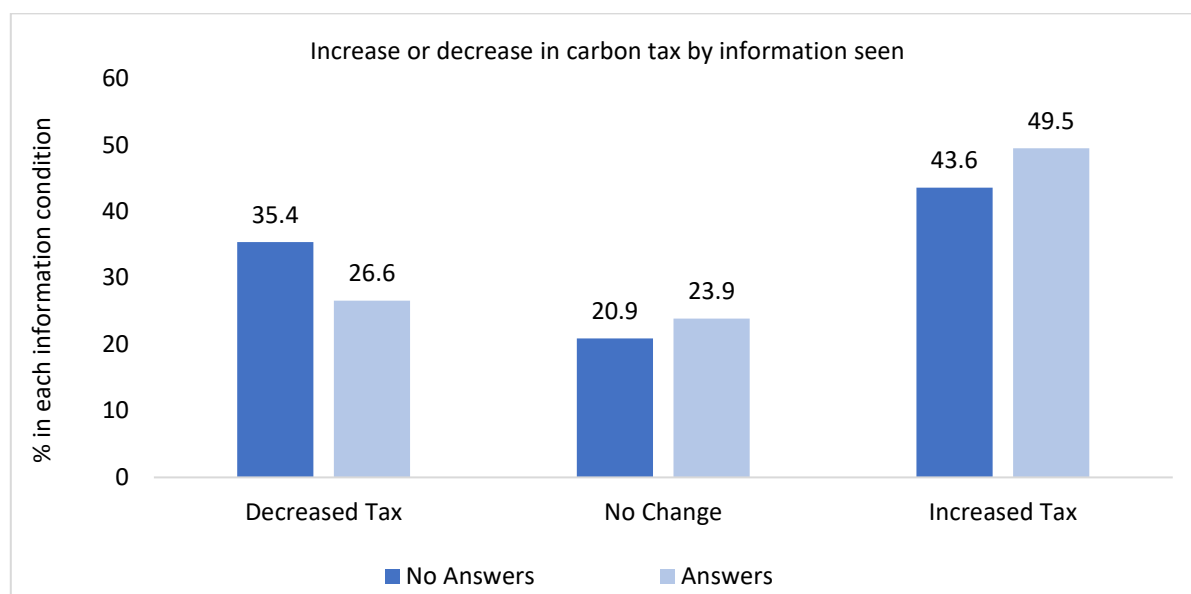
compared to less than a quarter (23.6 per cent) of those less worried. To test whether receiving answers to the quiz or reading about how the carbon tax is used affected this judgement, we modelled belief using an ordered logistic regression model (Appendix C). The effect of quiz answers was significant at the 10 per cent level ($p = .068$), with those who received the answers reporting that they more strongly believed the carbon tax can shift behaviour (Figure 3.18). To illustrate the size of this difference, 37 per cent of participants who read the answers to the quiz gave a 6 or 7 when asked about whether the carbon tax would be effective, compared to 29.4 per cent of those who did not see the answers. This represents a shift in opinion of one-in-four people, from reading the information provided in the quiz answers (which, importantly, did not reference carbon taxation). Despite most people (92.7 per cent) reporting that they were unaware of how the revenue from the carbon tax is used, reading about its use did not affect belief in its effectiveness (nor was there an interaction between reading about its use and receiving the answers to the quiz). The effect of receiving the quiz answers persisted when socio-demographic controls were added to the model and when controls were added for quiz performance and worry about climate change. Those aged over 60 believed carbon taxation is more effective than younger participants. Participants living outside of Leinster were more sceptical of its efficacy.

FIGURES 3.19A AND 3.19B RESPONSES TO THE QUESTION ABOUT CARBON TAX AND AVERAGE RESPONSE BY KNOWLEDGE AND WORRY



Source: Authors' analysis.

Note: Responses on Figure 3.19a are grouped from a slider response scale from €0-80.

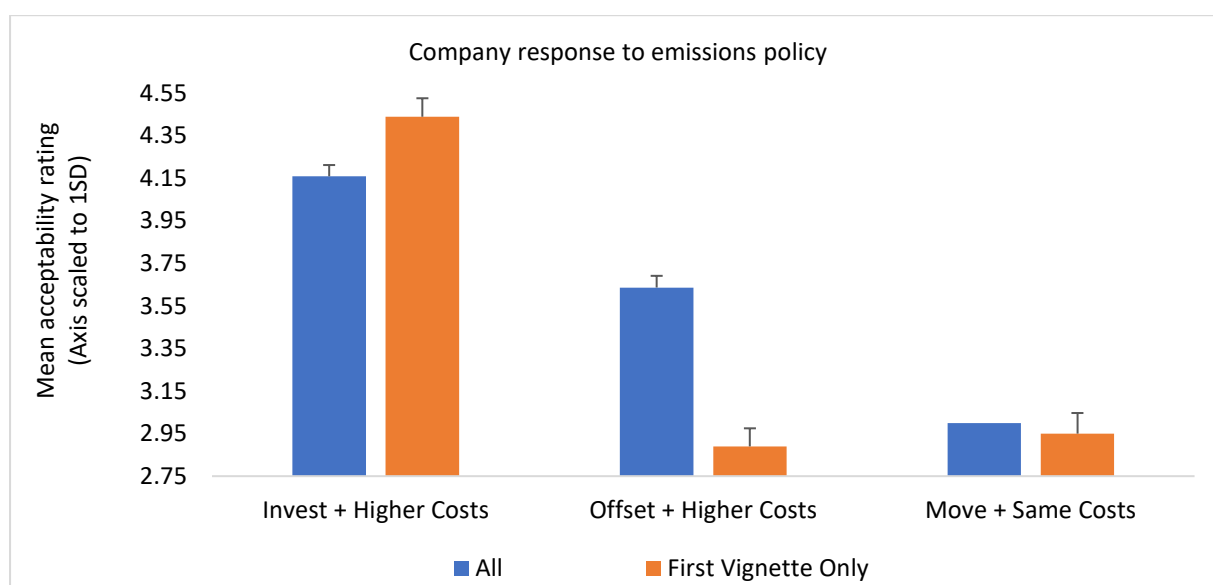
FIGURE 3.20 PERCENTAGE OF RESPONDENTS WHO CHANGED THE PRICE OF CARBON BY WHETHER QUIZ ANSWERS WERE SEEN

Source: Authors' analysis.

When asked about what they would set the price per tonne of carbon to, almost half of the sample (46.5 per cent) increased the tax from its current level and almost one-third (31.1 per cent) decreased it (Figure 3.19a; note that participants had been informed of the current level before answering). Again, worry was highly predictive of responses, while there was no significant relationship between knowledge and the proposed level of carbon tax (Figure 3.19b). However, statistical models showed again that receiving answers to the quiz had a significant effect on choices ($p = .010$; Appendix C). Those who saw the answers set the price of carbon to be higher on average than those who did not see the answers. Analysis of the distribution of responses shows that 35.4 per cent of those who did not see the answers decreased the rate of carbon tax compared to 26.6 per cent of those who received the answers (Figure 3.20). This represents a 25 per cent decrease in those who reduced the carbon tax rate, or a change in behaviour of one-in-four participants. In turn, more of those who saw the answers left the carbon tax rate the same (23.9 per cent vs. 20.9 per cent) or increased it (49.5 per cent vs. 43.6 per cent) than those who did not see the answers. There was no effect of reading about how the revenue is used ($p = .394$). The effect persisted when socio-demographic controls were added. There were few differences between socio-demographic groups, although those from higher socio-economic groups set a higher carbon tax than those in lower groups ($M_{AB} = €45.55$, $SD = 17.5$; $M_{C1C2} = €41.55$, $SD = 16.5$; $M_{DEF} = €38.55$, $SD = 16.4$). Exploratory analyses showed no interaction between seeing information and participant characteristics (including worry), implying the information had similar effects across subgroups.

At the end of the study, participants read vignettes about hypothetical companies responding to a change in policy to reduce emissions. Figure 3.21 shows the average acceptability judgements. Mixed effects ordinal logistic regression models predicting acceptability ratings to the vignettes are reported in Appendix C. Participants judged that the decision to move processes abroad in order to avoid emissions fines was less acceptable than purchasing offsets or investing in new processes, even though costs could be kept lower for customers by doing so. They also judged purchasing offsets to be less acceptable than investing in new processes. The order the participants read the vignettes, however, affected judgements. Looking only at the first vignette the participants read, investing in new processes was judged as more acceptable than moving processes abroad ($t(667) = 11.46, p < .001$) and purchasing offsets ($t(664) = 19.92, p < .001$) but there was no difference in judgements between moving processes abroad or purchasing offsets ($t(663) = 0.64, p = .526$).

FIGURE 3.21 AVERAGE ACCEPTABILITY JUDGEMENTS TO VIGNETTES ABOUT COMPANY RESPONSES TO EMISSIONS POLICY



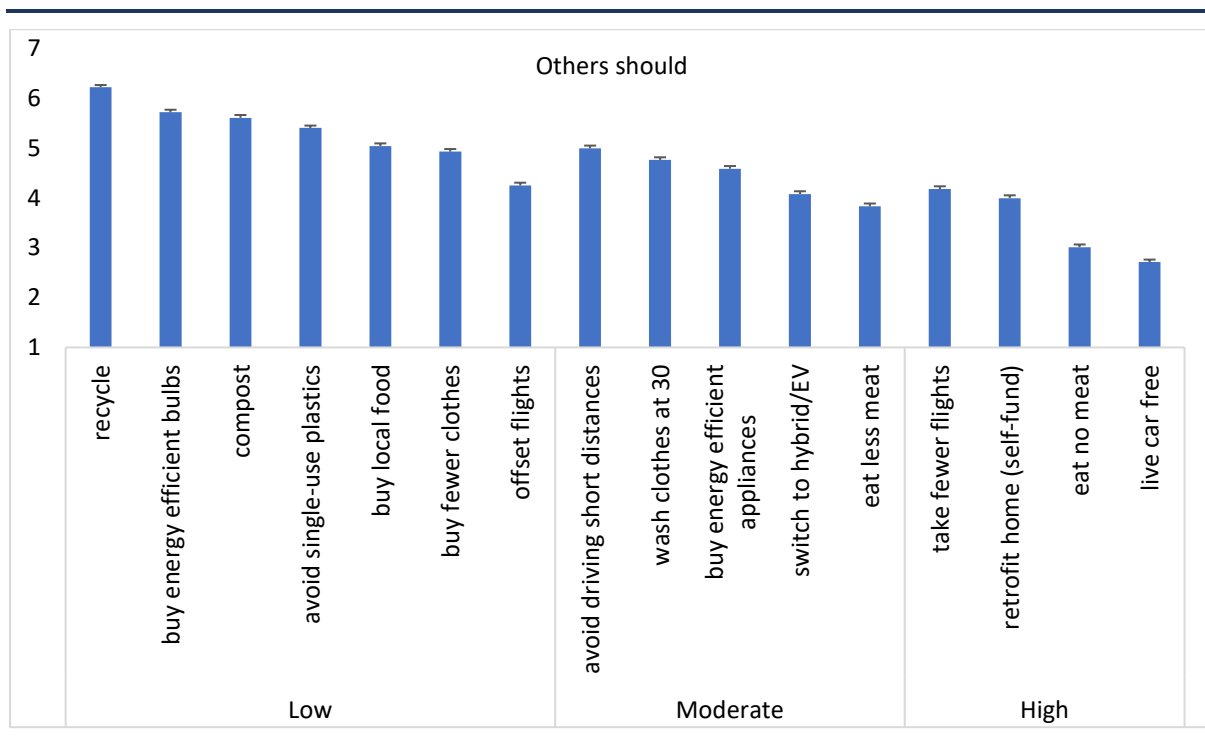
Source: Authors' analysis.

3.4 BEHAVIOURAL JUDGEMENTS AND INTENTIONS

After responding to the carbon taxation questions, participants were asked about the kinds of behaviours that are acceptable or unacceptable for others to engage in, considering the effort involved in making change and the impact people have on the environment. They rated environmentally harmful but low-impact actions, such as putting recyclable waste in the general waste bin, as more unacceptable for others to continue doing than harmful, high-impact ones, such continuing to drive a car or continuing to eat meat (Figure 3.22). Those who scored higher on the quiz judged environmental harm to be more unacceptable, although again worry

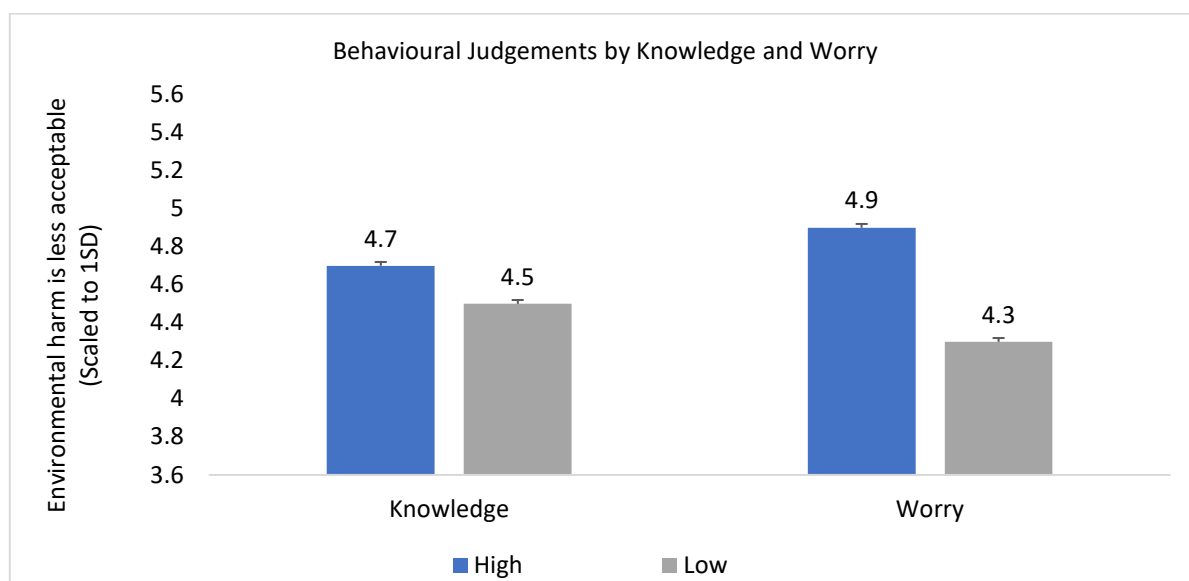
was a stronger predictor (Figure 3.23). To assess the effect of reading the quiz answers on these judgements, we first standardised participant ratings for each behaviour and then categorised the standardised judgements as Completely Acceptable, Acceptable, Unacceptable, Completely Unacceptable. We ran a mixed-effects ordinal logit on these judgements, with random effects at the participant level and cluster-robust standard errors (Appendix D). Results show that participants indeed judged lower-impact, environmentally harmful behaviours as more unacceptable than moderate- and high-impact ones ($ps < .001$). However, those who saw the quiz answers more strongly differentiated between the environmental impact of behaviours. They judged environmentally harmful, lower-impact actions as more acceptable ($p = .045$) than those who did not see the answers and they rated moderate- and high-impact behaviours as more unacceptable ($p < .001$, $p = .022$, respectively). Effects were small, however, at approximately 5 per cent of a standard deviation (Figure 3.24).

FIGURE 3.22 AVERAGE JUDGEMENTS THAT IT IS UNACCEPTABLE FOR OTHERS NOT TO ENGAGE IN MITIGATION BEHAVIOURS



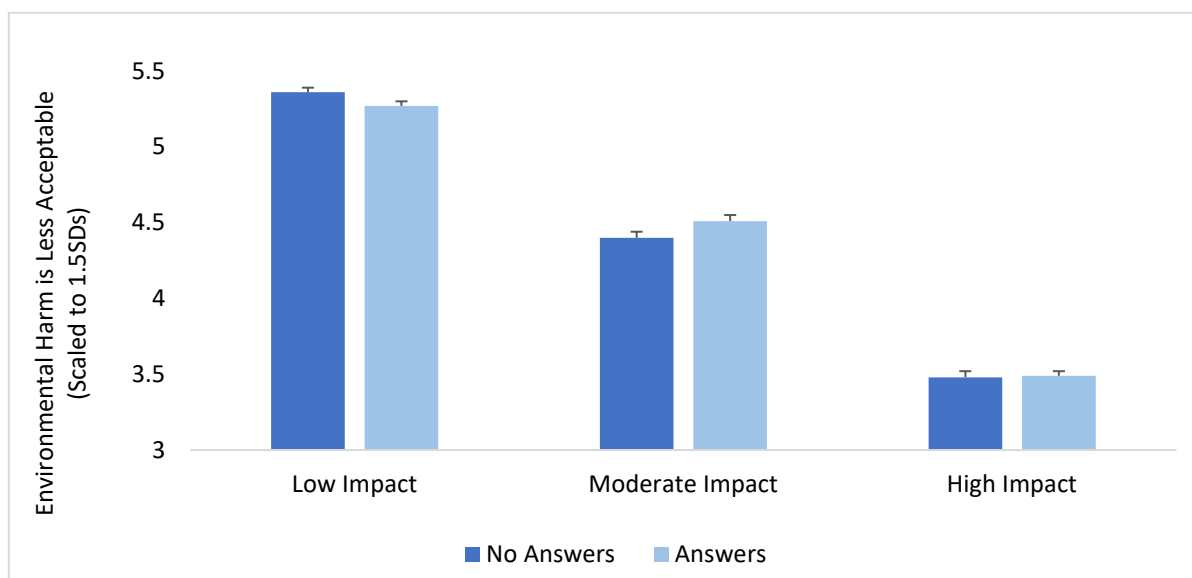
Source: Authors' analysis.

Note: Error bars are the standard error of the mean. The scale ranged from 1 to 7.

FIGURE 3.23 BEHAVIOURAL JUDGMENTS BY KNOWLEDGE AND WORRY

Source: Authors' analysis.

Note: Error bars are the standard error of the mean.

FIGURE 3.24 AVERAGE JUDGEMENTS THAT IT IS UNACCEPTABLE FOR OTHERS NOT TO ENGAGE IN MITIGATION BEHAVIOURS BY IMPACT AND WHETHER QUIZ ANSWERS WERE SEEN

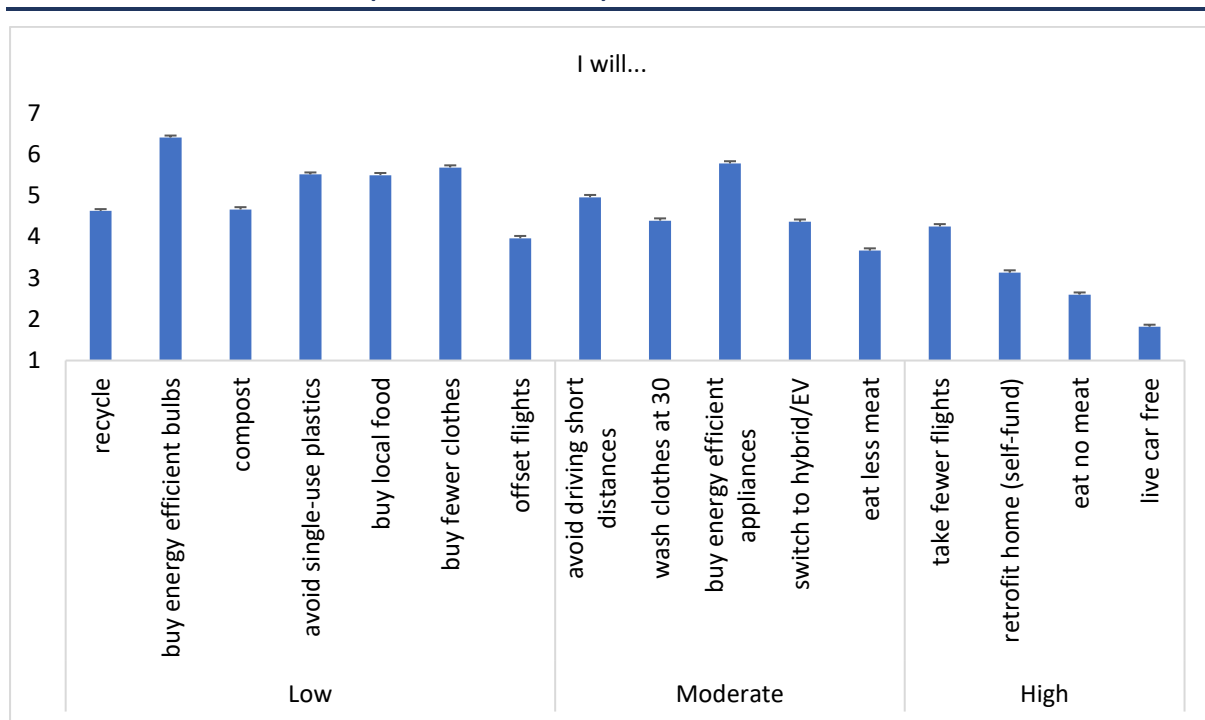
Source: Authors' analysis.

Note: Error bars are the standard error of the mean.

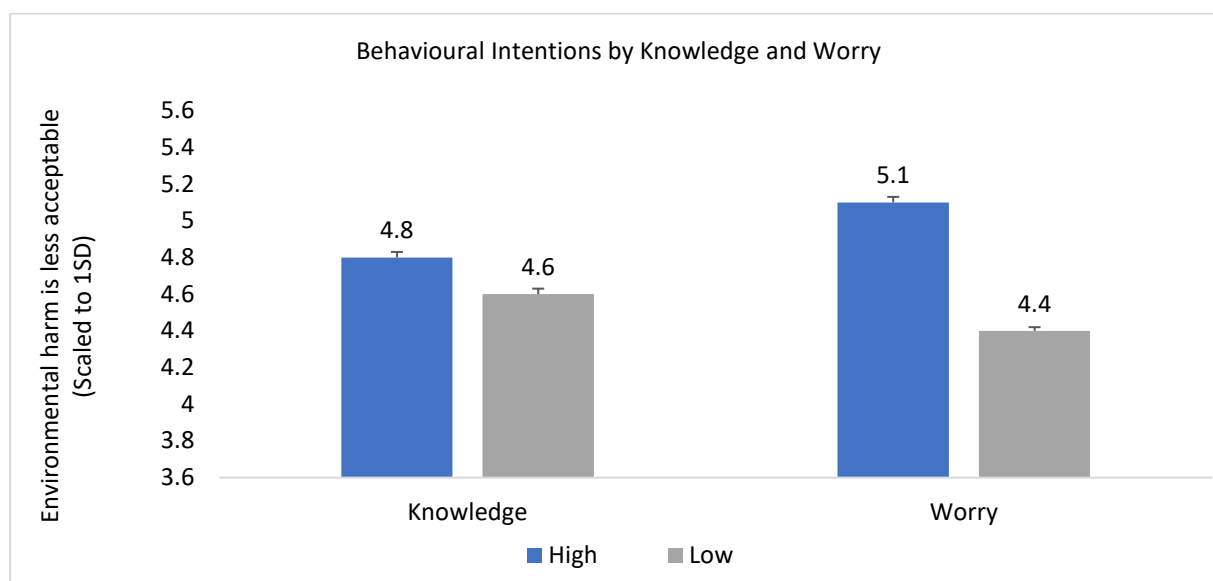
Participants were also asked about their own likelihood of engaging with different environmentally friendly behaviours in the future (Figure 3.25). These behaviours were matched to the questions about the behaviour of others (e.g. instead of judging whether it is acceptable for others to continue to eat meat, they were asked their own likelihood of no longer eating meat in the future). The questions were tailored to the participant (e.g. vegetarian participants were not asked about reducing their meat intake). Participants who scored more highly on the quiz were

not more likely to report intentions to act in environmentally friendly ways in the future, but again worry was a strong predictor of responses (Figure 3.26). The same analytic approach as before showed that participants were less willing to engage in higher-impact behaviours than lower impact ones, but there was an interaction between impact and having seen the quiz answers. Compared to those who did not see the answers, participants who did were marginally more willing to engage in moderate-impact behaviours ($p = .089$) and significantly more willing to engage in high-impact ones ($p = .042$), although effects are again small at approximately 6 per cent of a standard deviation (Figure 3.27). There was no difference in their willingness to engage in low impact behaviours.

FIGURE 3.25 AVERAGE INTENTIONS FOR THE FUTURE FOR ENVIRONMENTALLY FRIENDLY BEHAVIOURS (WHERE RELEVANT)

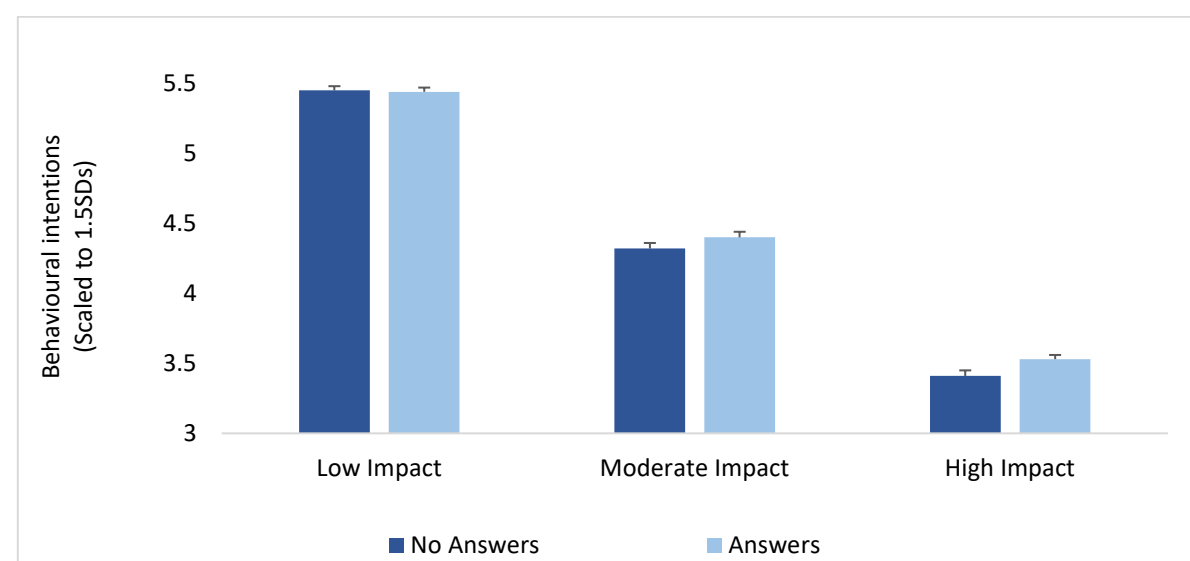


Source: Authors' analysis.
Note: Error bars are the standard error of the mean. Respondents were only asked this question if they reported they did not already engage in the behaviour (e.g. if they reported they already wash clothes at 30° they were not asked whether they would do this in the future).

FIGURE 3.26 BEHAVIOURAL INTENTIONS BY KNOWLEDGE AND WORRY

Source: Authors' analysis.

Note: Error bars are the standard error of the mean.

FIGURE 3.27 AVERAGE INTENTIONS FOR THE FUTURE FOR ENVIRONMENTALLY FRIENDLY BEHAVIOURS (WHERE RELEVANT) BY IMPACT AND WHETHER QUIZ ANSWERS WERE SEEN

Source: Authors' analysis.

Note: Error bars are the standard error of the mean.

The effect of the quiz answers on judgements and intentions persisted when socio-demographic controls were added to the models. Age and gender were related to both types of responses, with older participants and women judging environmentally harmful actions as more unacceptable. People aged over 60 and women were also more likely to report intentions to act in environmentally friendly ways in the future.

The final measure assessed real behaviour. Almost half (49.4 per cent) of the sample opted to donate €2 of their payment to a carbon offset charity. Worry and score on the quiz were both positive predictors of donation, with worry again showing stronger predictive power. Those who scored highly on the quiz were more likely to donate than those who did less well (56.1 per cent vs. 44.1 per cent) and 60.8 per cent of those classified as highly worried donated, compared to 41.6 per cent of those less worried. There was no evidence that those who saw answers to the quiz were more likely to donate than those who did not, $\chi^2(1, N = 1,000) = 1.17, p = .278$, and there was no change when socio-demographic controls were added to a logit model predicting donation (Appendix D). There were some socio-demographic differences. Fewer men donated than women (45.2 per cent vs. 53.8 per cent) and more of those aged over 60 donated than those in younger age groups (59.5 per cent vs. 44.4 per cent of 30-59 year olds and 44.2 per cent of under 30s).

CHAPTER 4

Discussion and conclusion

The results show good understanding of some fundamentals of climate change among the public, but there is considerable scope for improving comprehension. In particular, the public struggle with *relative* influences, such as sectoral contributions to emissions and the relative impact of various mitigative behaviours. In this section, we highlight specific instances where misperceptions can be addressed, as highlighted by our quiz. Most importantly, we highlight the implications of improving people's scientific understanding for supporting change, as demonstrated by our main experimental test of providing participants with the climate quiz answers.

4.1 UNDERSTANDING OF CLIMATE CHANGE IN IRELAND

Our findings demonstrate that climate scepticism is not a substantial issue in Ireland. Almost 90 per cent of Irish adults accept that human activity is causing the Earth's atmosphere to warm (compared to 72 per cent of UK adults and 57 per cent in the US; Marlon et al., 2020; YouGov, 2021). A similar proportion recognise carbon dioxide as a greenhouse gas. A large majority also identify fossil fuel heat sources, petrol and diesel vehicles and agricultural livestock as sources of greenhouse gas emissions. There is less awareness, however, that other agricultural practices, waste decomposing in landfills and hybrid vehicles emit greenhouse gases. For example, approximately two-thirds of people are not aware that disturbing soil (e.g. by cutting down trees and tilling) releases carbon, implying potential scope for public education on carbon sinks (e.g. Pendrill et al., 2019; West and Marland, 2002). Perhaps related to these misperceptions of agricultural practices, almost one-in-three adults are not aware that the agricultural sector is one of the main contributors of greenhouse gases in Ireland (Environmental Protection Agency, 2021).

Most people are aware of the effects of climate change. A large majority (ranging from 84-94 per cent) recognise effects on biodiversity, ice caps, extreme weather and ocean warming, and most are aware that many effects (e.g. melting ice caps) are occurring at an accelerated rate. Fewer, however, recognise 'climate feedback loops' (Lawrence et al., 2020). Almost half cannot correctly identify a real feedback loop when presented with a list of options. Approximately one-in-three are not aware that climate change has implications for the spread of infectious diseases (Lindgren et al., 2012).

Understanding of the individual actions that can be taken to address climate change is substantially poorer, with many people overestimating the benefits of low-impact actions and underestimating the benefits of high-impact ones.

Reducing meat intake is one of the most effective ways for an individual to reduce their carbon footprint (e.g. Wynes and Nicholas, 2017), however the proportion who identified eating a plant-based diet as high-impact was at chance level; almost one-in-three people believe it has a low impact. Three-quarters of people overestimate the impact of buying local food, which is considerably less beneficial than reducing meat intake (Ritchie and Roser, 2021). In place of high-impact actions, there is a tendency to focus on waste-generating activities. While these are important, people tend to overestimate the relative impact of not littering, recycling, using re-usable shopping bags and purchasing unpackaged food. Note that each of these actions benefit the environment but have limited impact on climate change.

4.2 SUPPORT FOR CHANGE

Moving away from individual behaviour, the public anticipate that achieving emissions targets will entail high costs. Over 80 per cent believe that significant investment will be required and almost everyone (97 per cent) believes that meeting emissions targets will cost households money. The public is divided, however, over when they expect the benefits of investment: 48 per cent expect benefits relatively soon while 52 per cent expect few short-term benefits.¹² (Note that these questions did not make up part of the quiz, since the correct response is not certain.) Acceptance of the costs of climate mitigation was also observed in the responses to the vignettes about hypothetical company responses to emissions policy: people judge investing in new industrial processes to reduce emissions to be more acceptable than moving production to jurisdictions with more relaxed policy, even if it results in higher costs for consumers in Ireland.

Perceptions of the carbon tax are also somewhat divided, although less so now than in 2016, when the European Social Survey found that over half of the public were against any increase on fossil fuel taxes (European Social Survey, 2016). Over 60 per cent of people believe it is an effective way to encourage businesses and households to shift towards sustainable energy sources and almost half of the public (47 per cent) would increase it from the level set in Budget 2022. One-in-four would increase it by at least €10 per tonne and some (4 per cent) increased the tax to the maximum end of the scale. However, over 20 per cent of people believe carbon taxation to be ineffective and almost one-in-three believe it should be decreased (although only 5 per cent set it below €10).

¹² This difference may be related to the idea that many people perceive climate change as a problem with high 'psychological distance' (i.e. affecting other people, such as those in other countries or future generations) (Spence et al., 2012; Loy and Spence, 2020). An interesting avenue for future research would be to explore the differences in the psychological distance of climate action.

Importantly, opinions on carbon taxation are related to how much people know about climate change. In this study, engagement with scientific information about climate change increased belief in the effectiveness of a carbon tax, even though the information was not directly related to carbon taxation. In fact, specific information about how revenue is hypothecated and used had no effect on perceptions (cf. Amdur et al., 2014; Bachus et al., 2019; Bristow et al., 2010; Douenne and Fabre, 2020; Nowlin et al., 2020). We cannot be sure of why this information had no effect in Ireland. It may have aligned with people's expectations for how the revenue would be used, may have been perceived as complex (given the spread across multiple schemes), or may not have led participants to trust that benefits would arise from the expenditure. Further research is needed to explore reasons for this finding.

The effect of the quiz answers was not small: scientific information on the causes, effects and ways to tackle climate change resulted in 25 per cent more people believing carbon taxation to be a highly effective way of motivating behavioural change. Similarly, seeing the answers led to a 25 per cent decrease in the number of people who believed that the price per tonne of carbon should be reduced. Identifying which pieces of information had the strongest influence on carbon tax opinion will require further research, but can plausibly be linked to the questions with poorest performance (e.g. the relative environmental impact of various individual actions). Alternatively, the effects may be the result of simply engaging with the information, such as confirming a guess or learning the correct answer after giving an incorrect one. Moreover, it is worth noting that there may be important information about climate change that would matter for the public's opinion but was not included in our quiz.

The results suggest, however, that giving people good scientific information about climate change has a much stronger effect on support for mitigation policies than on individual behaviour. While our statistical models showed that information on climate change increased willingness to engage with moderate- and high-impact behaviours, the effects were small. It could be argued that even small shifts in intentions in the right direction are helpful but, given the already tenuous links between self-reported intentions and behaviour, such small changes in intentions are unlikely to translate into the kind of behaviour change required.¹³ Moreover, there was no effect of information on the measure of real behaviour we employed (i.e. carbon offset donations).

¹³ Note that this interpretation pertains only to the information provided in our study; other information on the climate may have larger effects on intentions and behaviour.

4.3 SOCIO-DEMOGRAPHIC DIFFERENCES

In addition, we recorded specific socio-demographic differences in responses that are worth highlighting. The results show that climate change is a greater concern for higher socio-economic status groups; they are more likely to spontaneously think of climate change as an issue, select it as the main problem facing Ireland, are more worried about it, and more supportive of the carbon tax, even controlling for educational attainment (cf. Thalmann, 2004). Efforts beyond improving public information on climate science will be required to address the concerns of lower socio-economic groups. There were also consistent effects of gender and age. Women are more worried about climate change, intend to do more to address it and are more likely to donate money to offset their carbon emissions, although men did better on the quiz (similar to research in other countries, e.g. Douenne and Fabre, 2020). Gender-based differences are potentially important, given that men are twice as likely to hold senior policymaker positions (controlling for age, education and length of service; Russell et al., 2017). Moreover, despite the narrative that climate change is an issue championed by the young, older people are more likely to support carbon taxation, have stronger intentions to act in environmentally friendly ways and are more likely to donate to offset their emissions (cf. O' Connor et al., 2019). (Note, however, that we did not measure civic engagement – such as protests – and some unreported, exploratory analyses suggested that age differences may be larger for lower-impact actions than higher-impact ones.)

4.4 CLIMATE CONCERN

Overall, worry was the strongest correlate we recorded of support for carbon taxation, intentions to act pro-environmentally in the future and donations of money to a carbon offset charity (e.g. Bouman et al., 2020; van der Linden, 2015). The public do seem concerned about climate change (see also Leiserowitz et al., 2021). It was the third most cited concern before being prompted to think about the environment. Almost 70 per cent of people report being highly worried about it when asked directly. One-in-eight Irish adults view climate change as the most important issue facing the country, higher than the number who judge the economy to be the most important issue. However, concern is dwarfed by concerns about housing and healthcare. The results also show that 63 per cent of people do not think of climate change when asked about the main issues facing people in Ireland¹⁴ and almost one-in-three report that they are not very worried about it.

¹⁴ Note that question wording may have played a role in the proportion who listed climate change in the open text question, as most people (88.3 per cent) believe climate change will have similar or worse effects on other countries. Research by the European Commission (2021) shows that 31 per cent of Irish people view climate change as the most important issue facing the world.

4.5 CONCLUSION

Hence, while concern about the climate has been absorbed by much of the public, to a large minority the issue remains peripheral. Knowledge of the basics of climate change (such as its causes and effects) is good, but there is scope for improving in other areas (e.g. the relative influence of different sectors, in particular agriculture, and the relative impact of various environment behaviours on emissions). The good news is that a substantial proportion of the public do not display motivated reasoning about climate mitigation and are willing to change their mind; a simple quiz intervention shifted the opinion of one-in-four of those who otherwise would have sought to decrease the current level of carbon tax. Hence, providing good information on climate change to the public has the potential to generate support for policies that experts agree are likely to be effective. However, effects of information are limited. Further experimental tests that examine the interplay between psychological factors and proposed economic policy will be essential to identify effective ways to address concerns and motivate change.

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APPENDIX A

Table A.1 presents the sample characteristics, with the national breakdown according to 2016 Census data from the Central Statistics Office for comparison.

TABLE A.1 SAMPLE CHARACTERISTICS

| | | <i>n</i> | % | CSO % |
|--------------------|--------------------------------|----------|--------|--------|
| Gender | Men | 509 | 50.9 | 49.6 |
| | Women | 489 | 48.9 | 50.4 |
| | Prefer Not To Say/Other | 2 | 0.2 | |
| Age | 18 – 39 years | 328 | 32.8 | 38.3 |
| | 40 – 59 years | 336 | 33.6 | 36.3 |
| | 60 years + | 336 | 33.6 | 25.4 |
| Education | Degree or above | 407 | 40.7 | 42.0 |
| | Below degree | 593 | 59.3 | 58.0 |
| Employment | In Labour Force | 612 | 61.2 | 62.3 |
| | (Of which, Employed) | (578) | (90.6) | (92.1) |
| | (Of which, Unemployed) | (34) | (9.4) | (7.9) |
| | Not in Labour Force | 388 | 38.8 | 37.7 |
| Living Area | Urban | 651 | 65.1 | 60.8 |
| | Rural | 349 | 34.9 | 39.1 |
| Nationality | Irish | 909 | 90.9 | 88.4 |
| | Non-Irish | 91 | 9.1 | 11.6 |

Source: Authors' analysis.

Note: For responses to our measure of Living Area, participants self-reported whether they consider themselves to live in a rural or urban area, whereas the CSO figures are calculated based on Census data and definitions. The estimates for Employment are from the CSO's COVID-adjusted estimates from October 2021.

APPENDIX B

TABLE B.1 SOCIO-DEMOGRAPHIC PREDICTORS OF CLIMATE CONCERN

| | Climate Change Open Text) | Climate Change (Selected) | Worry |
|---------------------------------------|------------------------------|------------------------------|------------------------------|
| Male (Ref: Female) | -0.14 (0.14) | -0.01 (0.20) | -0.40** (0.12) |
| Age (Ref: u40 years) | | | |
| 40 – 59 years | 0.25 (0.19) | 0.50 [†] (0.28) | 0.12 (0.16) |
| 60+ years | 0.08 (0.26) | -0.27 (0.41) | 0.18 (0.22) |
| Region (Ref: Dublin) | | | |
| Rest of Leinster | 0.28 (0.19) | 0.06 (0.29) | 0.14 (0.16) |
| Munster | 0.24 (0.19) | 0.30 (0.28) | -0.05 (0.16) |
| Connacht/Ulster | 0.19 (0.23) | 0.43 (0.32) | 0.14 (0.19) |
| Urban (Ref: Rural) | -0.02 (0.16) | -0.03 (0.23) | 0.07 (0.13) |
| Degree (Ref: No degree) | 0.27 [†] (0.15) | 0.38 [†] (0.22) | 0.20 (0.13) |
| Socio-economic grade (Ref: AB) | | | |
| C1C2 | -0.38* (0.17) | -0.53* (0.23) | -0.22 (0.14) |
| DEF | -0.60** (0.21) | -0.66* (0.31) | -0.38* (0.18) |
| Employment (Ref: Unemployed) | | | |
| Retired | 0.25 (0.28) | 0.98* (0.42) | 0.27 (0.24) |
| Working | 0.21 (0.19) | 0.11 (0.30) | 0.17 (0.16) |
| Homeowner (Ref: Renter) | -0.19 (0.18) | 0.00 (0.27) | 0.06 (0.15) |
| Child u18 (Ref: No child u18) | -0.44** (0.17) | -0.50 [†] (0.26) | -0.24 [†] (0.14) |
| Irish (Ref: Non-Irish) | 0.10 (0.24) | -0.26 (0.33) | -0.32 (0.21) |
| Participants | 1,000 | 1,000 | 1,000 |

Source: Authors' analysis.

Note: [†]p < .10, *p < .05, **p < .01, ***p < .001. Standard errors are reported in parentheses.

TABLE B.2 OLS MODEL OF STANDARDISED QUIZ SCORES

| | 1 |
|---------------------------------------|--------------------|
| Male (Ref: Female) | 0.29*** (0.06) |
| Age (Ref: u40 years) | |
| 40 – 59 years | 0.13 (0.08) |
| 60+ years | 0.04 (0.12) |
| Region (Ref: Dublin) | |
| Rest of Leinster | -0.06 (0.09) |
| Munster | 0.07 (0.08) |
| Connacht/Ulster | -0.04 (0.10) |
| Urban (Ref: Rural) | -0.02 (0.07) |
| Degree (Ref: No degree) | 0.37*** (0.07) |
| Socio-economic grade (Ref: AB) | |
| C1C2 | -0.05 (0.07) |
| DEF | -0.34*** (0.09) |
| Employment (Ref: Unemployed) | |
| Retired | 0.04 (0.12) |
| Working | -0.03 (0.08) |
| Homeowner (Ref: Renter) | 0.00 (0.08) |
| Child u18 (Ref: No child u18) | -0.05 (0.07) |
| Irish (Ref: Non-Irish) | 0.29** (0.11) |
| Worry | 0.15*** (0.02) |
| Participants | 1,000 |

Source: Authors' analysis.

Note: †p < .10, *p < .05, **p < .01, ***p < .001. Standard errors are reported in parentheses.

APPENDIX C

TABLE C.1 ORDINAL LOGISTIC REGRESSION MODELS PREDICTING BELIEF IN THE EFFECTIVENESS OF CARBON TAXATION

| | 1 | 2 | 3 |
|---|-----------------|------------------|-------------------|
| Answers Seen (Ref: No Answers) | 0.21† (0.11) | 0.20 (0.11) | 0.21† (0.11) |
| Revenue Use Info. (Ref: No info) | 0.09 (0.11) | 0.09 (0.11) | -0.07 (0.12) |
| Male (Ref: Female) | | -0.14 (0.12) | 0.09 (0.12) |
| Age (Ref: u40 years) | | | |
| 40 – 59 years | | 0.15 (0.16) | 0.21 (0.16) |
| 60+ years | | 0.37† (0.22) | 0.45* (0.22) |
| Region (Ref: Dublin) | | | |
| Rest of Leinster | | -0.17 (0.16) | -0.25 (0.16) |
| Munster | | -0.39* (0.16) | -0.38* (0.16) |
| Connacht/Ulster | | -0.44* (0.10) | -0.50** (0.19) |
| Urban (Ref: Rural) | | 0.12 (0.13) | 0.14 (0.13) |
| Degree (Ref: No degree) | | -0.15 (0.13) | -0.15 (0.13) |
| Socio-economic grade (Ref: AB) | | | |
| C1C2 | | -0.25† (0.14) | -0.24† (0.14) |
| DEF | | -0.32† (0.18) | -0.16 (0.18) |
| Employment (Ref: Unemployed) | | | |
| Retired | | 0.37 (0.23) | 0.42† (0.23) |
| Working | | 0.18 (0.16) | 0.27† (0.16) |
| Homeowner (Ref: Renter) | | -0.19 (0.15) | -0.29† (0.15) |
| Child u18 (Ref: No child u18) | | 0.06 (0.14) | 0.13 (0.14) |
| Irish (Ref: Non-Irish) | | -0.25 (0.20) | -0.10 (0.20) |
| Worry | | | 0.50*** (0.04) |
| Quiz Score | | | -0.03 (0.02) |
| Participants | 1,000 | 1,000 | 1,000 |

Source: Authors' analysis.

Note: †p < .10, *p < .05, **p < .01, ***p < .001. Standard errors are reported in parentheses.

TABLE C.2 ORDINAL LOGISTIC REGRESSION MODELS PREDICTING CARBON TAX SETTING

| | 1 | 2 | 3 |
|---|-----------------|-------------------|-------------------|
| Answers Seen (Ref: No Answers) | 0.29* (0.11) | 0.28* (0.11) | 0.30** (0.12) |
| Revenue Use Info. (Ref: No info) | 0.10 (0.11) | 0.12 (0.11) | -0.02 (0.12) |
| Male (Ref: Female) | | -0.04 (0.11) | -0.14 (0.12) |
| Age (Ref: u40 years) | | | |
| 40 – 59 years | | 0.02 (0.16) | 0.04 (0.16) |
| 60+ years | | 0.19 (0.22) | 0.16 (0.23) |
| Region (Ref: Dublin) | | | |
| Rest of Leinster | | -0.14 (0.16) | -0.20 (0.17) |
| Munster | | -0.24 (0.16) | -0.25 (0.16) |
| Connacht/Ulster | | -0.22 (0.19) | -0.26 (0.20) |
| Urban (Ref: Rural) | | -0.01 (0.13) | -0.03 (0.14) |
| Degree (Ref: No degree) | | 0.27* (0.13) | 0.24† (0.13) |
| Socio-economic grade (Ref: AB) | | | |
| C1C2 | | -0.33* (0.14) | -0.29* (0.14) |
| DEF | | -0.32** (0.18) | -0.45* (0.18) |
| Employment (Ref: Unemployed) | | | |
| Retired | | 0.16 (0.23) | 0.20 (0.24) |
| Working | | 0.10 (0.16) | 0.13 (0.16) |
| Homeowner (Ref: Renter) | | 0.01 (0.15) | -0.03 (0.15) |
| Child u18 (Ref: No child u18) | | -0.18 (0.14) | -0.11 (0.14) |
| Irish (Ref: Non-Irish) | | -0.45* (0.20) | -0.40† (0.21) |
| Worry | | | 0.41*** (0.04) |
| Quiz Score | | | -0.01 (0.03) |
| Participants | 1,000 | 1,000 | 1,000 |

Source: Authors' analysis.

Note: †p < .10, *p < .05, **p < .01, ***p < .001. Standard errors are reported in parentheses.

TABLE C.3 MIXED EFFECTS ORDINAL LOGISTIC REGRESSION MODELS PREDICTING VIGNETTES RESPONSES

| | 1 | 2 | 3 |
|---------------------------------------|--------------------|--------------------|--------------------|
| Vignettes (Ref: Invest) | | | |
| Move | -1.37*** (0.11) | -1.36*** (0.11) | -1.37*** (0.11) |
| Offset | -0.65*** (0.07) | -0.65*** (0.07) | -0.65*** (0.07) |
| Order (Ref: First) | | | |
| Second | 0.19* (0.09) | 0.19* (0.09) | 0.19* (0.09) |
| Third | 0.37*** (0.09) | 0.37*** (0.09) | 0.37*** (0.09) |
| Answers Seen (Ref: No Answers) | | 0.14 (0.08) | 0.12 (0.08) |
| Male (Ref: Female) | | 0.16† (0.09) | 0.22** (0.09) |
| Age (Ref: u40 years) | | | |
| 40 – 59 years | | -0.46*** (0.12) | -0.44*** (0.12) |
| 60+ years | | -0.38* (0.16) | -0.38* (0.16) |
| Region (Ref: Dublin) | | | |
| Rest of Leinster | | -0.02 (0.12) | -0.03 (0.12) |
| Munster | | 0.16 (0.12) | 0.17 (0.12) |
| Connacht/Ulster | | -0.01 (0.14) | -0.02 (0.14) |
| Urban (Ref: Rural) | | -0.06 (0.10) | -0.06 (0.10) |
| Degree (Ref: No degree) | | 0.00 (0.10) | 0.05 (0.10) |
| Socio-economic grade (Ref: AB) | | | |
| C1C2 | | -0.13 (0.11) | -0.13 (0.11) |
| DEF | | -0.11 (0.13) | -0.15 (0.13) |
| Employment (Ref: Unemployed) | | | |
| Retired | | 0.40* (0.17) | 0.40* (0.17) |
| Working | | 0.27* (0.12) | 0.26* (0.11) |

Contd.

TABLE C.3 CONTD.

| | 1 | 2 | 3 |
|--------------------------------------|-------|-----------------------------|-----------------------------|
| Homeowner (Ref: Renter) | | 0.22 [†] (0.11) | 0.22 [†] (0.11) |
| Child u18 (Ref: No child u18) | | 0.07 (0.10) | 0.07 (0.10) |
| Irish (Ref: Non-Irish) | | -0.34* (0.13) | -0.28* (0.13) |
| Worry | | | 0.08** (0.03) |
| Quiz Score | | | -0.06*** (0.02) |
| Participants | 1,000 | 1,000 | 1,000 |

Source: Authors' analysis.

Note: [†]p < .10, *p < .05, **p < .01, ***p < .001. Standard errors are reported in parentheses. Models contain participant random effects and cluster-robust standard errors.

APPENDIX D

TABLE D.1 MIXED EFFECTS ORDINAL LOGISTIC REGRESSION MODELS PREDICTING BEHAVIOURAL JUDGEMENTS AND INTENTIONS

| | 1 (Others) | 2 (Others) | 3 (Own) | 4 (Own) |
|---------------------------------------|--------------------|--------------------|---------------------|---------------------|
| Impact (Ref: Low) | | | | |
| Moderate | -0.39*** (0.05) | -0.39*** (0.05) | -0.14* (0.06) | -0.14* (0.06) |
| High | -0.44*** (0.06) | -0.44*** (0.06) | -0.85**** (0.07) | -0.85**** (0.07) |
| Answers Seen (Ref: No Answers) | -0.18* (0.09) | -0.13† (0.08) | -0.06 (0.09) | -0.07 (0.07) |
| Impact x Answers Seen | | | | |
| Moderate + Answers | 0.32*** (0.07) | 0.32*** (0.07) | 0.15† (0.09) | 0.16† (0.09) |
| High + Answers | 0.21* (0.09) | 0.21* (0.09) | 0.21* (0.11) | 0.22* (0.11) |
| Male (Ref: Female) | | -0.17** (0.06) | | -0.24*** (0.07) |
| Age (Ref: u40 years) | | | | |
| 40 – 59 years | | 0.52*** (0.08) | | 0.09 (0.09) |
| 60+ years | | 0.70*** (0.12) | | 0.26* (0.12) |
| Region (Ref: Dublin) | | | | |
| Rest of Leinster | | 0.02 (0.08) | | -0.06 (0.09) |
| Munster | | -0.02 (0.08) | | -0.07 (0.09) |
| Connacht/Ulster | | 0.14 (0.10) | | 0.01 (0.11) |
| Urban (Ref: Rural) | | 0.10 (0.07) | | 0.09 (0.07) |
| Degree (Ref: No degree) | | -0.11 (0.07) | | 0.01 (0.07) |
| Socio-economic grade (Ref: AB) | | | | |
| C1C2 | | -0.01 (0.07) | | -0.04 (0.13) |
| DEF | | 0.06 (0.09) | | 0.03 (0.10) |
| Employment (Ref: Unemployed) | | | | |
| Retired | | 0.31* (0.12) | | 0.17 (0.13) |
| Working | | 0.08 (0.08) | | 0.20* (0.09) |
| Homeowner (Ref: Renter) | | -0.02 (0.07) | | 0.01 (0.08) |

Contd.

TABLE D.1 CONTD.

| | 1 (Others) | 2 (Others) | 3 (Own) | 4 (Own) |
|--------------------------------------|---------------|-------------------|------------|-----------------------------|
| Child u18 (Ref: No child u18) | | -0.04 (0.07) | | 0.15 [†] (0.08) |
| Irish (Ref: Non-Irish) | | 0.03 (0.11) | | 0.01 (0.11) |
| Worry | | 0.30*** (0.02) | | 0.40*** (0.01) |
| Quiz Score | | 0.03** (0.01) | | 0.01 (0.01) |
| Participants | 1,000 | 1,000 | 1,000 | 1,000 |

Source: Authors' analysis.

Note: †p < .10, *p < .05, **p < .01, ***p < .001. Standard errors are reported in parentheses. Models contain participant random effects and standard errors clustered by participant.

TABLE D.2 LOGISTIC REGRESSION MODELS PREDICTING DONATION TO THE CARBON OFFSET CHARITY

| | 1 | 2 |
|---|------------------------------|-------------------|
| Answers Seen (<i>Ref: No Answers</i>) | -0.14 (0.13) | -0.11 (0.14) |
| Revenue Use Info. (<i>Ref: No Info</i>) | 0.05 (0.13) | -0.09 (0.14) |
| Male (<i>Ref: Female</i>) | -0.45** (0.13) | -0.41** (0.14) |
| Age (<i>Ref: u40 years</i>) | | |
| 40 – 59 years | 0.11 (0.18) | 0.08 (0.19) |
| 60+ years | 0.76** (0.26) | 0.81** (0.27) |
| Region (<i>Ref: Dublin</i>) | | |
| Rest of Leinster | 0.18 (0.19) | 0.15 (0.20) |
| Munster | 0.22 (0.18) | 0.22 (0.19) |
| Connacht/Ulster | 0.27 (0.22) | 0.24 (0.23) |
| Urban (<i>Ref: Rural</i>) | 0.07 (0.15) | 0.06 (0.16) |
| Degree (<i>Ref: No degree</i>) | 0.22 (0.15) | 0.07 (0.16) |
| Socio-economic grade (<i>Ref: AB</i>) | | |
| C1C2 | -0.11 (0.16) | -0.04 (0.17) |
| DEF | -0.21 (0.20) | 0.00 (0.21) |
| Employment (<i>Ref: Unemployed</i>) | | |
| Retired | -0.13 (0.27) | -0.11 (0.28) |
| Working | 0.18 (0.18) | 0.24 (0.19) |
| Homeowner (<i>Ref: Renter</i>) | 0.01 (0.17) | -0.02 (0.18) |
| Child u18 (<i>Ref: No child u18</i>) | -0.30 [†] (0.16) | -0.22 (0.17) |
| Irish (<i>Ref: Non-Irish</i>) | 0.33 (0.23) | 0.38 (0.25) |
| Worry | | 0.34*** (0.05) |
| Quiz Score | | 0.10*** (0.03) |
| Participants | 1,000 | 1,000 |

Source: Authors' analysis.

Note: [†]p < .10, *p < .05, **p < .01, ***p < .001. Standard errors are reported in parentheses.

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