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Leading by example from high-status individuals: exploring a crucial missing link in climate change mitigation

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Behaviour change has great potential to reduce greenhouse gas emissions quickly, helping to prevent dangerous global warming. Some of the most impactful changes are: flying less, eating less meat, driving electric cars, improving home energy efficiency, increased use of public transport and active travel. However, these choices have proved elusive at scale and are rarely encouraged or modelled by high-status individuals (“leaders”), despite established knowledge about the influence of leaders as role models. Applying theories of embodied leadership and credibility enhancing displays, our novel pre-registered survey experiment ($n = 1267$) reveals that visible leading by example from politicians and celebrities significantly increases the willingness of members of the UK public to make these high-impact low-carbon choices. In addition, leading by example greatly increases perceptions of leader credibility, trustworthiness, competence, and favourability. We find no significant effects of leading by example on people’s wider perceptions of climate change, but a strong “appetite for leadership” among the public is revealed. In light of these findings, we discuss how embodied leadership by way of visible low-carbon behaviour from leaders may provide a crucial “missing link” for climate change mitigation.

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Introduction

Rapidly eliminating greenhouse gas emissions to mitigate climate change requires wide-reaching shifts to low-carbon behaviour in wealthy societies (Masson-Delmotte et al. 2018; Creutzig et al. 2022; Shukla et al. 2022). Extensive social science research has both revealed the factors underlying consumptive behaviours and offered potential interventions, but voluntary behaviour change at scale has proved elusive (Kollmuss and Agyeman 2002; Whitmarsh and O'Neill 2010; Capstick et al. 2014; Steg et al. 2014; Demski et al. 2015; Mols et al. 2015; Whitmarsh et al. 2020). At the same time, governments have avoided introducing policies to limit high-carbon behaviours for fear of unpopularity and impinging on freedoms, instead preferring technical solutions (Willis 2020; Nelson and Allwood 2021; Newell et al. 2021). This stalemate has been described as a *governance trap*, whereby “governments and the public attribute responsibility for action to one another,” with neither taking the necessary steps to reduce behaviour-driven emissions (Pidgeon 2012; Newell et al. 2015). Novel approaches are therefore required to stimulate behaviour change (Levin et al. 2012; Capstick et al. 2014).

One such novel and untested approach is that leaders could *lead by example* by visibly adopting high-impact low-carbon behaviours with a view to shifting social norms (Tankard and Paluck 2016; Otto et al. 2019; Nielsen et al. 2021). Nations or blocs of nations often assert the importance of leading by example as they set climate targets and reduce territorial emissions (Oberthür and Roche Kelly 2008; Skjærseth 2016; UK Govt. 2021; Benulic et al. 2022; Diez and von Lucke 2023), but leading by example at an individual level is rarely discussed or encouraged, despite established knowledge about leader influence (Haslam et al. 2020; Northouse 2021) and the need for society-wide behaviour change.

We focus on the behaviour of leaders for three reasons: their status gives them heightened power to shift societal discourse and social norms (Tankard and Paluck 2016; Otto et al. 2019; Nielsen et al. 2021); they are likely to have considerably greater lifestyle emissions than most citizens, raising issues of equity and fairness (Capstick et al. 2020; Gore 2020; Akenji et al. 2021; Khalfan et al. 2023; Kukowski and Garnett 2023; Sultana 2023); and arguably they have more responsibility and power to guide society's response to climate change (Bateman and Mann 2016; Haslam et al. 2020). Importantly for this study, the signals sent by a leader's personal actions, in addition to their words, can convey meaning and contribute to the leader's influence (Henrich 2009, 2015; Holzmer 2013). Using a survey experiment, our study explores the potential effects of high-profile leaders “walking the talk” with high-impact low-carbon behaviours, such as flying less, eating less meat, driving an electric car, improving home efficiency, and choosing active travel. These behaviours have been shown to make some of the biggest reductions to a person's carbon footprint (Wynes and Nicholas 2017; Whitmarsh et al. 2021). Limited research in this area suggests that such action from leaders increases their credibility and can encourage others to adopt similar behaviour (Attari et al. 2016, 2019; Kraft-Todd et al. 2018; Sparkman and Attari 2020).

To define a “leader” we adopt a slight modification of Northouse's (2015, p 6) definition of leadership as: “a process whereby an individual intentionally influences a group to achieve a common goal”. We consider two types of leader with different societal roles, politicians and celebrities, who advocate for the “common goal” of reducing greenhouse gas emissions to prevent climate change. Politicians are responsible for steering society's response to climate change in terms of governance, discourse, and legislation. Celebrities such as musicians, sports stars or TV personalities are cultural figures that can influence people's attitudes and

behaviour in relation to environmental issues and have used their “intimate stranger” relationship with followers to highlight the moral dimensions of climate change (Boykoff and Goodman 2009; Alexander 2013; Doyle et al. 2017; Olmedo et al. 2020). Importantly, many celebrities and politicians have very large carbon footprints and correspondingly large potential to reduce their environmental impact through their behavioural choices (Gössling 2019a, 2019b; Otto et al. 2019; Nielsen et al. 2021).

Why focus on individual behaviour? The extent to which individual behaviour change should be prioritised is a contentious issue. Tackling climate change requires leadership from international organisations, states, local governments, NGOs, businesses and communities (Schunz 2019; Skjærseth et al. 2021). Resistance comes from powerful vested interests that have for decades sought to sow doubt about the threats of climate change and to delay action (Stoddard et al. 2021). Indeed there is evidence that the fossil fuel industry has tried to load responsibility for climate mitigation onto individuals as a deliberate strategy to prevent systemic change and regulation (Supran and Oreskes 2021). Others assert that challenging people's high-carbon behaviour is inherently “shaming” and divisive, and therefore should be avoided (Mann 2021; Hayhoe 2022). Counter arguments say that systemic, social and legislative changes are stimulated by the action of individuals, especially those with high status (Otto et al. 2019; Nielsen et al. 2021; Thunberg et al. 2022). Furthermore, continual media attention is paid to the behaviour of leaders that, it is said, undermines the credibility of their climate change message. Advocates of climate mitigation such as Bill Gates, Al Gore, Barack Obama, former US climate envoy John Kerry and many more have had their very high-carbon lifestyle choices criticised (Gössling 2019a; Scarborough 2023). In the UK, the choice of helicopters and private jets over lower-carbon travel options by Prime Ministers Rishi Sunak, Boris Johnson, Liz Truss and Kier Starmer, and the intercontinental flights taken by actress Emma Thompson to attend and promote an Extinction Rebellion climate protest, have been similarly critiqued (Cole 2019; Clark 2021; Sommerlad 2021; Calder 2022; Smith 2023). High-carbon choices like this often lead to passionate and unresolved arguments over whether such behaviour represents “hypocrisy” (Goodwin 2020). What seems clear is that the behaviour of leaders who are involved in the political, institutional and cultural response to climate change carries social and cultural meaning, and is of widespread interest (ibid). Less clear is the effect behaviour change from leaders may have on others' behaviour and public attitudes towards such behaviour. This is the focus of our study.

Judging the behaviour of others. The way people judge the actions of others is complex and there is no guarantee that a leader's low-carbon behaviour will be approved of or emulated. Raihani and Power (2021) describe how pro-social behaviour can be interpreted negatively because observers of the behaviour may suspect it is motivated by selfish or strategic reasons (e.g. image improvement), or because observers feel the behaviour may harm them in some way. In the case of low-carbon behaviour, such harm could result from an observer's sense that their own behaviour will look bad in comparison to the leader's, resulting in a drop in social status and/or moral standing. Another harm could be the fear that a valued behaviour, such as flying or meat eating, may become less acceptable in future due to a change in social norms signalled by the leader's behaviour. Such negative reactions can lead to “do-gooder derogation”, where someone's pro-social behaviour is derided as pointless or selfishly motivated

in order to maintain the observer's positive moral self-image (Minson and Monin 2012). For instance, if someone's actions are broadcast to others or appear self-aggrandising, observers may infer selfish motives (Raihani and Power 2021). Relatedly, stereotypes and stigmas surrounding vegan diets can cause non-vegans to distance themselves socially and behaviourally from such diets (Markowski and Roxburgh 2019). These stigmas have also been shown to deter vegans and vegetarians from expressing their meat-free preferences for fear of negative judgements (Bolderdijk and Cornelissen 2022). More broadly, stereotypes about activists and their motivations can limit their ability to bring about social change (Bashir et al. 2013).

However, pro-social behaviour is often viewed positively and can lead to emulation. Evidence suggests ordinary people (as opposed to activists) who engage in pro-environmental behaviours are perceived as more warm and competent, a key metric of interpersonal judgement that we also use in our current study (Li et al. 2023). Other research has shown that people perceive consumers of organic food as primarily driven by altruistic motives, but also by impression-management motives (van de Grint et al. 2021). More generally, there is evidence that trusted opinion leaders or "block leaders" within social networks may prompt pro-environmental behaviour in others (Abrahamse and Steg 2013; Geiger et al. 2019). Tankard and Paluck (2016) describe how the changing of social norms can hinge on "social referents" who have particular influence or social power within a group. For example, Greta Thunberg and the Fridays for Future movement have been shown to increase motivation to adopt pro-environmental behaviour in 30% of people in a Swiss sample (Fritz et al. 2023). Furthermore, the behaviour of people in a social network can do more than simply signal a social norm, but also convey information, influence attitudes, and increase perceived behavioural control (Westlake 2017; Severijns et al. 2023). These different forms of influence align closely with established functions of leadership such as showing the way, setting an example of appropriate behaviour, and maintaining a direction of travel (Gill 2011; Northouse 2021). It is these physical, embodied dimensions of leadership that are the focus of our study.

Theoretical framework. We position the research within the theory of "embodied leadership", which considers bodily actions as central to cognition, communication, understanding and meaning (Sinclair 2005; Glenberg 2010; Lord and Shondrick 2011; Holzmer 2013; Bonaccio et al. 2016; Knights 2021; Parra Vargas et al. 2023). Our extension of embodied leadership theory posits that a leader's low- or high-carbon behaviours represent an *embodiment* of their approach to climate change that carries meaning for observers of the behaviours (and perhaps for the leaders themselves). We explore hypotheses that a leader's embodied response to climate change can influence others' behaviour, their perceptions of the leader, and their perspectives on climate change. We contrast embodied leadership with existing manifestations of climate leadership that focus almost entirely on technical, technocratic, and economic solutions to climate change, while ignoring the actions of leaders themselves (Willis 2020; Nelson and Allwood 2021; Newell et al. 2021). We also highlight a related tendency in climate discourse to apply a "disembodied" framing in relation to low-carbon behaviour change. This framing, supported by those who argue against a focus on individual behaviour, deters paying attention to the behaviours of specific people or groups, especially those with high status and high personal emissions (Mann 2021), and rather considers consumer behaviour in an abstracted, impersonal way. The disembodied framing is based on a "flat" view of society

where the very large disparities of consumption and agency between individuals are shrouded behind a general idea that "everyone will need to change their behaviour at some point". We explore whether embodied leadership has the potential to counteract this disembodied perspective by making behaviour change personal, overt and connected to everyday life.

With embodied leadership as an overarching theory, we also apply the theory of credibility enhancing displays (CREDs) to explore how leading by example may change people's perceptions of leaders. CREDs consist of behaviours that involve effort or sacrifice and thereby convey a level of commitment and belief that cannot be communicated by words alone (Henrich 2009, 2015). There is some evidence that CREDs can work in the context of pro-environmental behaviour: specifically, people were more likely to buy solar panels if ambassadors of the product had themselves paid to fit the panels on their own homes (Kraft-Todd et al. 2018). By incurring the cost of fitting the panels, the ambassadors signified their genuine belief that it was a beneficial and correct thing to do. In other studies, climate scientists and other advocates have been perceived as more credible by the public if they have lower-carbon lifestyles (Attari et al. 2016, 2019; Sparkman and Attari 2020). Such mechanisms of social signalling and feedback are beginning to be included in climate modelling for behaviour-related emissions reductions (Moore et al. 2022). Definitions of credibility vary, but it commonly consists of perceived commitment, trustworthiness, honesty, competence, reliability, knowledge and skill (Kouzes and Posner 2004; Gill 2011; Williams et al. 2022). Our study measures perceptions of several of these constituents of leader credibility.

To operationalise the theories of embodiment and CREDs, we explore the effect of leaders adopting a suite of high-impact behaviours that lower substantially their total carbon footprint, rather than adopting individual low-carbon behaviours that might be undermined in the eyes of observers by a leader's other high-carbon behaviours, or might appear relatively easy rather than "credibility enhancing".

Research question and hypotheses. We pre-registered on OSF a survey and a plan for analysis involving 12 hypotheses relating to a three-part research question: does leading by example with high-impact low-carbon behaviour affect observers' (1) *willingness to act*, (2) their *perceptions of leaders*, and (3) their *perspectives on climate change*? A simple logic model is shown in Fig. 1 (OSF pre-registration: <https://doi.org/10.17605/OSF.IO/83UXA>). Deviations from the pre-registration are shown in Tables SM1 and SM2 in the Supplementary Material). Next, we explain each hypothesis.

Willingness To Act. Hypothesis 1a: Leaders who lead by example with high-impact low-carbon behaviour stimulate greater willingness to adopt such behaviour, compared to leaders who do not lead by example.

Hypothesis 1b: Leaders who lead by example with high-impact low-carbon behaviour stimulate greater willingness to adopt such behaviour, compared to "disembodied" statements about the need for lifestyle change.

We focus on *willingness to act* because it is an established measure of an individual's propensity to adopt low-carbon behaviour (Kollmuss and Agyeman 2002; Ferguson and Branscombe 2010; Bilandzic et al. 2017; Steentjes et al. 2017; Whitmarsh et al. 2020). Although willingness does not represent actual behaviour change, it has advantages for this study because it captures someone's openness to taking actions that may not yet be feasible due to financial or practical constraints, for example, taking more expensive rail journeys instead of flying, or installing

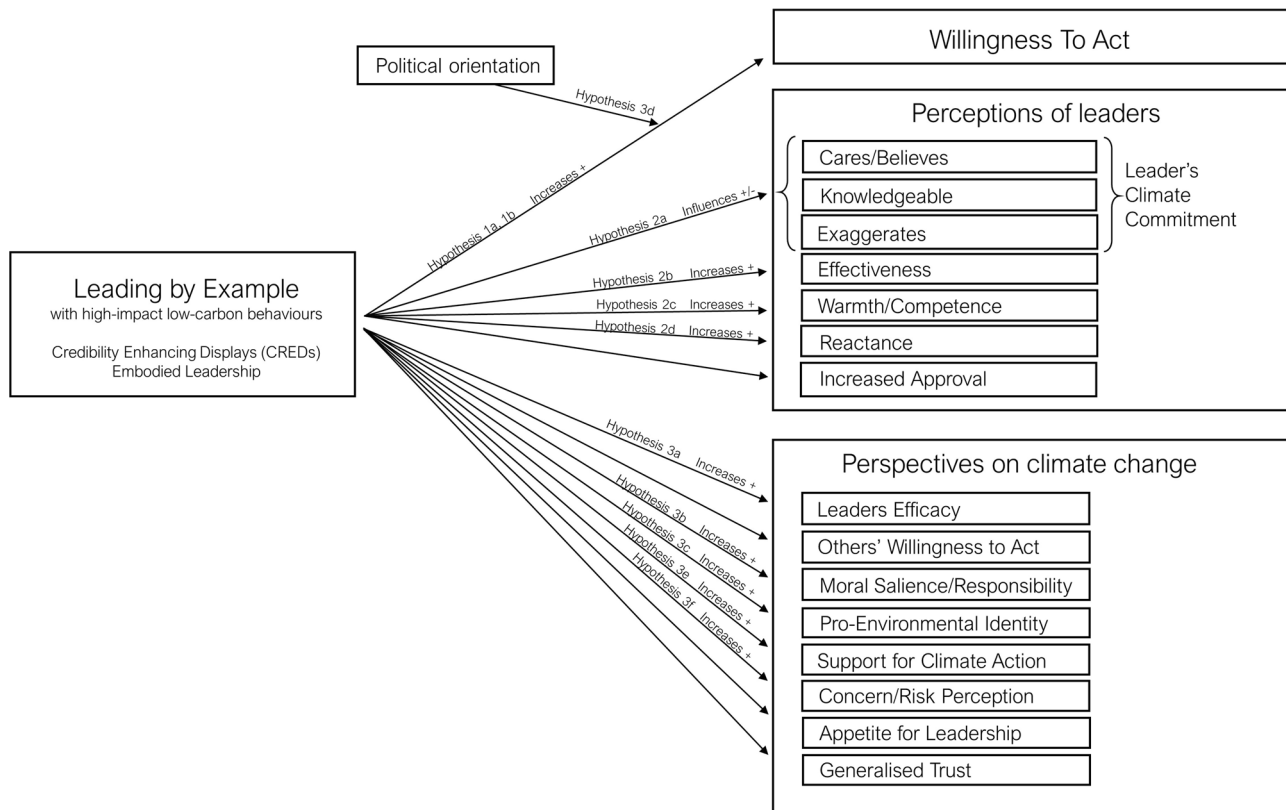


Fig. 1 Logic model. The model shows leading by example influencing the dependent variables willingness to act, perceptions of the leader, and perspectives on climate change, with political orientation moderating willingness to act. Hypotheses apply to some but not all dependent variables, with directions indicated by \pm . Credibility enhancing displays (CREDs) and embodied leadership provide the theoretical basis for the influence of leading by example.

expensive home efficiency measures. As such, willingness can indicate a level of increased enthusiasm for low-carbon actions in response to leader behaviour that would be missed by measures of intention to act or actual behaviour change. Because we are interested in respondents' enthusiasm to act in response to a leader's action, and for brevity, we did not ask whether respondents already partook of the low-carbon behaviours. This may add some noise to our measurement items. Hypothesis 1b allows us to explore whether embodied leadership has different effects to a disembodied framing of behaviour change, as discussed above.

We measure willingness with seven survey questions asking respondents the extent to which they agree or disagree with statements relating to the adoption of generic and specific low-carbon behaviours, such as "I would be willing to make significant changes to my lifestyle to help tackle climate change" and "I would be willing to fly less to help tackle climate change". Other behaviours were eating less meat, changing to an electric car, using public transport more often, improving home energy efficiency, and making some sacrifices. Table SM3 in the Supplementary Material shows all the measures in the survey.

Perceptions of leaders. The low- or high-carbon behaviour of leaders may influence how credible they are perceived to be and the motivations people attribute to them. This is important in the context of climate change because leaders who are viewed favourably generally have greater influence and ability to effect change (Haslam et al. 2020); for instance, credible politicians are likely to maintain more support for climate legislation, and credible celebrities are likely to be more successful as climate advocates. We therefore measure five types of perception of the leaders: their climate commitment; effectiveness; warmth and

competence; reactance (against the leader); and increased approval. These are described next.

Leader's Climate Commitment: The leader's climate commitment encompasses the extent to which respondents think the leader *believes* climate change is a serious issue, to what extent the leader is perceived to *care* about climate change, how *knowledgeable* the leader is perceived to be on the issue, and perceptions of how *committed* they are to addressing climate change. These factors contribute to a leader's credibility. We measure this by asking respondents the extent to which they agree or disagree with statements such as "The politician/celebrity¹ cares about climate change". We also explore whether respondents think the leader is *exaggerating* the issue of climate change.

Hypothesis 2a: Leaders who lead by example with high-impact low-carbon behaviour influence perceptions of the *Leader's Climate Commitment*.

We did not specify a direction for this hypothesis due to the variety of items measured. Principle component analysis on the measurement items identified three separate components that we use in our analysis: perceptions that the leader cares about climate change and believes it is a serious issue (Cares/Believes); perceptions that the leader is knowledgeable about climate change and potential solutions (Knowledgeable); and perceptions that the leader exaggerates climate change (Exaggerates).

Effectiveness: Perceptions of a leader's effectiveness are a common measure of credibility in leadership research, including such factors as persuasiveness, dedication, and effort (Cremer and Knippenberg 2004; Johnson et al. 2008; Lowe et al. 1996). We designed our measures of effectiveness to suit a climate change context, for instance by asking respondents the extent to which

they agree or disagree with statements such as “The politician/celebrity is good at persuading other people that climate change is an important issue.”

Hypothesis 2b: Leaders who lead by example with high-impact low-carbon behaviour stimulate greater perceptions of leader *Effectiveness*.

Warmth and Competence: Perceptions of warmth and competence are established measures of interpersonal judgement that can affect a leader’s credibility (Choi and Mai-Dalton 1998; Laustsen and Bor 2017; Fiske 2018). To measure this, we asked respondents the extent to which they agree or disagree with statements such as “The politician/celebrity is competent and capable.” Within this scale we also measured how respondents perceived the leader’s trustworthiness, honesty and morality (Kouzes and Posner 2004).

Hypothesis 2c: Leaders who lead by example with high-impact low-carbon behaviour stimulate greater perceptions of leader *Warmth and competence*.

Reactance: It is possible that overt low-carbon behaviour from a leader may be viewed negatively if it is perceived as an unwelcome demand that others change their behaviour too (Raihani and Power 2021). For instance, a feeling of being morally judged in response to a leader’s low-carbon behaviour may backfire and lead to negative “reactance” (Monin et al. 2008; Minson and Monin 2012; Sparkman and Attari 2020). We tested this by asking respondents whether they agreed or disagreed with statements such as: “The politician/celebrity was trying to tell people what to do.” We also tested reactance in response to the disembodied information about the need for low-carbon behaviour change.

Hypothesis 2d: Leaders who lead by example with high-impact low-carbon behaviour stimulate greater *Reactance* to the leader.

Increased Approval: As leaders generally seek approval to maintain influence and/or popularity, we measured the extent to which leading by example increased each respondents’ approval of the leaders. We asked a single question about each leader: “... would you be more likely or less likely to vote for them?” (politician) or “...do you like and admire them more, or less?” (celebrity). There was no pre-registered hypothesis attached to this measure.

Perspectives on climate change. We explored various ways in which a leader’s visible low-carbon actions might influence other people’s perceptions of climate change as an issue, as follows.

Leaders efficacy: *Self-efficacy* and *collective efficacy* are established measures of the extent to which people think they are able contribute to tackling climate change, either individually or collectively (Doherty and Weblar 2016). We adapted these concepts to measure “leaders efficacy”, which encapsulates respondents’ perceptions that leaders will act on climate change and how effective this action may be, with questions such as: “How confident or doubtful are you that politicians [celebrities/business leaders] will take the necessary steps to tackle climate change?” and “How confident or doubtful are you that climate change will be kept within safe limits?”.

Hypothesis 3a: Leaders who lead by example with high-impact low-carbon behaviour stimulate higher levels of perceived *Leaders efficacy*.

Others’ Willingness To Act: It is increasingly understood that many peoples’ motivations to act pro-environmentally may be contingent on the perception that they are not acting alone

(Jugert et al. 2016; Fritsche et al. 2018). Therefore we were interested in whether leading by example affects respondents’ perceptions of other citizens’ willingness to act. For this we used the same behaviours as in the Willingness To Act scale above, but in reference to other people. For example, we asked respondents the extent to which they agree or disagree with statements such as “I think other people would be willing to fly less to help tackle climate change.” There was no pre-registered hypothesis attached to this measure.

Moral salience of climate change and personal responsibility: The extent to which climate change is viewed as a moral issue may influence people’s sense of responsibility to take action. Leaders have a role in linking issues to ideas of morality (Van Zant and Moore 2015) and can increase the moral salience of climate change (Schuldt 2017). We asked respondents the extent to which they agree or disagree with statements such as “Climate change is a moral and ethical issue” and “I have some personal responsibility for contributing to the causes of climate change”.

Hypothesis 3b: Leaders who lead by example with high-impact low-carbon behaviour stimulate higher levels of *Moral salience of climate change and personal responsibility*.

Pro-environmental identity: Leaders have the capacity to influence the self-identity and social-identity of followers (Haslam et al. 2020), while people’s sense of pro-environmental identity is a well-established predictor of willingness to adopt pro-environmental behaviour (Vesely et al. 2021). If a leader exemplifies low-carbon lifestyle choices, therefore, climate action may become more salient for followers. We measured agreement with items such as “Being environmentally-friendly is an important part of who I am” (Whitmarsh and O’Neill 2010; Capstick et al. 2015).

Hypothesis 3c: Leaders who lead by example with high-impact low-carbon behaviour stimulate higher levels of *Pro-environmental identity*.

Political orientation: Someone’s political orientation can be a strong predictor of their concern about climate change, with those on the right of politics tending to express less concern (Hornsey et al. 2016; Poortinga et al. 2019; Newman et al. 2020). This is deemed potentially problematic if support for climate action becomes politically polarised, which has happened in the United States (Lee et al. 2015) and to a lesser extent in the EU and the UK (McCright et al. 2016). We sought, therefore, to explore whether political orientation affects how people respond to leading by example. For instance, certain right-wing priorities such as individual liberty and freedom to consume may clash with the idea of adopting lower-carbon behaviours such as flying less. Alternatively, other right-wing principles such as self-regulation and personal discipline (Lakoff 1995) might lead to positive responses to leading by example. We sought to explore this latter proposition. A single question asked respondents to place themselves on an 11-point left/right scale (Whitmarsh and Corner 2017).

Hypothesis 3d: Leaders who lead by example with high-impact low-carbon behaviour *have more influence on those on the political right* in terms of willingness to act.

Support for climate action: Leaders can signal which issues deserve attention and what action is appropriate. We explored whether leaders’ personal actions influence people’s support for action on climate change. We tested this by asking respondents: “How much do you support or oppose the following actions to tackle climate change? (1) Government investment in new technologies; (2) strong international agreements that rapidly reduce greenhouse gas emissions.” These are climate measures mentioned in the experimental vignettes (see “Methods” section).

Hypothesis 3e: Leaders who lead by example with high-impact low-carbon behaviour stimulate higher levels of *Support for climate action*.

Concern, risk perception: Leaders have a role in framing social issues and guiding responses, including how crises are perceived and tackled (Grint 2005, 2010; Boin et al. 2017), so a leader adopting low-carbon behaviour may signal to others the seriousness of climate change. We asked respondents how concerned they are about climate change and the threat they perceive to themselves, their family, their country, other countries, and wildlife and ecosystems.

Hypothesis 3f: Leaders who lead by example with high-impact low-carbon behaviour stimulate higher levels of *Climate concern & risk perception*.

Appetite for leadership: Previous research has revealed a widespread desire among the public for governments to take the lead on climate change (Bickerstaff et al. 2008; Bedford et al. 2010; Demski et al. 2015; UK Climate Assembly 2020). This can even include a desire for regulation of behaviours that people may feel less able to regulate themselves, such as eating meat (Kukowski et al. 2023). However, less attention has been paid to any public desire for *individual* leadership by way of low-carbon behaviour change from leaders. In view of this, we asked respondents the extent to which they agree or disagree with six statements such as “Politicians, business leaders and celebrities should set an example by making lifestyle changes first” and “If politicians, business leaders and celebrities went first, I would be more willing to change my lifestyle to tackle climate change”. While differences between the experimental conditions were of some interest, this measure was predominantly seeking to explore overall attitudes about whether leaders *should* lead by example and what effect it might have. There was no pre-registered hypothesis attached to this measure.

Generalised Trust: The extent to which people believe in the good intentions and trustworthiness of others (known as “generalised trust”) has been shown to increase their willingness to make sacrifices for the environment (Macias 2015). We therefore explored the idea that leading by example may increase “generalised trust”. There was no pre-registered hypothesis attached to this measure.

Gender of leader, subject of survey, and demographics. Respondents were asked about the gender of the leader, what they thought the survey was about, and asked to give their age, education, income, and gender. There were no hypotheses associated with these measures.

Methods

We conducted a survey experiment using a nationally representative UK sample ($n = 1267$) to directly compare responses to leaders who are advocating for measures to address climate change (including the need for new technology, international agreements, and behaviour change) while either leading by example, or not leading by example. Leading by example meant the leader had adopted the following behaviour changes for the past two years: flying less, eating less meat, driving an electric car, improving home efficiency, and choosing active travel. These behaviours have been shown to make some of the biggest reductions to a person’s carbon footprint (Wynes and Nicholas 2017; Whitmarsh et al. 2021). Not leading by example meant the leader had not yet adopted these behaviours. Two types of leaders were included: politicians and celebrities. A comparison was also made with a control condition (“Disembodied”) that mentioned

the same measures to address climate change, but did not feature a leader.

Participants. A representative sample of the UK population was recruited in April 2021 via the online Prolific platform, which is established as a sound tool for scientific studies (Palan and Schitter 2018). The sample was representative in terms of all subgroups of gender, age, and ethnicity, meaning, for example, it contains the same proportion of 28–37-year-old Asian women as the national population, or as close as possible. The size of the target sample ($n = 1300$; 5 groups of 260) was based on previous related studies (Attari et al. 2016, 2019; Whitmarsh and Corner 2017; Sparkman and Attari 2020) and a statistical power calculation using the G-Power tool (version 3.1.9.2) (Perugini et al. 2018), which suggested a minimum of 260 respondents for each of five experimental conditions should be sufficient to provide a good chance of detecting significance for medium-to-small effect sizes ($d = 0.15$) with 95% power using ANOVA with five groups and a significance level of $\alpha = 0.05$. The expected small effect sizes were based on a similar vignette study by Whitmarsh and Corner (2017). Respondents were rewarded with £1.25, in line with Prolific’s recommended payment rate for a survey that takes around 10 min. Cardiff University ethics procedures were followed during recruitment, execution, and analysis of the survey. After data inspection and manipulation checks, 1267 of 1300 responses were judged as complete and valid. Table SM4 in the Supplementary Material shows the demographic breakdown of the sample.

Design. The experiment used a between-subjects 2 (Leader Action: Leading by Example, Not Leading by Example) \times 2 (Leader Type: Politician, Celebrity) design, plus a control condition referred to as “Disembodied” because it does not feature a leader. Respondents were allocated randomly in equal number to one of the five conditions. Table SM5 in the Supplementary Material shows the experimental design.

Procedure. We used Qualtrics survey software. Respondents gave informed consent and were told they would be given something to read, followed by questions. The order of the questions remained constant to facilitate deliberate priming effects. However, within each question, items were randomised where relevant to reduce ordering effects (Salkind 2010). Manipulation checks were included to ensure respondents had absorbed the important information, along with questions to check respondents were paying attention. All of the dependent variables (DVs) were measured in the Leader conditions but the DVs relating to perceptions of leaders were not included for the control condition because no leader was mentioned. The survey underwent two pilot phases, first with a group of around 10 experienced colleagues, and then with an “as live” experiment with 200 undergraduate students. There was very little missing data in the live survey responses, which was addressed following general guidelines laid out by de Leeuw et al. (2016) and Donders et al. (2006) (see Supplementary Material for details of the manipulation checks, ordering of the questions, priming effects, attention checks, and missing data.)

Materials. Respondents in the politician conditions were presented with the following introductory text: “Imagine you are watching an interview with a politician that you might consider voting for”. Those in the celebrity conditions were presented with the text: “Imagine you are watching an interview with a celebrity that you like or admire. For example this could be a TV presenter, a musician, a sportsperson, or maybe an actor.” After this,

Table 1 Statistical tests used in analysis (confirmatory or exploratory).

Statistical test	Objective
ANOVA to compare demographic constituents of each experimental condition	Exploratory. Ensure no large differences in demographics of respondents allocated to each experimental condition
Two-way omnibus MANOVA to test for main effects (no control condition)	Confirmatory. Test whether Leader Action has significant overall effect on DVs Exploratory. Test whether Leader Type has significant overall effect on DVs
ANOVAs on all DVs (no control condition)	Exploratory. Test for interaction between Leader Action and Leader Type Confirmatory. Test for significant differences in all DVs by Leader Action and Leader Type
MANOVA on a subset of relevant DVs (with control condition)	Confirmatory. Test for significant differences in subset of DVs to compare control condition with Leader conditions
MANOVA on Willingness To Act scale items (with control condition)	Exploratory. Compare the individual behaviours that comprise the Willingness To Act scale between conditions
ANOVA on Willingness To Act by Political outlook	Confirmatory. Test whether those on the political right respond more strongly to leading by example in terms of their willingness to act

respondents read a 200–300 word description of a fictional interview with the politician or celebrity, which followed an identical format until the experimental manipulation at the end. The description of the interview is summarised as follows:

The interviewer asked about climate change and what should be done about it. The politician/celebrity mentioned the need for new technology, international agreements, and behaviour change. The interviewer asked what behaviour changes would be required, and the politician/celebrity said flying less, eating less meat, driving electric cars, home energy efficiency, and active travel – all of which would halve a person’s carbon footprint. The interviewer asked the politician/celebrity if they had adopted these behaviours already, and the politician/celebrity said *yes, for two years* (in the leading by example condition) or *no, not yet* (in the not leading by example condition).

Direct quotes from the leaders were not used in the interview descriptions so that the focus remained on the leaders’ actions, rather than their language (see Supplementary Material Section 5 and Box SM1 a full explanation of the design and content of the conditions). For the control condition (Disembodied), respondents were presented with the following introductory text: “*Imagine you are watching a report about climate change and what should be done about it.*” This was followed by a description of the report, the contents of which followed the same pattern as for the leader conditions, using similar or identical language, but without reference to the politician or celebrity. The full text for the survey and conditions can be found here: <https://doi.org/10.17605/OSF.IO/83UXA>.

Analysis. As our scales were novel, we conducted factor analysis and component analysis to assess scale reliability and constituent components (Field 2018). Where more than one component was identified, these were separated (see Supplementary Material Section 6 for full details). We conducted confirmatory statistical analyses relating to the pre-registered hypotheses, and exploratory analyses where there were no a-priori hypotheses. Table 1 lists the statistical tests used.

Results

Using an ANOVA test we compared the five conditions for uneven demographic factors that might affect the results (Age, Education, Personal income, Gender, Political orientation). No significant differences were observed, confirming the effectiveness of the random allocation of participants to conditions.

Appetite for leadership. We first present descriptive statistics revealing respondents’ desire for low-carbon leadership, as shown in Fig. 2. As the experimental conditions did not prompt significant differences in respondents’ appetite for leadership, for each question we calculated a total agreement figure (comprising the percentage of respondents who strongly agreed, agreed, or somewhat agreed), and a similar total disagreement figure. Using these total figures, more than 86% of respondents agreed that “Politicians, business leaders and celebrities should set an example by making lifestyle changes first”, with 4% disagreeing. Seventy-nine percent disagreed that “The personal behaviour of politicians, business leaders and celebrities is not relevant to climate change”, with 12.5% agreeing. More than 77% agreed that “Everyone should make lifestyle changes at about the same time to tackle climate change”, with 8% disagreeing. This result may appear to contradict the first statement relating to the expectation that leaders should act first, although high levels of agreement with both statements may also indicate a desire for leadership *and* collective action. The phrase “at about the same time” might also allow for leaders acting first and others following soon after. Ninety percent agreed that “People with the biggest carbon footprints should make the biggest lifestyle changes to tackle climate change”, and only 3% disagreed with this statement. Fifty-three percent agreed that “If politicians, business leaders and celebrities went first, I would be more willing to change my lifestyle to tackle climate change”, with 20% disagreeing with this statement. Sixty-four percent agreed with the statement “If I knew that most other people were changing their lifestyles because of climate change, I would be more willing to change mine too”. Fourteen percent disagreed with this statement. Notwithstanding the possible contradiction mentioned above, these results reveal a strong appetite for leadership in the shape of leaders acting first and most. The results also indicate people are open to following such leadership. There was no hypothesis related to this measure.

Main effects. Using a similar process to Attari et al. (2016, 2019), we first centred the agree/disagree Likert scales around zero so that positive values represented agreement and negative values represented disagreement. This allows for clearer interpretation of the valence of responses. We used a two-way omnibus MANOVA test to examine the main effects of Leader Action and Leader Type. There was a statistically significant difference for Leader Action: ($F(15, 989) = 107.9, p < 0.001, \text{Wilk's Lambda} = 0.379, \eta^2_p = 0.621$) with a large effect size. There was a statistically significant difference for Leader Type: ($F(15, 989) = 5.89, p < 0.001, \text{Wilk's Lambda} = 0.918, \eta^2_p = 0.082$) with a small effect size. There was no statistically significant interaction between the IVs ($F(15, 989) = 0.968, p = 0.488, \text{Wilk's Lambda} = 0.986$).

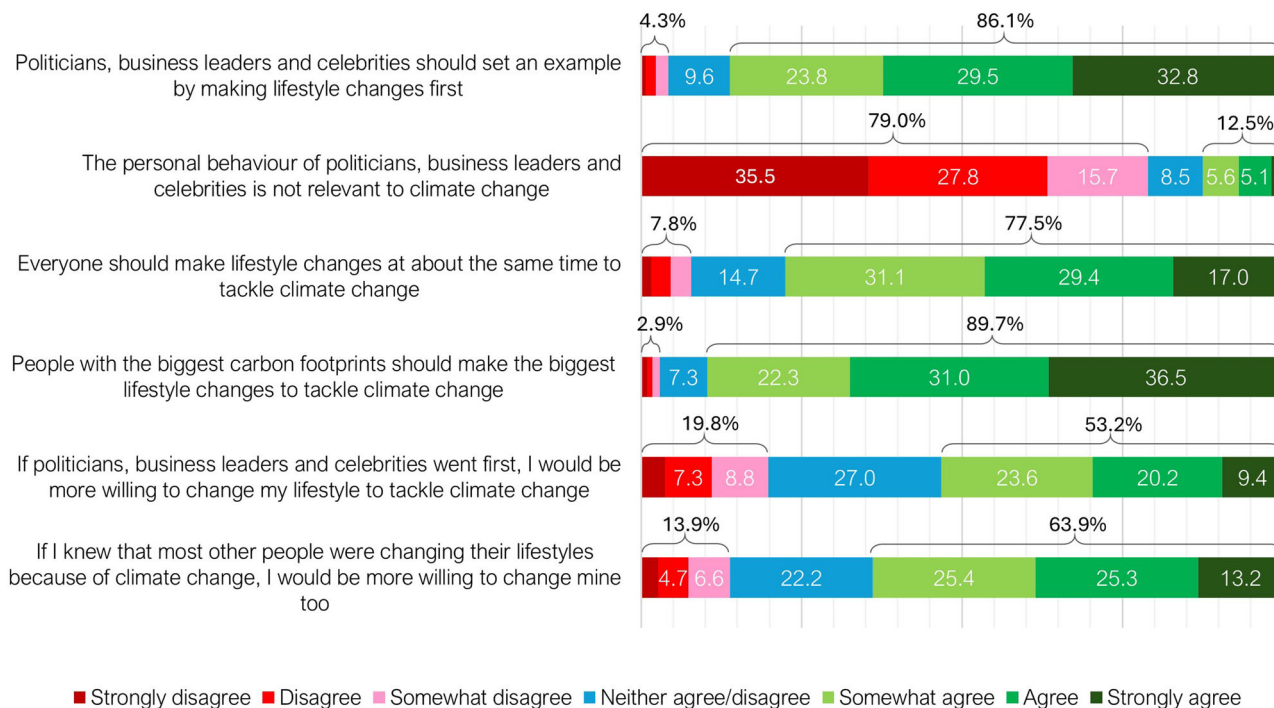


Fig. 2 Appetite for leadership. Levels of agreement with the statements are shown using a 7-point scale from “strongly disagree” to “strongly agree”. Percentage figures are shown for each point on the scale (space allowing). Total percentage figures are shown for agreement (comprising strongly agree, agree, somewhat agree) and disagreement (comprising strongly disagree, disagree, somewhat disagree). Vertical lines represent 5% on the scale.

In multiple follow-up ANOVA tests (Table 2) there was no statistically significant difference between the politician and celebrity for all but one of the DVs, indicating that responses to politicians and celebrities leading by example are largely consistent. The one exception was Increased Approval, where the Politician conditions ($M = 0.332$, $SD = 1.051$) resulted in a significantly higher score than the Celebrity conditions ($M = 0.126$, $SD = 1.014$), with a small effect size. There were no significant interaction effects between Leader Action and Leader Type at the level of $p < 0.003$, indicating that effects of Leader Action are generally consistent irrespective of the type of leader. We applied a Bonferroni correction to adjust for the 15 ANOVA tests resulting in a conservative p value of 0.003 (i.e. $0.05/15 = 0.003$) (Howell 2013).

Willingness To Act. Respondents in the Leading by Example conditions ($M = 1.347$, $SD = 1.101$) reported significantly higher willingness to adopt low-carbon behaviour compared to respondents in the Not Leading by Example conditions ($M = 1.139$, $SD = 1.093$), $F(1, 1007) = 8.940$, $p = 0.003$, $d = 0.19$, $\eta^2_p = 0.009$, with a small effect size. Hypothesis 1a is therefore supported. To test against the control condition, we used a one-way MANOVA to compare the Disembodied condition to the collapsed Leader Action conditions (see Fig. 3), revealing a significant difference between the conditions for Willingness To Act ($F(2, 1264) = 6.846$, $p = 0.001$). Post-hoc Tukey’s HSD tests for multiple comparisons (Table 3) showed that respondents in the Disembodied condition reported significantly higher willingness to adopt low-carbon behaviours compared to respondents in the Not Leading by Example condition ($p = 0.004$, 95% CI = 0.0713, 0.2543). Similarly, respondents in the Leading by Example condition reported significantly higher willingness to adopt low-carbon behaviours compared to respondents in the Not Leading by Example condition ($p = 0.007$, 95% CI = 0.0466, 0.3691), further supporting Hypothesis 1a. There was no statistically

significant difference between the Disembodied and the Leading by Example conditions. Notably, therefore, people who observed a leader who is leading by example did not express greater Willingness To Act compared to people who were exposed to Disembodied statements about the need for climate action and lifestyle change, meaning Hypothesis 1b is not supported. However, people who observed a leader who was not leading by example reported lower Willingness To Act compared to those who were exposed to Disembodied statements about the need for lifestyle change. This indicates that not leading by example results in lower levels of enthusiasm for low-carbon action among the public.

We explored the individual items of the Willingness To Act scale using a further MANOVA analysis (see Table 4). This revealed that respondents in the Disembodied and Leading by Example conditions reported significantly higher willingness than respondents in the Not Leading by Example conditions to make significant lifestyle changes, to use public transport more often, and to make some sacrifices to help address climate change. Respondents in the Leading by Example conditions also reported significantly higher willingness to fly less than respondents in the Not Leading by Example conditions. There were no significant differences between the conditions for willingness to eat less meat, to change to an electric car, and to increase home energy efficiency.

Perceptions of leaders. Respondents in the Leading by Example conditions reported significantly higher scores for the following perceptions of the leader: Cares/Believes, Warmth/Competence, Effectiveness, Knowledgeable, and Increased Approval (see Fig. 4). These results support hypotheses 2a (with the exception of Exaggerates), 2b and 2c indicating that leading by example results in favourable changes in perceptions of leaders.

Cares/Believes. Respondents in the Leading by Example conditions reported significantly higher perceptions that the leader

Table 2 Results of two-way ANOVA tests for Leader Type and Leader Action.

Dependent variables	Leader Type				F	p	η^2_p
	Politician		Celebrity				
	M	SD	M	SD			
Willingness To Act	1.325	1.034	1.166	1.160	5.125	0.024	0.005
Cares/Believes	1.100	1.485	1.040	1.557	0.400	0.527	0.000
Knowledgeable	1.513	1.086	1.496	1.200	0.025	0.876	0.000
Exaggerates	-1.493	1.355	-1.522	1.388	0.113	0.737	0.000
Warmth/Competence	0.599	1.210	0.711	1.258	3.348	0.068	0.003
Effectiveness	0.555	0.704	0.455	0.716	5.875	0.016	0.006
Reactance	-0.173	1.403	-0.051	1.532	1.657	0.198	0.002
Increased Approval ^a	0.332	1.051	0.126	1.014	12.176	0.001	0.012 ^b
Others' Willingness To Act	0.208	0.912	0.201	0.864	0.005	0.945	0.000
Moral Salience/Responsibility	1.456	1.142	1.415	1.234	0.280	0.597	0.000
Leaders Efficacy	-0.557	1.095	-0.630	1.141	1.011	0.315	0.001
Pro-Environmental Identity	1.141	1.111	0.976	1.149	5.262	0.022	0.005
Support Climate Action	1.429	0.681	1.374	0.744	1.473	0.225	0.001
Concern/Risk Perception	3.723	0.834	3.707	0.875	0.070	0.792	0.000
Appetite For Leadership	1.351	0.960	1.222	0.970	4.523	0.034	0.004

Dependent variables	Leader Action				F	p	η^2_p
	Leading by Example		Not Leading by Example				
	Mean	SD	Mean	SD			
Willingness To Act	1.347	1.101	1.139	1.093	8.940	0.003	0.009 ^b
Cares/Believes	2.199	0.762	-0.094	1.196	1321.261	0.000	0.568 ^d
Knowledgeable	1.805	1.022	1.195	1.181	76.986	0.000	0.071 ^c
Exaggerates	-1.535	1.405	-1.479	1.335	0.428	0.513	0.000
Warmth/Competence	1.248	0.986	0.045	1.167	314.011	0.000	0.238 ^d
Effectiveness	0.860	0.515	0.139	0.701	347.184	0.000	0.257 ^d
Reactance	-0.495	1.389	0.284	1.447	75.510	0.000	0.070 ^c
Increased Approval ^a	0.746	0.796	-0.304	0.986	349.584	0.000	0.258 ^d
Others' Willingness To Act	0.262	0.885	0.146	0.887	4.351	0.037	0.004
Moral Salience/Responsibility	1.470	1.139	1.399	1.239	0.904	0.342	0.001
Leaders Efficacy	-0.552	1.164	-0.636	1.069	1.439	0.231	0.001
Pro-Environmental Identity	1.136	1.091	0.976	1.170	4.964	0.026	0.005
Support Climate Action	1.443	0.687	1.358	0.740	3.560	0.059	0.004
Concern/Risk Perception	3.764	0.837	3.664	0.870	3.457	0.063	0.003
Appetite For Leadership	1.289	0.933	1.283	1.001	0.005	0.944	0.000

Significant results in bold ($p < 0.003$) with Bonferonni correction to adjust for the 15 ANOVA tests.
^aThe question used to measure Increased Approval was slightly different for each leader (see "Methods" section).
^bSmall effect size.
^cMedium effect size.
^dLarge effect size.

cares about climate change and believes it is a serious issue ($M = 2.199$, $SD = 0.762$) compared to respondents in the Not Leading by Example conditions ($M = -0.094$, $SD = 1.196$), $F(1, 1007) = 1321.261$, $p < 0.001$, $\eta^2_p = 0.568$, with a large effect size. The mean Cares/Believes score for respondents in the Not Leading by Example condition was marginally negative, indicating that leaders who do not lead by example were on average viewed as not caring about climate change, not believing it's serious, not being committed to tackling it, and not willing to make sacrifices. In contrast, the Cares/Believes scores in response to leaders who lead by example were positive on these measures.

Warmth/Competence. Respondents in the Leading by Example conditions rated the leaders significantly higher in terms of Warmth and Competence ($M = 1.248$, $SD = 0.986$) compared to respondents in the Not Leading by Example conditions ($M = 0.045$, $SD = 1.167$), $F(1, 1007) = 314.0$, $p < 0.001$, $\eta^2_p = 0.238$, with a large effect size. This indicates that leaders who lead by example were perceived as more: warm and friendly;

competent and capable; trustworthy; honest; inspirational; and likely to make moral and ethical decisions and share similar values to respondents. Figure 5 shows the constituent elements of the Warmth/Competence scale.

Effectiveness. Respondents in the Leading by Example conditions ($M = 0.860$, $SD = 0.515$) rated the leaders significantly higher for Effectiveness than those in the Not Leading by Example conditions ($M = 0.139$, $SD = 0.701$), $F(1, 1007) = 347.184$, $p < 0.001$, $\eta^2_p = 0.257$, with a large effect size. This indicates that leaders who lead by example were perceived as more: likely to work hard on climate change issues; likely to put climate change ahead of other issues; influential on climate issues; persuasive on climate issues; likely to get involved in local and national climate change campaigns; likely to use their influential position to help tackle climate change; and likely to support new laws that tackle climate change.

Knowledgeable. Respondents in the Leading by Example conditions ($M = 1.805$, $SD = 1.022$) rated the leaders as significantly

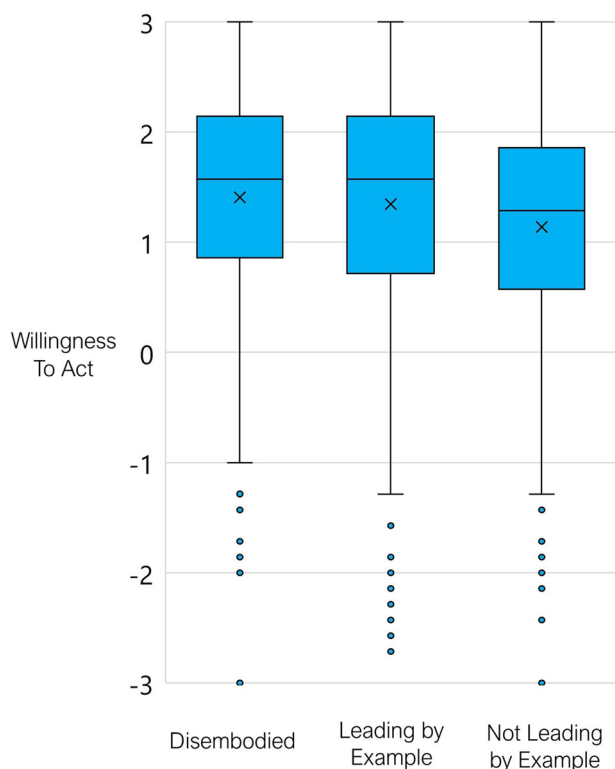


Fig. 3 Willingness To Act. Boxplots showing respondents' Willingness To Act for the experimental conditions. The y-axis represents respondents' level of agreement on a 7-point Likert scale from strongly disagree (−3) to strongly agree (3) with 7 statements about their willingness to make various impactful behavioural changes, such as “I would be willing to make significant changes to my lifestyle to help tackle climate change”. The x-axis shows the experimental conditions. Boxes show the interquartile range (IQR), along with the median (horizontal line within the box) and mean (x). The whiskers show $1.5 \times$ IQR, with outliers beyond. The Leading by Example and Disembodied conditions are significantly higher than the Not Leading by Example condition, with a small effect size.

more Knowledgeable than did those in the Not Leading by Example conditions ($M = 1.195$, $SD = 1.181$), $F(1, 1007) = 76.986$, $p < 0.001$, $\eta^2_p = 0.071$, with a medium effect size. This indicates that leaders who lead by example were perceived as more knowledgeable about climate change; and more in tune with what needs to be done to tackle it.

Increased Approval. Respondents in the Leading by Example conditions ($M = 0.746$, $SD = 0.796$) reported significantly higher levels of Increased Approval than those in the Not Leading by Example conditions ($M = -0.304$, $SD = 0.986$), $F(1, 1007) = 349.584$, $p < 0.001$, $\eta^2_p = 0.258$ with a large effect size. For the politician, increased approval meant an increased likelihood of voting for the politician. For the celebrity, it meant liking and admiring the celebrity more. Notably, the Leading by Example conditions showed on average a positive change in approval, whereas the Not Leading by Example conditions resulted in a slight decrease in approval.

Exaggerates. There was no statistically significant difference between the Leading by Example conditions ($M = -1.535$, $SD = 1.405$) and the Not Leading by Example conditions ($M = -1.479$, $SD = 1.335$) for perceptions that the leader exaggerates climate risk and gives it too much priority $F(1, 1007) = 0.428$, $p = 0.513$, $\eta^2_p = 0.000$.

Reactance was also measured in the Disembodied condition. The MANOVA test and multiple comparisons (Table 3) revealed respondents in the Not Leading by Example conditions ($M = 0.284$, $SD = 1.447$) reporting significantly higher Reactance than those in the Disembodied condition ($M = -0.718$, $SD = 1.326$) ($p < 0.001$, 95% C.I. = 0.750, 1.253), and the Leading by Example conditions ($M = -0.495$, $SD = 1.389$) ($p < 0.001$, C.I. = 0.571, 0.985). Respondents in the Disembodied and Leading by Example conditions reported negative Reactance scores in contrast to the positive score for those in the Not Leading by Example conditions. This indicates that leaders who do not lead by example tend to cause observers to feel they are being told what to do, preached at, and having their feelings manipulated by the leader. This result contradicts Hypothesis 2d, and reveals that leading by example did not trigger a negative, defensive reaction from observers.

Perspectives on climate change

Pro-Environmental Identity. Respondents in the Disembodied (control) condition reported significantly higher levels of Pro-Environmental Identity ($M = 1.210$, $SD = 1.163$) than those in the Not Leading by Example condition ($M = 0.977$, $SD = 1.170$) ($p < 0.02$, 95% C.I. = 0.029, 0.438). There was no significant difference on this measure between the Disembodied condition and the Leading by Example condition, or the Leading by Example condition and the Not Leading by Example condition. Hypothesis 3c was not supported therefore.

The following DVs saw no significant difference between the conditions: Others' Willingness To Act; Leaders Efficacy; Moral Salience/Responsibility; Support for Climate Action; and Climate Concern/Risk Perception. Our results therefore do not support hypotheses 3a, 3b, 3e, and 3f.

Political outlook. Figure 6 shows respondents' Willingness To Act split by their political orientation (left, centre, or right). As would be expected, Willingness To Act decreases from left to right. Within these groups, separate ANOVA tests revealed no statistically significant difference in Willingness To Act between the experimental conditions. Hypothesis 3d is not supported therefore. Importantly, the group sizes were inevitably smaller due to splitting by political orientation, which reduced statistical power. Notably, however, leading by example does appear to stimulate Willingness To Act for those on the right of politics, for whom enthusiasm for climate action is generally lower. We return to this in the “Discussion” section.

Discussion

Our study indicates that leaders who lead by example with high-impact low-carbon behaviours prompt significantly greater willingness among UK citizens to adopt the same low-carbon behaviours, compared to leaders who do not lead by example. We found no difference between the effect of leading by example and exposure to “disembodied” information about the need for action to mitigate climate change. The results indicate that if leaders are advocating for various forms of climate action including behaviour change, they will be more effective if they “walk the talk” by adopting a suite of low-carbon behaviours, and will have a negative effect on others' motivation if they do not. The behaviours in question are flying less, eating less meat, driving an electric car, improving home efficiency, choosing public transport and active travel. Visible and consistent low-carbon behaviours from leaders could, therefore, form part of efforts to encourage wider behaviour change among the public. In addition, our study reveals a strong desire among the UK public for behavioural leadership, with most survey respondents agreeing that leaders

Table 3 Multiple comparisons of conditions.

DV	Condition (I)	Mean	SD	Condition (J)	Mean diff (I-J)	p
Willingness To Act	Disembodied	1.4066	1.0629	Leading by Example	0.0594	0.755
	Leading by Example	1.3472	1.1008	Not Leading by Example	0.2078	0.007
	Not Leading by Example	1.1394	1.0934	Disembodied	-0.2672	0.004
Others' Willingness To Act	Disembodied	0.1769	0.9147	Leading by Example	-0.0847	0.426
	Leading by Example	0.2617	0.8854	Not Leading by Example	0.1156	0.099
	Not Leading by Example	0.1460	0.8866	Disembodied	-0.0309	0.893
Reactance	Disembodied	-0.7179	1.3256	Leading by Example	-0.2235	0.091
	Leading by Example	-0.4945	1.3893	Not Leading by Example	-0.7781	0.000
	Not Leading by Example	0.2836	1.4474	Disembodied	1.0016	0.000
Moral Salience/Responsibility	Disembodied	1.4269	1.1279	Leading by Example	-0.0432	0.880
	Leading by Example	1.4702	1.1389	Not Leading by Example	0.0715	0.600
	Not Leading by Example	1.3987	1.2389	Disembodied	-0.0282	0.947
Leaders Efficacy	Disembodied	-0.6692	1.1692	Leading by Example	-0.1174	0.360
	Leading by Example	-0.5519	1.1643	Not Leading by Example	0.0847	0.459
	Not Leading by Example	-0.6366	1.0690	Disembodied	0.0326	0.924
Pro-Environmental Identity	Disembodied	1.2103	1.1633	Leading by Example	0.0739	0.670
	Leading by Example	1.1363	1.0912	Not Leading by Example	0.1599	0.067
	Not Leading by Example	0.9765	1.1700	Disembodied	-0.2338	0.020
Support Climate Action	Disembodied	1.2103	0.7314	Leading by Example	0.0048	0.996
	Leading by Example	1.1363	0.6865	Not Leading by Example	0.0854	0.142
	Not Leading by Example	0.9765	0.7396	Disembodied	-0.0902	0.228
Concern/Risk Perception	Disembodied	3.7703	0.8229	Leading by Example	0.0061	0.995
	Leading by Example	3.7641	0.8366	Not Leading by Example	0.1001	0.147
	Not Leading by Example	3.6640	0.8701	Disembodied	-0.1062	0.230

Multiple comparisons with significance after Tukey's HSD adjustment. Significant comparisons shown in bold ($p < 0.05$).

Table 4 Multiple comparisons of conditions for specific behaviours in Willingness To Act scale.

DV	(I) Condition	Mean	SD	(J) Condition	Mean diff (I-J)	p
Significant lifestyle changes	Disembodied	1.3538	1.3114	Leading by Example	0.1288	0.419
	Leading by Example	1.2250	1.3685	Not Leading by Example	0.22505	0.022
	Not Leading by Example	1.0000	1.3349	Disembodied	-0.35385	0.002
Fly less	Disembodied	1.2308	1.6442	Leading by Example	-0.1254	0.585
	Leading by Example	1.3562	1.6180	Not Leading by Example	0.33802	0.004
	Not Leading by Example	1.0181	1.7261	Disembodied	-0.21262	0.219
Eat less meat	Disembodied	1.2115	1.7786	Leading by Example	0.04324	0.946
	Leading by Example	1.1683	1.7610	Not Leading by Example	0.22475	0.116
	Not Leading by Example	0.9435	1.8403	Disembodied	-0.26799	0.126
Change to electric car	Disembodied	1.3769	1.5634	Leading by Example	0.24776	0.120
	Leading by Example	1.1292	1.6859	Not Leading by Example	-0.00189	1.000
	Not Leading by Example	1.1310	1.6615	Disembodied	-0.24587	0.127
Use public transport more	Disembodied	1.0000	1.7728	Leading by Example	0.03914	0.955
	Leading by Example	0.9609	1.7271	Not Leading by Example	0.34997	0.005
	Not Leading by Example	0.6109	1.8235	Disembodied	-0.38911	0.012
Improve home energy efficiency	Disembodied	1.9808	1.0340	Leading by Example	0.03556	0.898
	Leading by Example	1.9452	1.0122	Not Leading by Example	0.12867	0.129
	Not Leading by Example	1.8165	1.1086	Disembodied	-0.16424	0.105
Make personal sacrifices	Disembodied	1.6923	1.0570	Leading by Example	0.04652	0.856
	Leading by Example	1.6458	1.1401	Not Leading by Example	0.19015	0.024
	Not Leading by Example	1.4556	1.2036	Disembodied	-0.23666	0.020

Multiple comparisons with significance after Tukey's HSD adjustment. Significant comparisons shown in bold ($p < 0.05$).

should act first and most to reduce their carbon footprints, and many respondents saying that they would be more likely to change their own behaviour if they saw leaders acting first. This points to the importance of considering fairness and the large differences between individuals' carbon footprints when promoting low-carbon lifestyle changes (Capstick et al. 2020; Gore 2020; Akenji et al. 2021; Khalfan et al. 2023; Sultana 2023). Notably, respondents also generally agreed that everyone should make lifestyle changes at "about the same time", perhaps

supporting prior evidence that both leadership *and* collective effort are desired by the public (UK Climate Assembly 2020).

In addition to encouraging others to change their behaviour, leaders who lead by example with high-impact low-carbon behaviours were rated significantly more favourably on all leadership criteria, compared to leaders who were not leading by example. They were believed to be more credible, more effective, more warm and competent, to care more about climate change, to believe it is more serious, to be more knowledgeable about it, to

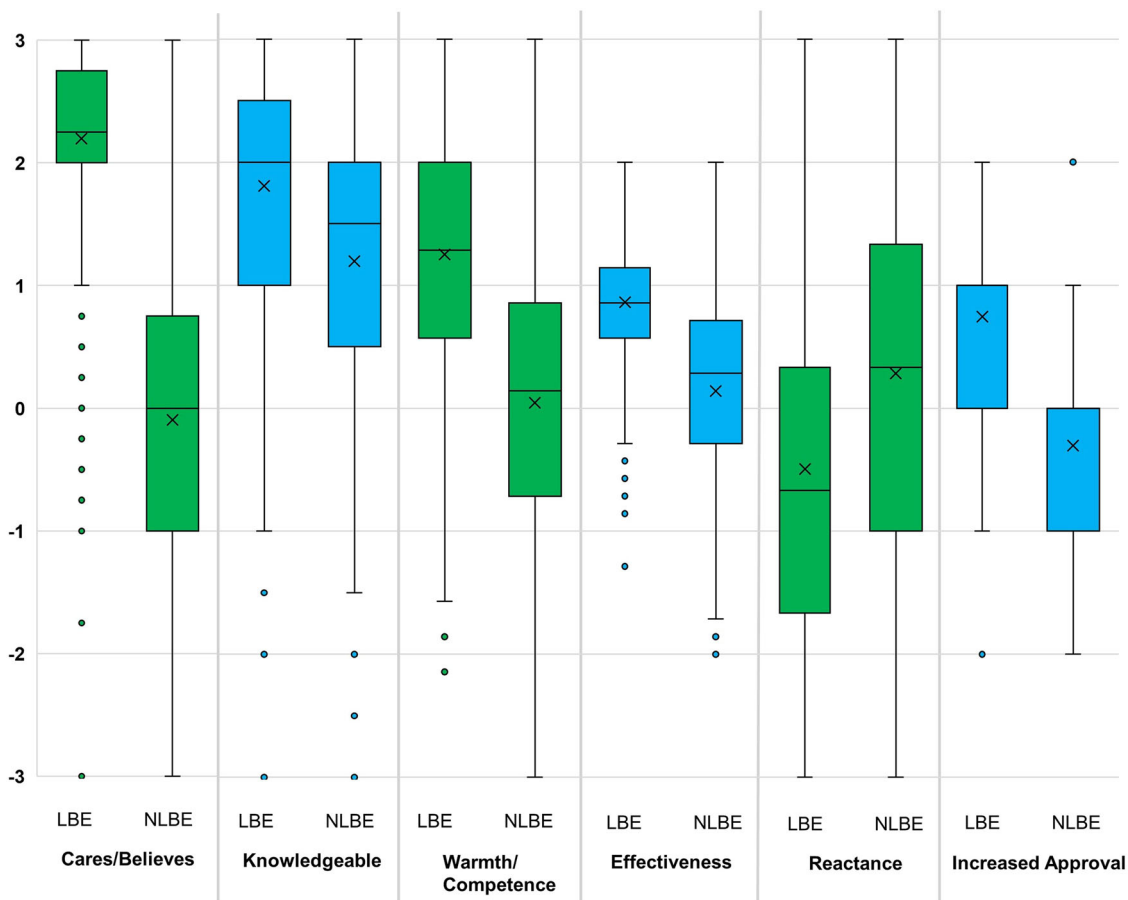


Fig. 4 Perceptions of leaders who lead by example vs not. Boxplots showing respondents' perceptions of leaders who are Leading by Example (LBE) vs Not Leading by Example (NLBE). Boxes show the interquartile range (IQR), along with the median (horizontal line within the box) and mean (x). The y-axis represents respondents' level of agreement on a 7-point Likert scale from strongly disagree (−3) to strongly agree (3) with the x-axis showing respondents' perceptions of the leaders, split according to the experimental conditions. All measures are significantly different for Leading by Example and Not Leading by Example, with large or medium effect sizes. The whiskers show $1.5 \times$ IQR, with outliers beyond.

be more effective climate leaders, and they enjoyed greater approval. They were also perceived as more trustworthy, honest, inspirational, and ethical. Leaders in our study who did not lead by example scored negatively for being trustworthy, making moral and ethical decisions, and being inspirational. Notably, example-setting leaders were perceived as more knowledgeable about climate change and climate solutions, even though there was no difference in leader knowledge in the experimental conditions. This indicates that the leaders' behaviour sent signals about their leadership credentials, over and above their words. Similarly, example-setting leaders were perceived as having greater ability to persuade others. Being perceived as persuasive, knowledgeable and knowing what to do are considered central tenets of effective leadership, especially in crisis situations (Boin et al. 2017; Northouse 2021).

Perhaps surprisingly, example-setting leaders did not prompt negative reactance, despite these leaders having adopted several high-impact low-carbon behaviours that might have made them appear a bit *too* virtuous. Furthermore, they were not perceived as exaggerating climate change or giving it too much priority. Our measure of reactance asked respondents if they felt manipulated or preached at, so respondents' lack of reactance is consistent with example-setting leaders being perceived as more honest and trustworthy. This result contrasts with previous research by Sparkman and Attari (2020) who found "extreme" pro-environmental behaviour could be subject to negative appraisals by way of "do-gooder derogation" (Minson and Monin 2012),

where someone else's behaviour is derided in order to maintain a positive moral self-image. An important difference in our study to Sparkman and Attari's is that our leaders did not make an explicit call for others to change their behaviour. In contrast, our leaders said people "will make changes when the time is right for them". This lack of a direct instruction to others may have helped to prevent negative reactance. Furthermore, the fact that our leaders were *asked* about their pro-climate behaviours, rather than describing their behaviours unprompted, may have avoided the impression that they were bragging. The idea of being invited to discuss pro-environmental behaviour has been described as a "licence to preach" whereby climate advocacy can become more socially acceptable and effective because it is not pushed on people (Bolderdijk 2023). This raises the important issue of how a leader's low-carbon actions become visible to others, how their actions are communicated, and how this may affect perceptions of the leader's motives. Our experimental vignettes deliberately sought to avoid the impression that the leaders were "preaching" or instructing others to act. We suggest this is not an unlikely scenario in the real world because high-profile leaders, such as politicians and celebrities, who advocate for climate action are often asked about their own climate-related behaviours (Gant 2021), providing an opportunity to speak about them (a "licence to preach"). In contrast, spontaneous communication by leaders about their low-carbon behaviours may be more susceptible to suspicion over their motives and lead to do-gooder derogation and other negative appraisals (Minson and Monin 2012; Raihani

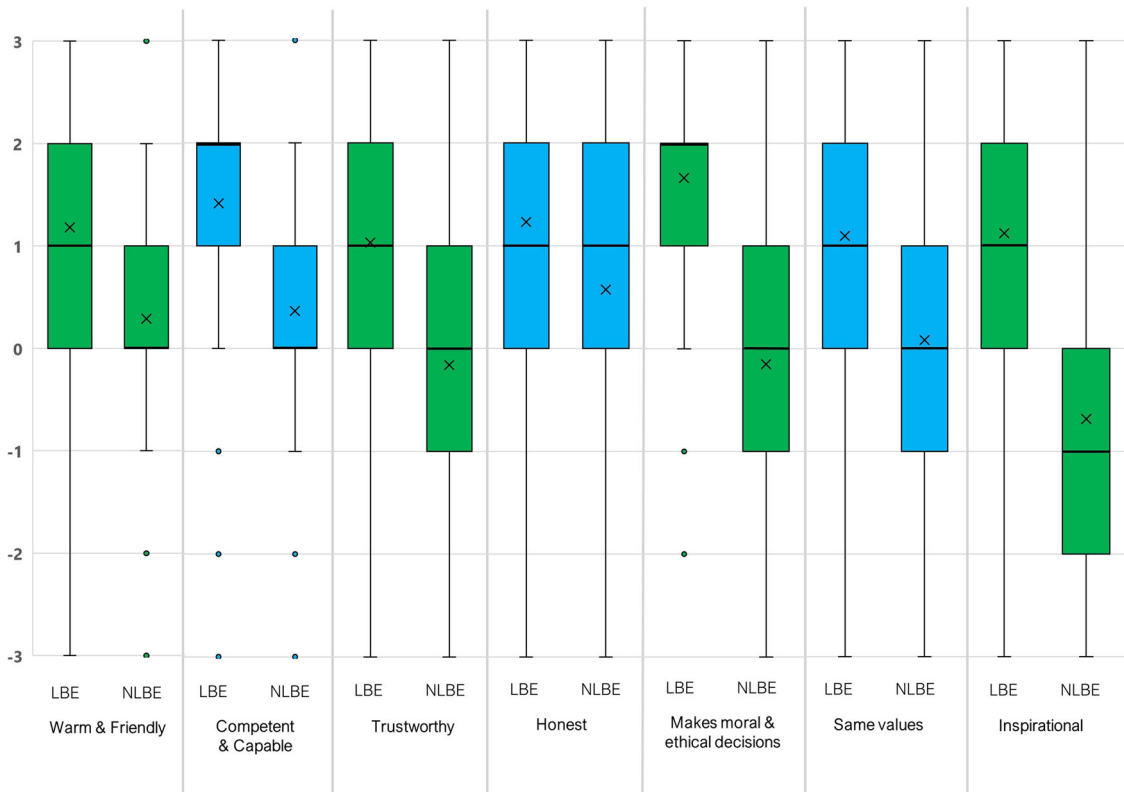


Fig. 5 Warmth/Competence scale items for leaders who lead by example vs not. Boxplots showing respondents' perceptions of leaders who are Leading by Example (LBE) vs Not Leading by Example (NLBE) for the individual items that comprise the Warmth/Competence scale. Boxes show the interquartile range (IQR), along with the median (bold horizontal line within the box) and mean (x). The y-axis represents respondents' level of agreement on a 7-point Likert scale from strongly disagree (−3) to strongly agree (3) with the individual items (x-axis) that made up the Warmth/Competence scale in Fig. 4, split according to the experimental conditions. Respondents in the Leading by Example (LBE) conditions rate the leaders higher on all measures compared to respondents in the Not Leading by Example (NLBE) conditions, with large or medium effect sizes. Notably, respondents in the Not Leading by Example conditions score the leaders negatively on average for being Trustworthy, Makes moral & ethical decisions, and Inspirational.

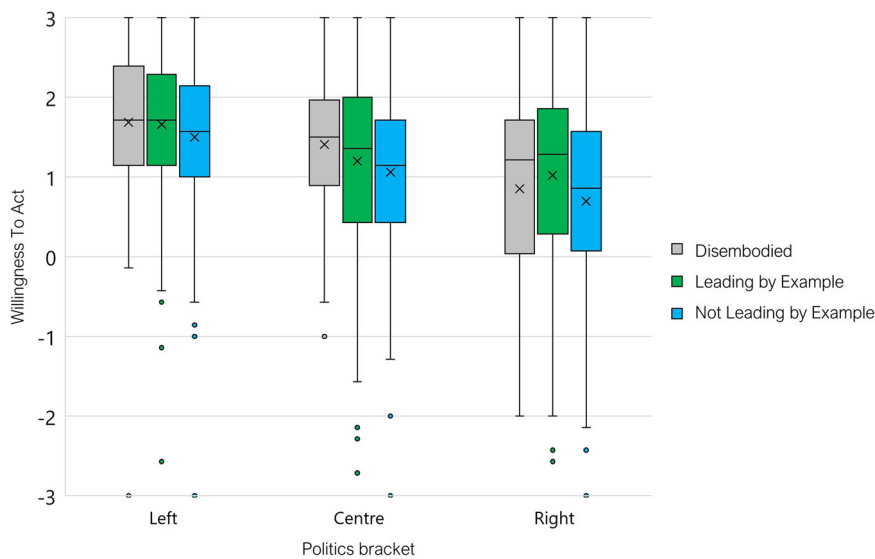


Fig. 6 Willingness To Act by Politics bracket. Boxplots showing respondents' Willingness To Act split by Politics Bracket. Boxes show the interquartile range (IQR), along with the median (horizontal line within the box) and mean (x). The y-axis represents respondents' level of agreement on a 7-point Likert scale from strongly disagree (−3) to strongly agree (3). Median and mean scores for the Leading by Example conditions are higher than for the Not Leading by Example conditions across the political spectrum (although not significantly so). As would be expected, Willingness To Act decreases from left to right. Notably, however, Leading by Example does appear to stimulate Willingness To Act for those on the right of politics, for whom enthusiasm for climate action is generally lower. The whiskers show $1.5 \times$ IQR, with outliers beyond.

and Power 2021). An example of this was when Prince Harry and Meghan Markle said publicly that they were having “two maximum” children because of environmental concerns, and were subsequently criticised for their private jet use and lavish lifestyle (Vidal 2019). The positive appraisals of example-setting leaders in our study can be compared with previous research that found ordinary people (as opposed to activists) who engage in pro-environmental behaviour are perceived positively in terms of warmth and competence (Li et al. 2023). In light of this, it seems that our example-setting leaders were not being perceived as “activists”, perhaps because they are modelling behaviour without directly telling others they should do it too. We suggest therefore that leading by example may be effective as a leadership intervention because it is voluntary and does not restrict people’s freedom of choice (a major concern for politicians in relation to climate policy), while still sending a signal that can stimulate behaviour change.

Notably, the responses to the politician and celebrity in our study were mostly consistent. This might appear surprising because celebrities are understood to be potentially very influential (Olmedo et al. 2020), whereas politicians are notoriously ill-trusted (Hosking 2014; Edelman 2020a, 2020b). However, our results lend support to the notion that politicians have a particularly important symbolic role in displaying leadership on climate change because of their responsibilities for steering societal responses to crises (Westlake 2017). Furthermore, our results indicate that leading by example has the potential to rebuild trust in politicians, despite their suspicions that it will backfire (Westlake et al. 2024).

Size of the effect on Willingness To Act. Leading by example had a small, positive effect on respondents’ willingness to adopt high-impact low-carbon behaviours ($\eta^2_p = 0.009$), indicating its potential to reduce greenhouse gas emissions. We suggest, however, that the small effect in our study may substantially underestimate the full potential of leading by example. This is because our survey experiment presented a single instance of an individual leader in a fictional interview, which likely limits how much respondents could relate to the leader. If a real politician or celebrity was seen to lead by example, the effect may be greater due to a stronger connection between leader and observers. Furthermore, if a multitude of leaders in differing social positions were observed leading by example in practice, low-carbon behaviours would be modelled repeatedly, with the potential to ripple through social networks and shift social norms (Abrahamse and Steg 2013; Tankard and Paluck 2016; Geiger et al. 2019). There is evidence of this amplification effect in the context of pro-environmental waste-disposal, where multiple people modelling a behaviour has been shown to result in greater and more durable emulation by others (Sussman et al. 2013). Furthermore, a range of example-setting leaders representing different groups could lessen the chances of stigmatisation and reactance against isolated leaders with whom people did not identify (Jackson 2005; Bashir et al. 2013; Markowski and Roxburgh 2019; Raihani and Power 2021; Bolderdijk and Cornelissen 2022).

Unpacking the specific elements of “willingness to act”, respondents who observed an example-setting leader expressed significantly higher willingness to make significant lifestyle changes, fly less, use public transport more often, and make some sacrifices, but not significantly higher willingness to eat less meat, change to an electric car, and improve home energy efficiency. However, trends in the data suggest that leading by example may have some positive effect on willingness to eat less meat and to improve home energy efficiency. Further research could explore in more detail how specific behaviours are influenced by leaders.

Together, our findings support the idea that leading by example with impactful low-carbon behaviour is a “credibility enhancing display” (Henrich 2009, 2015; Kraft-Todd et al. 2018) that enhances the perception of key traits of leadership such as commitment, trustworthiness, honesty, competence, knowledge and skill (Kouzes and Posner 2004; Gill 2011; Williams et al. 2022). This suggests example-setting leaders are likely to be more effective because they enjoy greater trust and confidence from the public, perhaps making them better able to usher in the societal transformations required to address the climate crisis (Shukla et al. 2022). For climate leaders such as politicians and celebrities, leading by example could therefore create a win-win situation: increasing their electability, popularity and effectiveness, as well as inspiring others to act. However, there are likely to be significant challenges for leaders who want to do this, as we discuss below.

Our findings also partially support the theory of “embodied leadership” whereby a leader’s physical response to climate change, rather than just their words, carries meaning and sends powerful signals to others. The combination of respondents’ strong appetite for leadership, their increased willingness to act in response to leaders’ behavioural cues, and their much more positive perceptions of leaders suggests that an embodied response to climate change from leaders may be an important addition to prevalent technical, technocratic and economic leadership approaches (Nelson and Allwood 2021; Newell et al. 2021). However, our study did not find evidence that respondents’ perspectives on climate change, such as climate concern or policy support, were significantly altered by leading by example. Further research could seek to examine these aspects of embodied leadership. In addition, further research would be valuable to explore what leadership behaviour comprises a credible embodied response to climate change, and how this may differ for various types of leader. For instance, would leaders switching private jet travel for chartered flights, or forgoing some flights altogether, be perceived as credible embodiment, in combination with other lower-carbon actions?

The political leaning of respondents had no statistically significant effect on the extent to which they were influenced by leaders’ low-carbon behaviours. Notably, those on the political right responded at least as positively to low-carbon leading by example as those on the left. Our results suggest, therefore, that leading by example might be an effective way of engaging those on the political right, perhaps because it aligns with conservative values of self-regulation and personal responsibility (Lakoff 1995). This finding warrants future research, as those on the right of politics tend to be less enthusiastic about climate action (Lee et al. 2015; Hornsey et al. 2016; McCright et al. 2016; Poortinga et al. 2019).

Implications for leader behaviour. We found no significant difference in willingness to act when comparing leading by example with “disembodied” information about the need for climate action. This might suggest that leading by example is not necessary or desirable to bring about behaviour change because basic information can be used. However, in reality the media repeatedly focuses on leaders’ behaviour, often including discussions of hypocrisy when leaders speak out on climate change (Goodwin 2020; Gant 2021). We suggest therefore that a disembodied approach to low-carbon behaviour change, as currently manifested when leaders avoid the topic (Newell et al. 2021), is impossible to maintain. Furthermore, with the IPCC and global governments increasingly recognising the need for rapid demand-side measures including behaviour change (Creutzig et al. 2022), while also stressing the need for climate action to be perceived as

fair (UK Climate Assembly 2020; Portner et al. 2022), avoiding the issue may become increasingly untenable for leaders, and may slow down climate mitigation. That said, overt low-carbon leading by example is likely to be problematic for leaders not least because accusations of hypocrisy are often made in bad faith and amplified by those trying to delay progress on climate change (Goodwin 2020), and achieving a lifestyle that is immune to criticism is probably impossible. In addition, leaders' concerns about reputation management are likely to make them reluctant to deviate from high-carbon norms (Raihani and Power 2021; Westlake et al. 2024). However, we suggest that, instead of baulking at the impossibility of achieving immediate perfection, leaders have a potent opportunity to embody a direction of travel towards lower emissions. We therefore make some initial recommendations for leaders, which could be tested with further research.

These recommendations stem from the design of our experimental vignettes which elicited positive responses to leading by example, and negative responses to its absence: (1) *Be clear that behaviour change is only part of the solution.* The public understands that systemic changes are required to tackle climate change and disapproves of primary responsibility being laid at the feet of individuals (Bickerstaff et al. 2008; Bedford et al. 2010; Demski et al. 2015; UK Climate Assembly 2020; Kukowski et al. 2023). Therefore, leading by example with personal behaviour change should be framed as a *contribution* to climate mitigation rather than the primary solution. For instance, the leaders in our vignettes stressed the need for international agreements, new technology *and* behaviour change. This approach contrasts with studies that present a binary choice between behaviour change *or* government-led change (e.g. Palm et al. 2020). (2) *Adopt behaviours that substantially reduce your total carbon footprint.* This helps to prevent a single low-carbon behaviour (e.g. eating less meat) being dismissed by observers as an easy token gesture that is undermined by other high-carbon behaviours (e.g. private jet use). (3) *When asked, clearly communicate the carbon-saving effects of your behaviour changes.* This serves to inform observers who may not possess full knowledge about the effect of different behaviours. Our vignettes stated that the behaviour changes would usually halve the leader's carbon footprint, and leaders talked about their own behaviour *after* the interviewer asked about it. This "licence to preach" may improve responses to leaders' low-carbon actions (Raihani and Power 2021; Bolderdijk 2023). (4) *Be consistent over time.* People are highly attuned to publicity stunts and opportunism from leaders. Our vignettes presented leaders as having changed their behaviour for the past two years, which may have increased trust and signalled long-term commitment. Further research could investigate the effects of leaders communicating more recent behaviour changes. (5) *Acknowledge other people's situational and temporal realities.* Leaders are likely to have more choice in their behavioural options than other people, and more scope to reduce emissions immediately (Nielsen et al. 2021). Our vignettes acknowledged that "not everybody will be able to do the same", which may have helped to avoid reactance based on perceptions of inequality and privilege (Raihani and Power 2021).

These recommendations may not be easy for leaders to follow as they represent a potentially substantial shift in behaviour that involves some effort and even sacrifice. Indeed it may be this perceived effort that enhanced our leaders' credibility in the eyes of respondents (Henrich 2009, 2015; Kraft-Todd et al. 2018; Raihani and Power 2021). As such, we suggest that these recommendations are consistent with an "embodied leadership" approach whereby the leaders' actions convey a meaningful physical commitment to tackling climate change and willingness to take effortful action that matches the scale of the problem.

Limitations and future research. There are some important limitations to the research. As already mentioned, expressed willingness to act by respondents does not necessarily translate to actual behavioural change. Further research could therefore seek to quantify tangible changes triggered by leaders who adopt low-carbon actions in practice, notwithstanding the challenges of attributing causality. However, for our study, willingness was considered a useful metric as it allowed us to measure potential differences in respondents' enthusiasm for action that may not have been captured by measures of intention or actual behaviour change. The realism of our experimental vignettes should be considered. The vignettes included a very clear contrast between leaders who appeared to be acting in line with their words, and leaders who were not. This contrast may be less clear-cut in reality, with leaders perhaps more likely to avoid the topic of specific behaviour changes rather than saying "we need behaviour change, but I haven't changed yet", which is the (much simplified) message of our not-leading-by-example vignettes. There are, however, many examples in the media where such contrasts between words and actions *are* highlighted, for instance an interview with the UK Labour Party's shadow business secretary Ed Miliband where he was rebuked explicitly for not "leading by example" when he revealed he did not have an electric car despite advocating strongly for an "electric car revolution" (Gant 2021). Furthermore, simple internet searches of "climate hypocrisy" produce hundreds of headlines about leaders, such as this one in the Washington Post: "Gore, Kerry and Gates: Hypocritical climate change warriors living large". The article questions the sincerity of the leaders by highlighting their private jet use, large property portfolios, and fossil fuel investments. While these leaders may not explicitly prioritise behaviour change, and attacks on them may involve bad-faith, strong scientific evidence from the IPCC states that substantial demand reduction in the shape of behaviour change will be necessary (Portner et al. 2022). Therefore leaders who advocate for climate action in line with scientific advice can be viewed as *implicitly* calling for behaviour change, such that a lack of visible personal action can be (and often is) viewed as hypocrisy. As such, we suggest that our experimental vignettes reflect a pertinent dichotomy between embodied leadership (leading by example) and verbal leadership (without leading by example) that very much exists in the real world. A further limitation is that ours is a single-country study, limiting its generalisability. Further research including cohorts from other nations would be valuable to explore whether cultural differences alter responses to leading by example. We have already mentioned the limitations of focusing on a single leader taking low-carbon action. Future research could explore whether multiple example-setting leaders stimulate greater effects, particularly relating to willingness to act. Our study looks at only two types of leader, politicians and celebrities, in quite a simple way. Future research could involve more sophisticated stimuli and study the behavioural influence of other leaders, for example business leaders, religious leaders and local community leaders. While our study considers leaders adopting a suite of low-carbon behaviours that represent an "embodied" approach to climate change, it may be more common that leaders advocate for a single type of behaviour change that is relatively easy for them and/or appropriate for a particular campaign or policy objective. Further research could explore the comparative effects on leader credibility and behavioural influence of exemplifying multiple vs single behaviours.

Conclusion

The evidence from our study points towards strong signalling effects of politicians and celebrities leading by example with high-

impact low-carbon actions. These effects include increasing the willingness of others to change their behaviour and raising perceptions of leader credibility, trustworthiness and effectiveness. Our findings support the theories of credibility enhancing displays and embodied leadership whereby effortful actions convey signals and meanings to observers that words alone do not. In view of this, leading by example goes well beyond the mere reduction in a leader's own carbon footprint by encouraging others to act and giving them greater confidence that climate leaders are serious about tackling climate change in a just and fair way. This could have wider climate mitigation impacts as willingness to adopt new norms and behaviours has been cited as an important factor in triggering social tipping points where rapid changes to behavioural norms could occur (Lenton et al. 2022). We suggest, therefore, that leading by example with high-impact low-carbon behaviours could help society to escape the “governance trap” that sees governments and individuals waiting for each other to act (Pidgeon 2012; Newell et al. 2015). As such, we suggest leading by example could represent a crucial “missing link” in climate change mitigation.

Data availability

The dataset generated during and analysed during this study is publicly available via OSF. <https://doi.org/10.17605/OSF.IO/83UXA>.

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Note

1 Respondents only saw the word relevant to their experimental condition (either “politician” or “celebrity”). This applies to all such survey questions.

References

- Abrahamse W, Steg L (2013) Social influence approaches to encourage resource conservation: a meta-analysis. *Glob Environ Change* 23(6):1773–1785. <https://doi.org/10.1016/j.gloenvcha.2013.07.029>
- Akenji L et al. (2021) 1.5-degree lifestyles: towards a fair consumption space for all. <https://hotorcool.org/1-5-degree-lifestyles/>
- Alexander J (2013) The case of the green vampire: eco-celebrity, Twitter and youth engagement. *Celebrity Stud* 4(3):353–368. <https://doi.org/10.1080/19392397.2013.831625>
- Attari SZ, Krantz DH, Weber EU (2016) Statements about climate researchers' carbon footprints affect their credibility and the impact of their advice. *Clim Change* 138(1–2):325–338. <https://doi.org/10.1007/s10584-016-1713-2>
- Attari SZ, Krantz DH, Weber EU (2019) Climate change communicators' carbon footprints affect their audience's policy support. *Clim Change* 154(3–4):529–545. <https://doi.org/10.1007/s10584-019-02463-0>
- Bashir NY, Lockwood P, Chasteen AL, Nadolny D, Noyes I (2013) The ironic impact of activists: negative stereotypes reduce social change influence. *Eur J Soc Psychol* 43(7):614–626. <https://doi.org/10.1002/ejsp.1983>
- Bateman TS, Mann ME (2016) The supply of climate leaders must grow. *Nat Clim Change* 6(12):1052–1054. <https://doi.org/10.1038/nclimate3166>
- Bedford T, Collingwood P, Darnton A, Evans D, Gatersleben B, Abrahamse W, Jackson T (2010) Motivations for pro-environmental behaviour—a research report completed for the Department for Environment, Food and Rural Affairs. DEFRA. <https://randd.defra.gov.uk/ProjectDetails.aspx?ProjectId=15628>
- Benulic K-S, Kropf M, Linnér B-O, Wibeck V (2022) The meaning of leadership in polycentric climate action. *Environ Politics* 31(6):1016–1036. <https://doi.org/10.1080/09644016.2021.1970087>
- Bickerstaff K, Simmons P, Pidgeon N (2008) Constructing responsibilities for risk: negotiating citizen—state relationships. *Environ Plan A* 40(6):1312–1330. <https://doi.org/10.1068/a39150>
- Bilandzic H, Kalch A, Soentgen J (2017) Effects of goal framing and emotions on perceived threat and willingness to sacrifice for climate change. *Sci Commun* 39(4):466–491. <https://doi.org/10.1177/1075547017718553>
- Boin A, Hart P, Stern E, Sundelius B (2017) The politics of crisis management: public leadership under pressure. Cambridge University Press. https://doi.org/10.1111/j.1467-9299.2007.00656_8.x
- Bolderdijk JW, Cornelissen G (2022) How do you know someone's vegan? They won't always tell you. An empirical test of the do-gooder's dilemma. *Appetite* 168:105719. <https://doi.org/10.1016/j.appet.2021.105719>
- Bolderdijk JW (2023) Words speak louder than actions. <https://www.uva.nl/en/profile/b/o/j.w.bolderdijk/j.w.bolderdijk.html#Profile>
- Bonaccio S, O'Reilly J, O'Sullivan SL, Chiochio F (2016) Nonverbal behavior and communication in the workplace: a review and an agenda for research. *J Manag* 42(5):1044–1074. <https://doi.org/10.1177/0149206315621146>
- Boykoff MT, Goodman MK (2009) Conspicuous redemption? Reflections on the promises and perils of the ‘celebritization’ of climate change. *Geoforum* 40(3):395–406. <https://doi.org/10.1016/j.geoforum.2008.04.006>
- Calder Si (2022) Liz Truss flew by private jet to Australia at cost of £500,000 to taxpayers. *The Independent*. Available at: <https://www.independent.co.uk/travel/news-and-advice/liz-truss-australia-private-jet-flight-b2001692.html>. Accessed 27 Jan 2022
- Capstick S, Lorenzoni I, Corner A, Whitmarsh L (2014) Prospects for radical emissions reduction through behavior and lifestyle change. *Carbon Manag* 5(4):429–445. <https://doi.org/10.1080/17583004.2015.1020011>
- Capstick S, Demski C, Sposato RG, Pidgeon N, Spence A, Corner A (2015) Public perceptions of climate change in Britain following the winter 2013/2014 flooding. Understanding Risk Group—Cardiff University. <http://orca.cf.ac.uk/74368/1/URG%2015-01%20Flood%20Climate%20report%201%20May%202015%20final.pdf>. Accessed 2 Oct 2020
- Capstick S, Khosla R, Wang S (2020) Bridging the gap—the role of equitable low-carbon lifestyles. United Nations Environment Programme Emissions Gap Report 2020
- Choi Y, Mai-Dalton RR (1998) On the leadership function of self-sacrifice. *Leadersh Q* 9(4):475–501. [https://doi.org/10.1016/S1048-9843\(98\)90012-1](https://doi.org/10.1016/S1048-9843(98)90012-1)
- Clark N (2021) Boris Johnson to jet home from COP26 despite urging others to take train. *The Sun*. 1 November. <https://www.thesun.co.uk/news/16604165/boris-johnson-fly-cop26-jet-train/>. Accessed 8 Aug 2022
- Cole H (2019) Actress Emma Thompson spotted on carbon-spewing BA plane to New York. *Mail Online*. 4 May. <https://www.dailymail.co.uk/news/article-6993173/Actress-Emma-Thompson-spotted-carbon-spewing-BA-plane-jetting-New-York.html>. Accessed 7 May 2019
- Cremer DD, Knippenberg Dvan (2004) Leader self-sacrifice and leadership effectiveness: the moderating role of leader self-confidence. *Organ Behav Hum Decis Process* 95(2):140–155. <https://doi.org/10.1016/j.obhdp.2004.04.002>
- Creutzig F et al. (2022) Demand, services and social aspects of mitigation. In: *Climate change 2022: mitigation of climate change. Contribution of Working Group III to the sixth assessment report of the intergovernmental panel on climate change*. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter_05.pdf. Accessed 12 Nov 2022
- Demski C, Butler C, Parkhill KA, Spence A, Pidgeon NF (2015) Public values for energy system change. *Glob Environ Change* 34:59–69. <https://doi.org/10.1016/j.gloenvcha.2015.06.014>
- Diez T, von Lucke F (2023) Global justice and EU climate policy in a contested liberal international order. *Int Aff* 99(6):2221–2239. <https://doi.org/10.1093/ia/iaad231>
- Doherty KL, Weblen TN (2016) Social norms and efficacy beliefs drive the Alarmed segment's public-sphere climate actions. *Nat Clim Change* 6(9):879–884. <https://doi.org/10.1038/nclimate3025>
- Donders ART, van der Heijden GJMG, Stijnen T, Moons KGM (2006) Review: a gentle introduction to imputation of missing values. *J Clin Epidemiol* 59(10):1087–1091. <https://doi.org/10.1016/j.jclinepi.2006.01.014>
- Doyle J, Farrell N, Goodman MK (2017) *Celebrities and climate change*. Oxford University Press. <https://doi.org/10.1093/acrefore/9780190228620.013.596>
- Edelman (2020a) Edelman trust barometer 2020 global. https://www.edelman.com/sites/g/files/aattus191/files/2020-01/2020%20Edelman%20Trust%20Barometer%20Global%20Report_LIVE.pdf
- Edelman (2020b) Edelman trust barometer 2020 UK supplement. <https://www.edelman.co.uk/sites/g/files/aattus301/files/2020-02/2020%20Edelman%20Trust%20Barometer%20UK%20Launch%20Deck.pdf>
- Ferguson MA, Branscombe NR (2010) Collective guilt mediates the effect of beliefs about global warming on willingness to engage in mitigation behavior. *J Environ Psychol* 30(2):135–142. <https://doi.org/10.1016/j.jenvp.2009.11.010>
- Field A (2018) *Discovering statistics using IBM SPSS statistics*, 5th edn. SAGE Publications Ltd
- Fiske ST (2018) Stereotype content: warmth and competence endure. *Curr Dir Psychol Sci* 27(2):67–73. <https://doi.org/10.1177/0963721417738825>
- Fritsche I, Barth M, Jugert P, Masson T, Reese G (2018) A social identity model of pro-environmental action (SIMPEA). *Psychol Rev* 125(2):245–269. <https://doi.org/10.1037/rev000090>
- Fritz L, Hansmann R, Dalimier B, Binder CR (2023) Perceived impacts of the Fridays for Future climate movement on environmental concern and behaviour in Switzerland. *Sustain Sci* 18(5):2219–2244. <https://doi.org/10.1007/s11625-023-01348-7>
- Gant J (2021) Ed Miliband says UK needs ‘electric cars’... but DOESN'T own one. *Mail Online*. <https://www.dailymail.co.uk/news/article-9400979/Ed-Miliband->

- declares-UK-needs-electric-car-revolution-admitting-DOESNT-one.html. Accessed 31 May 2021
- Geiger N, Swim JK, Glenna L (2019) Spread the green word: a social community perspective into environmentally sustainable behavior. *Environ Behav* 51(5):561–589. <https://doi.org/10.1177/0013916518812925>
- Gill R (2011) *Theory and practice of leadership*, 2nd ed. SAGE, Thousand Oaks, CA, London
- Glenberg AM (2010) Embodiment as a unifying perspective for psychology: embodiment as a unifying perspective. *Wiley Interdiscip Rev Cogn Sci* 1(4):586–596. <https://doi.org/10.1002/wcs.55>
- Goodwin J (2020) Should climate scientists fly? A case study of arguments at the system level. *Informal Log* 40(2):157–203. <https://doi.org/10.22329/il.v40i2.6327>
- Gore T (2020) *Confronting carbon inequality: putting climate justice at the heart of the COVID-19 recovery*. Oxfam. <https://oxfamlibrary.openrepository.com/bitstream/handle/10546/621052/mb-confronting-carbon-inequality-210920-en.pdf>
- Gössling S (2019a) Celebrities, air travel, and social norms. *Ann Tour Res* 79:102775. <https://doi.org/10.1016/j.annals.2019.102775>
- Gössling S (2019b) These celebrities cause 10,000 times more carbon emissions from flying than the average person. *The Conversation*. <http://theconversation.com/these-celebrities-cause-10-000-times-more-carbon-emissions-from-flying-than-the-average-person-123886>. Accessed 23 Oct 2019
- Grint K (2005) Problems, problems, problems: the social construction of leadership. *Hum Relat* 58(11):1467–1494. <https://doi.org/10.1177/0018726705061314>
- van de Grint LTM, Evans AM, Stavrova O (2021) Good eats, bad intentions? Reputational costs of organic consumption. *J Environ Psychol* 75:101622. <https://doi.org/10.1016/j.jenvp.2021.101622>
- Grint K (2010) Wicked problems and clumsy solutions: the role of leadership. In: *The new public leadership challenge*. Palgrave Macmillan, pp 169–186
- Haslam SA, Reicher SD, Platow MJ (2020) *The new psychology of leadership: identity, influence and power*. Routledge
- Hayhoe K (2022) *Saving us: a climate scientist's case for hope and healing in a divided world*. One Signal Publishers
- Henrich J (2009) The evolution of costly displays, cooperation and religion. *Evol Hum Behav* 30(4):244–260. <https://doi.org/10.1016/j.evolhumbehav.2009.03.005>
- Henrich J (2015) *The secret of our success: how culture is driving human evolution, domesticating our species, and making us smarter*. Princeton University Press
- Holzmer D (2013) Leadership in the time of liminality. In: *The embodiment of leadership: a volume in the international leadership series, building leadership bridges*. Wiley
- Hornsey MJ, Harris EA, Bain PG, Fielding KS (2016) Meta-analyses of the determinants and outcomes of belief in climate change. *Nat Clim Change* 6(6):622–626. <https://doi.org/10.1038/nclimate2943>
- Hosking G (2014) *Trust: a history*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780198712381.001.0001>
- Howell D (2013) *Statistical methods for psychology*, 8th edn. Wadsworth Cengage Learning, Australia
- Jackson T (2005) Motivating sustainable consumption. *Sustainable Development Research Network*, p 30. <https://timjackson.org.uk/wp-content/uploads/2018/04/Jackson-2005-Motivating-Sustainable-Consumption.pdf>. Accessed 3 Dec 2016
- Johnson SK, Murphy SE, Zewdie S, Reichard RJ (2008) The strong, sensitive type: effects of gender stereotypes and leadership prototypes on the evaluation of male and female leaders. *Organ Behav Hum Decis Process* 106(1):39–60. <https://doi.org/10.1016/j.obhdp.2007.12.002>
- Jugert P, Greenaway KH, Barth M, Büchner R, Eisentraut S, Fritsche I (2016) Collective efficacy increases pro-environmental intentions through increasing self-efficacy. *J Environ Psychol* 48:12–23. <https://doi.org/10.1016/j.jenvp.2016.08.003>
- Khalfan A et al. (2023) Climate equality: a planet for the 99%. *Oxfam International*. <https://policy-practice.oxfam.org/resources/climate-equality-a-planet-for-the-99-621551/>
- Knights D (2021) *Leadership, gender and ethics: embodied reason in challenging masculinities*, 1st edn. Routledge. <https://doi.org/10.4324/9781351030342>
- Kollmuss A, Agyeman J (2002) Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ Educ Res* 8(3):239–260. <https://doi.org/10.1080/13504620220145401>
- Kouzes JM, Posner BZ (2004) Follower-oriented leadership. In: *Encyclopedia of leadership*. SAGE Publications. <https://doi.org/10.4135/9781412952392.n111>
- Kraft-Todd GT, Bollinger B, Gillingham K, Lamp S, Rand DG (2018) Credibility-enhancing displays promote the provision of non-normative public goods. *Nature* 563(7730):245–248. <https://doi.org/10.1038/s41586-018-0647-4>
- Kukowski CA, Bernecker K, Nielsen KS, Hofmann W, Brandstätter V (2023) Regulate me! Self-control dissatisfaction in meat reduction success relates to stronger support for behavior-regulating policy. *J Environ Psychol* 85:101922. <https://doi.org/10.1016/j.jenvp.2022.101922>
- Kukowski CA, Garnett EE (2023) Tackling inequality is essential for behaviour change for net zero. *Nat Clim Change* 1–3. <https://doi.org/10.1038/s41558-023-01900-4>
- Lakoff G (1995) Metaphor, morality, and politics, or, why conservatives have left liberals in the dust. *Soc Res* 62(2):177–213
- Laustens L, Bor A (2017) The relative weight of character traits in political candidate evaluations: warmth is more important than competence, leadership and integrity. *Elect Stud* 49:96–107. <https://doi.org/10.1016/j.electstud.2017.08.001>
- Lee TM, Markowitz EM, Howe PD, Ko C-Y, Leiserowitz AA (2015) Predictors of public climate change awareness and risk perception around the world. *Nat Clim Change* 5(11):1014–1020. <https://doi.org/10.1038/nclimate2728>
- de Leeuw ED, Hox JJ, Boevé A (2016) Handling do-not-know answers: exploring new approaches in online and mixed-mode surveys. *Soc Sci Comput Res* 34(1):116–132. <https://doi.org/10.1177/0894439315573744>
- Lenton TM et al. (2022) Operationalising positive tipping points towards global sustainability. *Glob Sustain* 5:e1. <https://doi.org/10.1017/sus.2021.30>
- Levin K, Cashore B, Bernstein S, Auld G (2012) Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. *Policy Sci* 45(2):123–152. <https://doi.org/10.1007/s11077-012-9151-0>
- Li LMW, Xia W, Ito K (2023) Stereotypes of pro-environmental people: perception of competence and warmth. *J Environ Psychol* 91:102133. <https://doi.org/10.1016/j.jenvp.2023.102133>
- Lord RG, Shondrick SJ (2011) Leadership and knowledge: symbolic, connectionist, and embodied perspectives. *Leadersh Q* 22(1):207–222. <https://doi.org/10.1016/j.leaqua.2010.12.016>
- Lowe KB, Kroeck KG, Sivasubramaniam N (1996) Effectiveness correlates of transformational and transactional leadership: a meta-analytic review of the MLQ literature. *Leadersh Q* 7(3):385–425. [https://doi.org/10.1016/S1048-9843\(96\)90027-2](https://doi.org/10.1016/S1048-9843(96)90027-2)
- Macias T (2015) Risks, trust, and sacrifice: social structural motivators for environmental change*. *Soc Sci Q* 96(5):1264–1276. <https://doi.org/10.1111/ssqu.12201>
- Mann ME (2021) *The new climate war: the fight to take back our planet*. Public Affairs
- Markowski KL, Roxburgh S (2019) If I became a vegan, my family and friends would hate me.* Anticipating vegan stigma as a barrier to plant-based diets. *Appetite* 135:1–9. <https://doi.org/10.1016/j.appet.2018.12.040>
- Masson-Delmotte V et al. (2018) *An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. IPCC. <https://www.ipcc.ch/sr15/>
- McCright AM, Dunlap RE, Marquart-Pyatt ST (2016) Political ideology and views about climate change in the European Union. *Environ Politics* 25(2):338–358. <https://doi.org/10.1080/09644016.2015.1090371>
- Minson JA, Monin B (2012) Do-gooder derogation: disparaging morally motivated minorities to defuse anticipated reproach. *Soc Psychol Personal Sci* 3(2):200–207. <https://doi.org/10.1177/1948550611415695>
- Mols F, Haslam SA, Jetten J, Steffens NK (2015) Why a nudge is not enough: a social identity critique of governance by stealth. *Eur J Polit Res* 54(1):81–98. <https://doi.org/10.1111/1475-6765.12073>
- Monin B, Sawyer PJ, Marquez MJ (2008) The rejection of moral rebels: Resenting those who do the right thing. *J Personal Soc Psychol* 95(1):76–93. <https://doi.org/10.1037/0022-3514.95.1.76>
- Moore FC, Lacasse K, Mach KJ, Shin YA, Gross LJ, Beckage B (2022) Determinants of emissions pathways in the coupled climate–social system. *Nature* 603(7899):103–111. <https://doi.org/10.1038/s41586-022-04423-8>
- Nelson S, Allwood J (2021) Technology or behaviour? Balanced disruption in the race to net zero emissions. *Energy Res Soc Sci* 78:102124. <https://doi.org/10.1016/j.erss.2021.102124>
- Newell P, Bulkeley H, Turner K, Shaw C, Caney S, Shove E, Pidgeon N (2015) Governance traps in climate change politics: re-framing the debate in terms of responsibilities and rights. *Wiley Interdiscip Rev Clim Change* 6(6):535–540. <https://doi.org/10.1002/wcc.356>
- Newell P, Daley F, Twena M (2021) *Changing our ways? Behaviour change and the climate crisis*. The Cambridge Sustainability Commission on Scaling Behaviour Change. <https://www.cambridge.org/core/journals/global-sustainability/cambridge-sustainability-commissions/changing-our-ways>
- Newman N, Fletcher R, Schulz A, Andi S, Nielsen RK (2020) *Reuters Institute digital news report 2020*. Reuters Institute. https://reutersinstitute.politics.ox.ac.uk/sites/default/files/2020-06/DNR_2020_FINAL.pdf
- Nielsen KS, Nicholas KA, Creutzig F, Dietz T, Stern PC (2021) The role of high-socioeconomic-status people in locking in or rapidly reducing energy-driven greenhouse gas emissions. *Nat Energy* 1–6. <https://doi.org/10.1038/s41560-021-00900-y>
- Northouse PG (2015) *Leadership: theory and practice*, 7th edn. Sage, Los Angeles
- Northouse PG (2021) *Leadership: theory and practice*, 9th edn. Sage, Thousand Oaks
- Oberthür S, Roche Kelly C (2008) EU leadership in international climate policy: achievements and challenges. *Int Spect* 43(3):35–50. <https://doi.org/10.1080/03932720802280594>

- Olmedo A et al. (2020) A scoping review of celebrity endorsement in environmental campaigns and evidence for its effectiveness. *Conserv Sci Pract* 2(10):e261. <https://doi.org/10.1111/csp.2.261>
- Otto IM, Kim KM, Dubrovsky N, Lucht W (2019) Shift the focus from the super-poor to the super-rich. *Nat Clim Change* 9(2):82–84. <https://doi.org/10.1038/s41558-019-0402-3>
- Palan S, Schitter C (2018) Prolific.ac—a subject pool for online experiments. *J Behav Exp Financ* 17:22–27. <https://doi.org/10.1016/j.jbef.2017.12.004>
- Palm R, Bolsen T, Kingsland JT (2020) ‘Don’t tell me what to do’: resistance to climate change messages suggesting behavior changes. *Weather Clim Soc* 1–29. <https://doi.org/10.1175/WCAS-D-19-0141.1>
- Parra Vargas E, Philip J, Carrasco-Ribelles LA, Alice Chicchi Giglioli I, Valenza G, Marin-Morales J, Alcañiz Raya M (2023) The neurophysiological basis of leadership: a machine learning approach. *Manag Decis* 61(6):1465–1484. <https://doi.org/10.1108/MD-02-2022-0208>
- Perugini M, Gallucci M, Costantini G (2018) A practical primer to power analysis for simple experimental designs. *Int Rev Soc Psychol* 31(1):20. <https://doi.org/10.5334/irsp.181>
- Pidgeon N (2012) Public understanding of, and attitudes to, climate change: UK and international perspectives and policy. *Clim Policy* 12(sup01):S85–S106. <https://doi.org/10.1080/14693062.2012.702982>
- Poortinga W, Whitmarsh L, Steg L, Böhm G, Fisher S (2019) Climate change perceptions and their individual-level determinants: a cross-European analysis. *Glob Environ Change* 55:25–35. <https://doi.org/10.1016/j.gloenvcha.2019.01.007>
- Portner H-O et al. (2022) Climate change 2022: impacts, adaptation and vulnerability. Contribution of Working Group II to the sixth assessment report of the intergovernmental panel on climate change. IPCC
- Raihani NJ, Power EA (2021) No good deed goes unpunished: the social costs of prosocial behaviour. *Evolut Hum Sci* 3:e40. <https://doi.org/10.1017/ehs.2021.35>
- Salkind NJ (2010) Order effects. In: Salkind NJ (ed) *Encyclopedia of research design*. <https://doi.org/10.4135/9781412961288>
- Scarborough R (2023) Gore, Kerry and Gates: Hypocritical climate change warriors living large. *The Washington Times*. <https://www.washingtontimes.com/news/2023/nov/20/gore-kerry-and-gates-hypocritical-climate-change-w/>. Accessed 28 May 2024
- Schuldt JP (2017) Brief exposure to Pope Francis heightens moral beliefs about climate change. *Clim Change* 11. <https://doi.org/10.1007/s10584-016-1893-9>
- Schunz S (2019) The European Union’s environmental foreign policy: from planning to a strategy? *Int Politics* 56(3):339–358. <https://doi.org/10.1057/s41311-017-0130-0>
- Severijns R, Streukens S, Brouwer J, Lizin S (2023) Social influence and reduction of animal protein consumption among young adults: insights from a socio-psychological model. *J Environ Psychol* 90:102094. <https://doi.org/10.1016/j.jenvp.2023.102094>
- Shukla PR et al. (2022) Summary for policymakers. In: *Climate change 2022: mitigation of climate change*. Contribution of Working Group III to the sixth assessment report of the intergovernmental panel on climate change. IPCC
- Sinclair A (2005) Body possibilities in leadership. *Leadership* 1(4):387–406. <https://doi.org/10.1177/1742715005057231>
- Skjærseth JB (2016) Linking EU climate and energy policies: policy-making, implementation and reform. *Int Environ Agreem Politics Law Econ* 16(4):509–523. <https://doi.org/10.1007/s10784-014-9262-5>
- Skjærseth JB, Andresen S, Bang G, Heggelund GM (2021) The Paris agreement and key actors’ domestic climate policy mixes: comparative patterns. *Int Environ Agreem Politics Law Econ* 21(1):59–73. <https://doi.org/10.1007/s10784-021-09531-w>
- Smith M (2023) Rishi Sunak’s 200-mile helicopter trip—train journey is just 10 min more. *The Mirror*. <https://www.mirror.co.uk/news/politics/rishi-sunaks-200-mile-helicopter-30584807>. Accessed 31 July 2023
- Sommerlad J (2021) Sir Keir Starmer condemned by environmental activists for flying to Edinburgh. *The Independent*. <https://www.independent.co.uk/climate-change/news/climate-keir-starmer-labour-flight-b1833733.html>. Accessed 14 June 2021
- Sparkman G, Attari SZ (2020) Credibility, communication, and climate change: How lifestyle inconsistency and do-gooder derogation impact decarbonization advocacy. *Energy Res Soc Sci* 59:101290. <https://doi.org/10.1016/j.erss.2019.101290>
- Steenjens K et al. (2017) European Perceptions of Climate Change (EPCC): topline findings of a survey conducted in four European countries in 2016. EPCC. <http://orca.cf.ac.uk/98660/7/EPCC.pdf>. Accessed 10 May 2017
- Steg L, Bolderdijk JW, Keizer K, Perlaviciute G (2014) An integrated framework for encouraging pro-environmental behaviour: the role of values, situational factors and goals. *J Environ Psychol* 38:104–115. <https://doi.org/10.1016/j.jenvp.2014.01.002>
- Stoddard I et al. (2021) Three decades of climate mitigation: why haven’t we bent the global emissions curve? *Annu Rev Environ Resour* 46(1):653–689. <https://doi.org/10.1146/annurev-environ-012220-011104>
- Sultana F (2023) Whose growth in whose planetary boundaries? Decolonising planetary justice in the Anthropocene. *Geo Geogr Environ* 10(2). <https://onlinelibrary.wiley.com/doi/abs/10.1002/geo2.128>. Accessed 7 June 2024
- Supran G, Oreskes N (2021) Rhetoric and frame analysis of ExxonMobil’s climate change communications. *One Earth* 4(5):696–719. <https://doi.org/10.1016/j.oneear.2021.04.014>
- Sussman R, Greeno M, Gifford R, Scannell L (2013) The effectiveness of models and prompts on waste diversion: a field experiment on composting by cafeteria patrons. *J Appl Soc Psychol* 43(1):24–34. <https://doi.org/10.1111/j.1559-1816.2012.00978.x>
- Tankard ME, Paluck EL (2016) Norm perception as a vehicle for social change: vehicle for social change. *Soc Issues Policy Rev* 10(1):181–211. <https://doi.org/10.1111/sipr.12022>
- Thunberg G, Capstick S, Whitmarsh L (2022) Individual action, social transformation. In: *The climate book*. Penguin, UK
- UK Climate Assembly (2020) The path to net zero. House of Commons. <https://www.climateassembly.uk/recommendations/www.climateassembly.uk/report/>
- UK Govt. (2021) Net zero strategy: build back greener. UK Government. <https://www.gov.uk/government/publications/net-zero-strategy>
- Vesely S et al. (2021) Climate change action as a project of identity: eight meta-analyses. *Glob Environ Change* 70:102322. <https://doi.org/10.1016/j.gloenvcha.2021.102322>
- Vidal J (2019) Well done, Prince Harry, for talking about population—but ditch the private jets. *The Guardian*. 31 July. <https://www.theguardian.com/commentisfree/2019/jul/31/prince-harry-talking-population-royal-family-two-children>. Accessed 1 August 2019
- Westlake S, Demski C, Pidgeon N (2024) We can’t be too saintly”: Why members of parliament in the United Kingdom are reluctant to lead by example with low-carbon behaviour. *Energy Res Soc Sci* 117:103717. <https://doi.org/10.1016/j.erss.2024.103717>
- Westlake S (2017) A counter-narrative to carbon supremacy: do leaders who give up flying because of climate change influence the attitudes and behaviour of others? SSRN. <https://papers.ssrn.com/abstract=3283157>
- Whitmarsh L, O’Neill S (2010) Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *J Environ Psychol* 30(3):305–314. <https://doi.org/10.1016/j.jenvp.2010.01.003>
- Whitmarsh L, Corner A (2017) Tools for a new climate conversation: a mixed-methods study of language for public engagement across the political spectrum. *Glob Environ Change* 42:122–135. <https://doi.org/10.1016/j.gloenvcha.2016.12.008>
- Whitmarsh L, Poortinga W, Capstick S (2021) Behaviour change to address climate change. *Curr Opin Psychol* 42:76–81. <https://doi.org/10.1016/j.copsyc.2021.04.002>
- Whitmarsh L, Capstick S, Moore I, Köhler J, Le Quére C (2020) Use of aviation by climate change researchers: structural influences, personal attitudes, and information provision. *Glob Environ Change* 65:102184. <https://doi.org/10.1016/j.gloenvcha.2020.102184>
- Williams R, Raffo DM, Randy Clark W, Clark LA (2022) A systematic review of leader credibility: its murky framework needs clarity. *Manag Rev Q*. <https://doi.org/10.1007/s11301-022-00285-6>
- Willis R (2020) Too hot to handle? The democratic challenge of climate change. Bristol University Press
- Wynes S, Nicholas KA (2017) The climate mitigation gap: education and government recommendations miss the most effective individual actions. *Environ Res Lett* 12(7):074024. <https://doi.org/10.1088/1748-9326/aa7541>
- Van Zant AB, Moore DA (2015) Leaders’ use of moral justifications increases policy support. *Psychol Sci* 26(6):934–943. <https://doi.org/10.1177/0956797615572909>

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Author contributions

Steve Westlake: conceptualisation, theoretical framework, research design, data gathering, analysis, writing—original draft, writing—revisions, writing—approval of final version; Christina Demski: conceptualisation, theoretical framework, research design, writing—review and editing; Nick Pidgeon: theoretical framework, research design, writing—review and editing.

Competing interests

The authors declare no competing interests.

Ethical approval

The survey and methodology were examined, approved, and endorsed by the School of Psychology Research Ethics Committee at Cardiff University on 12 March 2021 (ref: EC.21.01.12.6239R2A). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Informed consent

Informed consent was obtained from all participants before the data were collected. We informed each participant of their rights, the purpose of the study, and our procedures to safeguard their personal information.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-024-03787-8>.

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