Vote, Tweet, Campaign, Repeat: Using Twitter to predict environmental voting intentions

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Abstract

Government policies are key to combating climate change and biodiversity loss, however political action requires electoral support. Engaging with the electorate through social media is an integral part of political communications, informing voters on politicians' voting intentions. Here, we examine whether environmental messaging on Twitter by UK politicians can be used to predict the likelihood of them voting for pro-environmental measures. Using historical Twitter data and voting records, we determine that environmental messaging has increased over the last decade, but the probability of voting environmentally has not. Instead, voting trends are highly heterogenous over time, varying by political party. However, after accounting for party effects, politicians with higher levels of environmental messaging are more likely to vote against party lines in favour of environmental measures. This work suggests that environmental messaging can be used to inform voting intentions, but is a poor predictor compared to political party association.

Introduction

In 2019 the UK government passed a motion to declare an environment and climate change emergency¹. The motion was proposed by the then opposition leader Jeremy Corbyn stating: "This is no longer about a distant future, we're talking about nothing less than the irreversible destruction of the environment within our lifetimes." Despite setting no legal requirements, declarations such as this are seen as the strongest statements from

governments, with hopes that they could lead to a change in response to environmental issues ². Although there has been a recent increase in climate action ², climate and the environment have been talking points across the political spectrum for decades: "The danger of global warming is as yet unseen, but real enough for us to make changes and sacrifices, so that we do not live at the expense of future generations" Margaret Thatcher, 1990; "Our effect on the environment, and in particular on climate change, is large and growing", Tony Blair, 2004; "Whether you like it or not it is a matter of when, not if, your country and your people will have to deal with the security impact of climate change," Boris Johnson, 2020.

There is increasing global pressure on governments to address the effects of anthropogenic changes to biodiversity and climate ³⁻⁵. This change in attitude has largely come about due to high profile international conventions and reports (e.g. ⁶⁻⁸), as well as a rising public awareness through increasing mainstream media coverage ^{9,10}. This in turn led to the Paris Climate Change Agreement ¹¹, a legally binding international agreement to limit global warming to below 2°C compared to pre-industrial levels. All in all, indicating a political will to address the current biodiversity and climate crisis, supported by both the scientific community ¹² and members of the public ¹³.

Government policies are a key measure in combating climate change and biodiversity loss, yet political action requires support from the electorate ¹⁴. As a result, there is incentive for politicians to demonstrate that their views on particular subjects (e.g. biodiversity loss) are in alignment with targeted sections of the electorate. Enter Twitter. Since its creation in 2006, Twitter has rapidly become a core part of political messaging and strategy across the world ¹⁵⁻¹⁸, allowing politicians to self-promote and curate a favourable public persona ¹⁹. Furthermore, studies have shown that social media activity can be closely related to electoral outcomes ¹⁹⁻²², even though social media users do not represent an unbiased sample of the population ²¹. This motivates politicians to manage accounts in a way that demonstrates their character and personality - traits that interest potential voters ²⁰. For example, in the 2008 US presidential election Barak Obama became the first President to use Twitter as an official form of communication to reach voters, with the majority of

tweets composed by a professional team²³. Obama subsequently became the most followed person on Twitter, with 130 million followers at the time of writing. By the 2016 US election Twitter was a core part of both Hillary Clinton and Donald Trump's election campaigns, despite contrasting styles^{24,25}.

As with all power, the use of Twitter in politics is open to abuse. It is theoretically possible for politicians to curate a persona, that does not accurately reflect their views or voting intentions. A simplified example of this would be a member of the public voting for a politician because of a perceived view as a result of a curated online persona, and the politician then voting in the opposite direction once elected. Similar research has been conducted in businesses, where more sustainable businesses were more likely to promote their sustainability i.e. sustainability advertising was not just a public relations stunt²⁶. However, the same has not yet been evaluated for politicians.

Here, we explore whether UK politicians that are more vocal about environmental matters on Twitter are more likely to vote pro-environmentally. We do this in three stages. First, we determine whether tweets by Members of Parliament (MPs) mentioning environmental terms has changed over the past decade. Second, we determine whether the number of MPs voting for environmental measures has changed over the same time. Finally, we explore whether MPs that are more outspoken on Twitter regarding environmental issues are more likely to vote for the environment. However, the analysis of this final point is complicated by the political party system in UK government. Under this system members of parliament (MPs) are often "whipped" into voting along party lines, with clear career benefits to "toeing the party line" and negatives to "breaking the whip"²⁷. In some cases, however, MPs may dissent as a result of ideological differences²⁷. Since the Climate Change Act in 2008 environmental and climate issues have become an increasing part of political agendas, with cross party support for a number of measures²⁸. However, this is not always the case, meaning that party affiliations are likely to be a key factor in vote patterns. As a result, we control for the whip by determining how likely it is for each MP to deviate from their party line and vote for pro-environmental measures when the party is predicted to vote against (or *vis*

versa) i.e. whether MPs are willing to vote against their party in favour of environmental measures. We expect to see that the majority of variation around vote patterns to be explained by political party, but also that those who tweet more prolifically regarding the environment being more likely to vote in favour of environmental measures. If, however, we find no relationship between environmental messaging and voting intentions, it raises questions about the relationship between the social media persona of politicians and the reality of voting patterns at a key moment in terms of climate change and biodiversity loss.

Methods

Data

Twitter Data

We collated posts on Twitter (where accounts were available – 588 out of 650) from all current MPs (since the 2019 general election). Due to a high turnover of MPs at recent general elections, the ten longest serving MPs (for each political party) that either lost their seat or stood down at or after the 2015 general election were also included to maximise the number of MPs that took part in multiple environmental votes. Where parties had more than ten former MPs, a random sample was taken to make up the ten former MPs per party. In these instances, an additional number of high-profile former MPs (party leaders, cabinet, or shadow cabinet ministers) were also included to account for MPs that may have had relatively short parliamentary careers but had large social media followings and therefore online influence. Independent MPs were treated on a case-by-case basis and assigned to a political party if they were former members of the party for the majority of the period between October 2008 to present, or until their exit from parliament. This information was taken from the UK Parliament website (<https://members.parliament.uk/members/Commons>).

Independent MPs were assigned as independent if they sat as Independents for the majority of the above period. MPs that changed parties were removed from the analysis, as were any belonging to parties with fewer than five MPs over the analysis period. Sinn Féin MPs were

also removed due to their policy of abstentionism, preventing comparison of tweets and votes. A total of 653 MPs were included in the Twitter analysis, with 579 current sitting MPs.

The last (up to) 3,200 tweets (the limit set by Twitter) over the last 10 years (2010-2020) were downloaded for each MP using the *rtweet* R package ²⁹. These tweets were all in the public domain. For some MPs, the 3,200 tweets covered their entire tweet history. For other, more prolific tweeters, the 3,200 tweets only covered a proportion of their tweet history, therefore not all historic tweets are included in the analysis (Figure S1). Not all tweets occurred whilst an individual was an MP, with some tweets occurring prior to election or after leaving parliament.

Using this dataset, all tweets were classified as containing environmental terms or not. These terms included: climate, nature, wildlife, conservation, carbon, emissions, global warming, renewable, flood, drought, ocean acidification, coral bleaching, wildfire, pollution, poaching, fossil fuel, insect decline, extinction, deforestation, microplastic, greenhouse, environment, and terms that stemmed from the following: recycl*, pollinat*, sustain*, and biodivers*. It should be noted that this is not an exhaustive list of environment-based terms and that it is likely that some tweets regarding the environment were missed. Additionally, not all tweets containing these search terms may be about environmental matters (e.g. the term environment could relate to a hostile political environment). However, the list covers a broad range of environmental subjects and provides a fast way of assessing tweets, the vast majority of which will be related to the environment. A total of 17,461 tweets contained at least one environmental term out of a total of 910,214. These tweets were classified as environmental messaging and assigned a score of 1. Tweets without environmental terms i.e. not environmental messaging, were assigned a score of 0.

Parliamentary Data

For the vote data, we compiled 16 environment-related votes. Votes were selected from a Guardian newspaper investigation of MP climate vote records ³⁰. The 16 votes selected (Table 1) were chosen by the Guardian in consultation with a number of environmental

groups and researchers. Their selection of votes aimed to cover a range of policies affecting UK carbon emissions ³¹. Political partisanship is well established in the UK press ^{32,33}, therefore using any single newspaper as a basis of vote selection is open to potential political bias, The Guardian, for example, self identifies as “left leaning” and “a liberal voice”. Whilst using votes selected by a national newspaper raises the possibility of vote selection being biased towards one side or another of the political spectrum, the methodology used by Duncan and Watts (2019) included environmental groups and academics to determine the votes used, with some disagreement between contributors. It should also be noted that this study makes no attempt to discuss the practical, social or financial aspects of each vote and purely looks at the proposed environmental aspects in relation to how MPs tweet about the environment.

MP vote records were taken from the division repository on www.publicwhip.org.uk an independent, not-for-profit, open-source database of divisions in the Houses of Parliament and Lords dating back to 1997. For each division (item to be voted on), MPs that voted pro-environmentally were given a score of 1 and MPs that voted negatively were scored 0. Abstentions, absences and votes for both Aye (meaning yes) and No in a single division were not included in the analysis. MPs that voted in fewer than five votes were removed from the analysis as were any MPs belonging to parties with fewer than five MPs during the analysis period. A total of 374 MPs and 3790 votes were included in the analysis.

Table 1. Sixteen environmental divisions (votes) used in the analysis. Date in day-month-year.

Division	Date
Climate change bill – third reading (and other amendments)	28-10-2008
Airport expansion (parliamentary approval)	24-02-2009
Government to sign up to 10:10 climate change campaign – rejected	21-10-2009

Energy bill – clause 42 – energy efficiency requirement for landlords of private rental properties	14-09-2011
Energy bill – clause 11 – subsidy of nuclear power generation	03-06-2013
Energy bill – clause 1 – requirement to set a decarbonisation target range	04-06-2013
Energy bill – third reading	04-06-2013
Energy bill – clause 10 – financial incentives for larger small scale low carbon generation plants	04-06-2013
Infrastructure bill – new clause 9 – moratorium on onshore unconventional petroleum – review impacts of exploitation	26-01-2015
Infrastructure bill – new clause 1 – environmental permits for hydraulic fracturing activities	26-01-2015
Finance bill – application of climate change levy tax to electricity generated from renewable sources	08-09-2015
Finance bill – clause 42 – vehicle tax – relation to carbon dioxide emissions – surcharge for vehicles costing over £40,000	26-10-2015
Energy bill – new clause 3 – carbon capture and storage strategy for the energy industry	14-03-2016
Energy bill – new clause 8 – setting a decarbonisation target range	14-03-2016
Energy bill – clause 79 – onshore wind power – delay exclusion of onshore wind contribution to renewable electricity generation requirements	14-03-2016
National policy statement: airports – Heathrow north-west runway	25-06-2018

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162 Models

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164 *Change in voting and environmental messaging*

165 To assess how environmental messaging (which we define here as tweets containing at

166 least one environmental term) and voting patterns have changed over time, we developed

two logistic regression models. Both models contained a binary value indicating whether 1) tweets contained environmental terms, or 2) whether MPs voted environmentally. For both models, date, defined as years since 1970, was used as a predictor. For the Twitter model, MPs were included as a random intercept nested within political party. For the vote model, a visual inspection of the vote data showed inconsistent vote trends over time, with some MPs increasing environmental voting over time, and others decreasing. These trends tended to be grouped by party. To account for this, a random slope was included in the model to allow votes to vary over time for MPs nested within political parties.

As an accompaniment to the environmental messaging model, we also characterised overall word use within tweets by identifying the 50 most used words. We then repeated this, using only tweets that contained at least one environmental term. All punctuation and numbers were removed, as well as all stop words (e.g. common words like ‘the’ and ‘a’) specified by the ‘tm’ R package ^{34,35}.

Link between environmental vote records and environmental messaging

To determine if there was a relationship between environmental voting and messaging, we first had to control for the effect of the whip. As a result, we used the ‘Change in voting’ model above to extract the predicted probability of voting environmentally at each vote, for each party – in essence, the party averages over time. Next, we developed individual logistic regressions for each MP, with vote as the response and date of vote as a predictor. From this, we extracted the predicted probability of voting environmentally at each vote, for each MP. We then subtracted each MP’s predicted environmental voting probability from the respective party average, deriving each MP’s deviance from the party line, over time. We then averaged this deviance across the votes and multiplied by 100, creating a percentage deviance score whereby 100% means an MP deviates completely from the party to vote pro environmentally, and -100% means an MP deviates completely from the party to vote against environmental legislation. We only estimated these values for parties with five or

more MPs, leaving only five political parties (Conservative n = 203, Labour n = 130, Scottish National Party n = 5, Liberal Democrats n = 15 & Democratic Unionist Party n = 6).

We developed a generalised least squares regression to understand how environmental messaging and constituency demographics affected the probability of deviating from a party and voting environmentally. Party deviance (inverse hyperbolic sine transformed) was used as a response variable and the following predictors (z transformed) were included to account for differences in constituency demographics and Twitter usage: proportion of environmental tweets per MP, number of Twitter followers per MP (log10 transformed), and the average weekly wages (available from the ONS: Office of National Statistics - published 2019) and population densities (log10 transformed) in each MPs constituency - available from ONS (England and Wales), National Records of Scotland (Scotland), and Northern Ireland Statistics and Research Agency (Northern Ireland) – published 2020, 2020 & 2019 respectively. A random intercept for party was included. An exponential spatial correlation structure (using the constituencies' latitude and longitude centroid) was also included to account for the spatial autocorrelation of MPs from neighbouring constituencies sharing similar voting patterns.

Results

Change in environmental messaging and vote records

No broadly environmental words occurred within the 50 most used words across all tweets (figure 1a), indicating the rarity of tweets on these issues. However, in tweets with at least one environmental term 15 of the 50 most used words were related to sustainability, with themes focussed broadly on the environment and climate change (fig 1b).

Figure 1. The most frequently used words a) across all tweets in the analysis, b) across all tweets in the analysis containing at least one environmental term. Broadly environmental terms are coloured green. Word size is proportional to frequency.

The probability of environmental messaging (i.e. tweets containing environmental terms) increased over time (coef = 0.215, SE = 0.008, $z = 28.38$, $p < 0.001$; Figure 2), where on average, MPs increased sustainable messaging by 24% (odds ratio = 1.24) per year. However, in the majority of cases, the probability of tweet using sustainable messaging remained low (less than one tenth of tweets).

The likelihood of an MP voting environmentally did not change significantly over time (coef = -0.185, SE = 0.227, $z = -0.816$, $p = 0.414$, Figure 3). In both the tweet and vote models the fixed effect (date) explained relatively little of the variation within the data (marginal R^2 of 0.04 and 0.02 respectively). But including random effects for party greatly increased the model fits with a conditional R^2 of 0.22 and 0.74 respectively. The random

slopes were particularly important in the vote model, as MPs followed remarkably similar patterns to the party line.

Figure 2. a) Probability of a tweet containing an environmental term (score = 1) over time. Individual MPs are coloured by party and bold lines indicate party averages. b) Proportion of tweets containing environmental terms by party over the study period. Y-axes have been cropped to 0.15 to show major trends.

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242 Figure 3. a) Probability of voting environmentally (score = 1) across 16 parliamentary votes.
 243 Individual MPs are coloured by party and bold lines indicate party averages. b) Proportion of
 244 environmental votes voted for by parties over the study period.

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246 *Link between environmental voting and environmental messaging*

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248 The probability of deviating from party lines and voting environmentally increased
 249 with environmental messaging (coef = 0.216, SE = 0.06, $t = 3.83$, $p < 0.001$, Figure 4a) and
 250 with average wage (coef = 0.004, SE = 0.002, $t = 2.70$, $p = 0.007$, Figure 4b). Population
 251 density and number of Twitter followers had no effect on the probability of deviating from a
 252 party (Figures 4c and 4d). As with the previous models, the party random intercept effect (as
 253 well as the spatial correlation structure) accounted for a greater proportion of the variation
 254 within the data than the fixed effects alone ($R^{2\text{Marginal}}$: 0.05, $R^{2\text{Conditional}}$: 0.27).

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Figure 4. Marginal effects and 95% confidence intervals of fixed effects in the environmental voting vs tweets and constituency demographics model, with all other variables held at their mean. Fixed effects: a) Percentage of tweets that contain environmental messaging (at least one environmental term). b) Constituency average weekly wage (£). c) Constituency population density (km²). d) Number of followers on Twitter). Points indicate raw values and are coloured by party. Solid lines indicate a significant effect. For c) and d) x-axes are on the log10 scale.

Discussion

We explored how environmental messaging and environmental voting patterns of UK MPs have changed over time and assessed whether messaging was backed up by action on environmental issues, or whether the online presentation of environmental concern was distinct from the realised voting pattern of the MP. We found evidence that environmental messaging has increased over the past decade, but environmental voting has not. Instead, pro-environmental voting decreased in some parties and increased in others, with the vast majority of variation (74%) explained by political parties. In spite of this, we found evidence

that MPs with higher environmental messaging were more likely to vote pro-environmentally, even when the party line was against the proposal, although the overall effect was small.

Our analysis of Twitter data showed that the probability of an MP publishing a tweet containing an environmental term has increased over the past decade from 0.002 in 2010 to 0.016 in 2020. Whilst significant, this increase still only accounts for a small number of tweets published by MPs, as highlighted by the fact that none of the 50 most used words across all tweets are broadly environmental (Fig 1). The increase in likelihood is less surprising than the relative rarity of tweets containing environmental terms. Environmental matters have become increasingly important to both members of the public and political agendas^{28,36}, therefore it makes sense to see an increase in the likelihood of environmental tweets. As we enter a critical period for climate and environmental policy¹¹, it is likely that the prevalence of such tweets will increase in the years to come.

There was no overall increase in the probability of MPs voting for environmental measures over time. As described earlier, political party accounted for the majority of the variation within the data. This is strong evidence to suggest that the best way to determine how an MP is likely to vote on an environmental matter is to determine the party line. It is interesting to note that the two major parties (Labour and Conservative) see a switch in voting intentions, with Labour MPs initially being less likely to vote for environmental matters and Conservative MPs more likely to vote favourably. The switch in voting patterns appears to occur after 2010, therefore it is possible that this switch is due to the results of the 2010 general election that saw a Labour government replaced by a Conservative-Liberal Democrat coalition. Whilst we do not wish to be drawn into the economics of environmental policies, these data may suggest that environmental policies are more favourable to opposition parties than those in power.

The final stage of our analysis investigated the remaining variation within the voting patterns data. Our model found that the likelihood of voting against party lines, in favour of environmental measures was higher when MPs were more vocal about environmental matters on Twitter. It should be noted, however, that the likelihood remains small, with only

an 0.22% increase in the probability of voting with every 1% increase in tweets. Average weekly wage was also positively associated with voting pro-environmentally, with 0.38% increase in probability per £100 increase in constituency-average weekly wages. At the national level it has been shown environmental interest is correlated with wealth³⁷, despite environmental impacts being seen as lower risk³⁸. It is interesting to see some evidence for this trend at a local level, with MPs representing wealthier constituents more likely to vote in favour of environmental measures. The conditional R^2 value of this model is only 0.055, suggesting that many additional factors, not included in the analysis are likely to be relevant.

A limitation of this work is the selection of votes used in the analysis. Using a single national newspaper as a source of votes could result in political bias as it would be possible to cherry pick votes that cast a particular party in a pro or anti-environmental light. However, this concern does not seem relevant in this case, as both major political parties voted for and against environmental matters and the differing opinions of stakeholders involved in the original article by Duncan and Watts (2019) suggest a balance of opinion.

A further limitation of the work is the classification of tweets. As mentioned in the methods not all tweets containing the key terms selected will be related to environmental matters. Additionally, the sentiment of tweets has not been included in the analysis. An assumption of this work is that people mentioning environmental matters are more likely to vote in favour of the environment. However, if someone is consistently vocally opposed to environmental matters it is unlikely that they would vote for them. New tools built to analyse the sentiment of tweets e.g. Johnson et al. (2021), could be used to add further nuance to the analysis.

As has been amply demonstrated in recent years, when it comes to politics, not everything posted on social media is true⁴⁰. However, the use of Twitter by MPs in terms of environmental messaging allows some cautious optimism. We found that MPs that tweet more frequently about environmental matters are more likely to vote in favour of the environment. However, because the vast majority of variation within the data is explained by which political party an MP belongs to, environmental tweeting only accounts for a small, but

significant fraction of the variation within the data. These results mean that even if an MP has a high likelihood of tweeting environmentally, the party they belong to is a far better predictor of whether they will vote along environmental lines. This is not to say that MPs that tweet environmentally are feigning interest in order to win votes, just that environmental interests are likely to be over-ruled by the party system and the benefits that arise with toeing the line vs the negatives for rebelling²⁷. Our analysis shows that there are occasions where MPs are willing to vote against the party line in favour of environmental measures, and this is more likely to be the case if they are vocal about environmental matters on Twitter.

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Data Availability

The Twitter data are protected and so cannot be shared but can be sourced independently at <https://github.com/ropensci/rtweet>. Vote records are freely available from <https://www.publicwhip.org.uk/>

Author Contributions

MPG and TFJ developed the ideas and analysed the data. MPG collected the data and wrote the manuscript. TFJ critiqued the ideas and contributed critically to a draft of the work.

Ethics statement

Research met institutional ethics guidelines with all data in the public domain. We opted to preserve MPs' anonymity.

Competing interests

Between 2017 and 2020, TFJ was a member of the Labour party. TFJ no longer holds any political memberships.

References

1. UK-Parliament. 'The most important issue of our time,' Opposition calls to declare climate emergency. (2019). Available at: <https://www.parliament.uk/business/news/2019/may/mps-debate-the-environment-and-climate-change/>. (Accessed: 3rd March 2021)
2. Davidson, K. *et al.* The making of a climate emergency response: Examining the attributes of climate emergency plans. *Urban Clim.* **33**, 100666 (2020).
3. Newbold, T. *et al.* Global effects of land use on local terrestrial biodiversity. *Nature* **520**, 45–50 (2015).
4. McGill, B., Dornelas, M., Gotelli, N. & Magurran, A. Fifteen forms of biodiversity trend in the anthropocene. *Trends Ecol. Evol.* **30**, 104–113 (2015).
5. Sala, O. *et al.* Global Biodiversity Scenarios for the Year 2100. *Science* (80-.). **287**, 1770–1774 (2000).
6. IPCC. *Summary for Policymakers. In: Global Warming of 1.5°C. 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.* (2018).
7. IPBES. *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* (2019).
8. Convention on Biological Diversity. Convention on Biological Diversity. (2020). Available at: <https://www.cbd.int/>. (Accessed: 27th February 2020)

- 382 9. Schmeller, D. *et al.* Advantages of Volunteer-Based Biodiversity Monitoring in Europe.
383 *Conserv. Biol.* **23**, 307–316 (2009).
- 384 10. Legagneux, P. *et al.* Our House Is Burning: Discrepancy in Climate Change vs.
385 Biodiversity Coverage in the Media as Compared to Scientific Literature. *Front. Ecol.*
386 *Evol.* **5**, 1–6 (2018).
- 387 11. UNFCCC. Paris Agreement. (2015). Available at: [https://unfccc.int/process-and-](https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement)
388 [meetings/the-paris-agreement/the-paris-agreement](https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement).
- 389 12. Ripple, W., Wolf, C., Newsome, T., Barnard, P. & Moomaw, W. World Scientists’
390 Warning of a Climate Emergency. *Bioscience* **70**, 8–12 (2020).
- 391 13. IPSOS. *Earth Day 2020 - How do Great Britain and the world view climate change*
392 *and Covid-19?* (2020).
- 393 14. McCrea, R., Leviston, Z. & Walker, I. Climate Change Skepticism and Voting
394 Behavior: What Causes What? *Environ. Behav.* **48**, 1309–1334 (2016).
- 395 15. Frame, A. & Brachotte, G. Le tweet stratégique: Use of Twitter as a PR tool by French
396 politicians. *Public Relat. Rev.* **41**, 278–287 (2015).
- 397 16. Golbeck, J., Grimes, J. & Rogers, A. Twitter Use by the U.S. Congress Jennifer. *J.*
398 *Am. Soc. Inf. Sci. Technol.* **61**, 1612–1621 (2010).
- 399 17. Grant, W., Moon, B. & Grant, J. Digital dialogue? australian politicians’ use of the
400 social network tool twitter. *Aust. J. Polit. Sci.* **45**, 579–604 (2010).
- 401 18. Graham, T., Broersma, M., Hazelhoff, K. & van ’t Haar, G. Between broadcasting
402 political messages and interacting with voters: The use of Twitter during the 2010 UK
403 general election campaign. *Inf. Commun. Soc.* **16**, 692–716 (2013).
- 404 19. Kruike-meier, S. How political candidates use Twitter and the impact on votes.
405 *Comput. Human Behav.* **34**, 131–139 (2014).
- 406 20. Buccoliero, L., Bellio, E., Crestini, G. & Arkoudas, A. Twitter and politics: Evidence
407 from the US presidential elections 2016. *J. Mark. Commun.* **26**, 88–114 (2020).
- 408 21. DiGrazia, J., McKelvey, K., Bollen, J. & Rojas, F. More tweets, more votes: Social
409 media as a quantitative indicator of political behavior. *PLoS One* **8**, 1–5 (2013).

- 410 22. Tumasjan, A., Sprenger, T., Sandner, P. & Welpe, I. Predicting elections with Twitter:
411 What 140 characters reveal about political sentiment. *ICWSM 2010 - Proc. 4th Int.*
412 *AAAI Conf. Weblogs Soc. Media* 178–185 (2010).
- 413 23. Aharony, N. Twitter use by three political leaders: An exploratory analysis. *Online Inf.*
414 *Rev.* **36**, 587–603 (2012).
- 415 24. Ross, A. & Caldwell, D. 'Going negative': An APPRAISAL analysis of the rhetoric of
416 Donald Trump on Twitter. *Lang. Commun.* **70**, 13–27 (2020).
- 417 25. Enli, G. Twitter as arena for the authentic outsider: exploring the social media
418 campaigns of Trump and Clinton in the 2016 US presidential election. *Eur. J.*
419 *Commun.* **32**, 50–61 (2017).
- 420 26. Johnson, T. & Greenwell, M. Is sustainability advertising just a public relations stunt ?
421 (2021) doi:10.31235/osf.io/avy4d
- 422 27. Willumsen, D. & Öhberg, P. Toe the line, break the whip: explaining floor dissent in
423 parliamentary democracies. *West Eur. Polit.* **40**, 688–716 (2017).
- 424 28. Carter, N. The politics of climate change in the UK. *Wiley Interdiscip. Rev. Clim.*
425 *Chang.* **5**, 423–433 (2014).
- 426 29. Kearney, M. rtweet: Collecting and analyzing Twitter data. *J. Open Source Softw.* **4**,
427 1829 (2019).
- 428 30. Duncan, P., Voce, A., Watts, J., Hulley-Jones, F. & McMullan, L. Guardian climate
429 score: how did your MP do? *The Guardian* (2019).
- 430 31. Duncan, P. & Watts, J. How the Guardian scored each MP's climate record. *The*
431 *Guardian* (2019).
- 432 32. Brandenburg, H. Political bias in the Irish Media: A quantitative study of campaign
433 coverage during the 2002 general election. *Irish Polit. Stud.* **20**, 297–322 (2005).
- 434 33. Brandenburg, H. Party Strategy and Media Bias: A Quantitative Analysis of the 2005
435 UK Election Campaign. *J. Elections, Public Opin. Parties* **16**, 157–178 (2006).
- 436 34. Feinerer, I. & Hornik, K. tm: Text Mining Package. (2020). Available at: [https://cran.r-](https://cran.r-project.org/package=tm)
437 [project.org/package=tm](https://cran.r-project.org/package=tm).

- 438 35. Feinerer, I., Hornik, K. & Meyer, D. Text mining infrastructure in R. *J. Stat. Softw.* **25**,
439 1–54 (2008).
- 440 36. Pidgeon, N. Public understanding of, and attitudes to, climate change: UK and
441 international perspectives and policy. *Clim. Policy* **12**, (2012).
- 442 37. Franzen, A. & Vogl, D. Two decades of measuring environmental attitudes: A
443 comparative analysis of 33 countries. *Glob. Environ. Chang.* **23**, 1001–1008 (2013).
- 444 38. Lo, A. & Chow, A. The relationship between climate change concern and national
445 wealth. *Clim. Change* **131**, 335–348 (2015).
- 446 39. Johnson, T. *et al.* classecol: classifiers to understand public opinions of nature.
447 *Methods Ecol. Evol.* **0**, 1–13 (2021).
- 448 40. Allcott, H. & Gentzkow, M. Social media and fake news in the 2016 election. *J. Econ.*
449 *Perspect.* **31**, 211–236 (2017).
- 450