

Motivating the selfish to stop idling: Self-interest cues can improve environmentally relevant driver behaviour

Julie Van de Vyver^a, Dominic Abrams^{b,*}, Tim Hopthrow^b, Kiran Purewal^b, Georgina Randsley de Moura^b, Rose Meleady^c

^a School of Psychology, University of Lincoln, UK

^b Centre for the Study of Group Processes, School of Psychology, University of Kent, UK

^c School of Psychology, University of East Anglia, UK



ARTICLE INFO

Article history:

Received 15 November 2017

Received in revised form 16 January 2018

Accepted 22 January 2018

Available online 14 February 2018

Keywords:

Self-interest

Pro-environmental behaviour

Kin

Behavioural change

Engines

ABSTRACT

Air pollution has a huge and negative impact on society, and idling engines are a major contributor to air pollution. The current paper draws on evolutionary models of environmental behaviour to test whether appeals to self-interest can encourage drivers to turn off their engines at long wait stops. Using an experimental design, drivers were shown one of three self-interest appeals (financial, health, kin) while waiting at a congested level-crossing site in the UK. Results showed that all three self-interest appeals increased the chances of drivers turning off their engines compared to the control condition. Specifically, drivers were approximately twice as likely to turn off their engines in the self-interest conditions (39–41% compliance) compared to drivers in the control condition (22% compliance). Thus, self-interest motives can be effective for promoting pro-environmental behavioural compliance. Theoretical and applied implications of this research are discussed.

© 2018 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The current paper reports a field experiment that complements recent studies testing the efficacy of different theory-based approaches to influencing vehicle drivers' pro-environmental behaviour (Meleady et al., 2017).¹ The present study draws on recent evolutionary models of environmental behaviour change (De Dominicis, Schultz, & Bonaiuto, 2017; Van Vugt, Griskevicius, & Schultz, 2014) to examine whether and how car drivers' self-interest may be harnessed to reduce engine idling at long wait stops. Importantly, we distinguish between three types of self-interest messages (financial-focused, health-focused, and kin-focused) to see how they affect behavioural change. Although the three self-interest messages used are all consistent with evolutionary theory, they may also invoke more proximal motivations which are not dependent on evolutionary assumptions. These proximal motivations are: people's cognitive bias to avoid material loss (Tversky & Kahneman, 1991), their motivation to avoid personal mortality (Greenberg et al., 1990), and their inclination to protect the young (Batson, Lishner, Cook, & Sawyer, 2005; Bleske-Rechek, Nelson, Baker, Remiker, & Brandt, 2010; Burnstein, Crandall, & Kitayama, 1994).

* Corresponding author at: Centre for the Study of Group Processes, School of Psychology, University of Kent, Canterbury, UK.

E-mail address: D.Abrams@kent.ac.uk (D. Abrams).

¹ Other studies testing social psychological interventions on engine idling have investigated the role of self-monitoring (Meleady et al., 2017) and social norms (Player et al., 2018). It is notable that there is a comparably low level of compliance in the control conditions across these different studies.

1.1. Harnessing self-interest

Environmental problems are often caused or exacerbated by evolutionarily adaptive psychological biases (Van Vugt et al., 2014). Many environmental issues can be considered as social dilemmas where the interests of the individual are at odds with the interests of the collective. Ample empirical evidence shows that, in social dilemmas, most people make self-interested choices in one-shot encounters (Fehr & Gächter, 2002; Komorita & Parks, 1994; Van Lange, Balliet, Parks, & van Vugt, 2013). If all individuals in a group each pursue their own self-interest, this results in damaging consequences for the collective. For example, it may be in an individual's self-interest to drive to work because it is faster and more convenient than the alternatives. However, this choice harms the collective's interests by causing greater air pollution, congestion, and use of natural resources. The question therefore becomes, if self-interest is such an unavoidable psychological bias, how can we use this bias to promote environmentally-responsible rather than damaging behaviour? Specifically, are there ways to view the boundaries of the self more widely so that self-interest and collective benefit become aligned? (cf. Hopthrow & Abrams, 2010).

Recent evolutionary and social psychological models of environmental behavioural change propose that, although self-interest may diminish peoples' motivation to engage in environmental behaviour, carefully designed interventions can in fact harness this self-interest tendency and use it to encourage greater pro-environmental behaviour (see De Dominicis et al., 2017; Nolan & Schultz, 2015; Van Vugt et al., 2014). Specifically, environmental campaigns could highlight particular personal benefits of engaging in pro-environmental behaviours, and thereby promote a greater behavioural uptake. There is some empirical support for the effectiveness of self-interest frames in environmental contexts. For example, across three studies De Dominicis et al. (2017) showed that self-interest messages (e.g., "save 50% on your energy bill"; "public transit pass is 75% less expensive than using your car") were effective for promoting energy conservation and the use of public transportation.

1.2. Null effects of self-interest interventions

Nevertheless, programs designed to appeal to self-interest have also been criticized (Bolderdijk, Steg, Geller, Lehman, & Postmes, 2013), and a number of recent field studies have reported null effects when testing the impact of self-interest interventions on behavioural compliance in a range of applied contexts such as the promotion of recycling behaviours (Evans et al., 2013). Bolderdijk et al. (2013) found that a self-interest frame ("Do you care about your finances? Get a free tire check") did not significantly promote behavioural compliance compared to a control message ("Get a free tire check"). Similarly, Asensio and Delmas (2015) found that, compared to a control condition, providing information about economic impacts of household energy use (e.g., monthly billings) also did not significantly affect householders' energy use.

1.3. When and why might self-interest work?

In the preceding examples self-interest may not have been a particularly powerful strategy for promoting behavioural compliance because these contexts involved behaviours over which people may have already considered their self-interest, and in which the presence of others (i.e., the collective relevance) was not necessarily involved. It therefore seems likely that the potential impact of self-interest on behaviour depends on the particular type of context and within that the scope for a particular focus of self-interest to create a new impetus for behaviour. The current research aims to further understand whether and when self-interest may be harnessed to affect pro-environmental behavioural compliance in a situation where self-interest may not be generally salient. Below we outline why more research is required to understand when and why self-interest may impact behavioural compliance.

1.3.1. Framing

In Asensio and Delmas' (2015) study the monthly household savings estimates were relatively small (roughly equivalent to two cups of coffee), and may therefore not have been sufficient to motivate household behavioural change. Moreover, participants had probably already given thought to their energy costs and may have felt comfortable with their existing usage levels. Indeed, in De Dominicis et al.'s (2017) study, in which self-interest did significantly enhance behavioural compliance, the financial gain was extremely high (e.g., 50% reduction of energy bill). Thus, it seems likely that financial incentives have to be very salient or large in order to engage self-interest, but this might be difficult to envisage in the context of making pro-environmental choices. Indeed, although the majority of studies in this field have focused on messages tapping into "financial savings", "financial gain", and "financial incentives" (see Delmas, Fischlein, & Asensio, 2013), a promising approach may be to frame financial-focused messages in terms of avoiding loss. Moreover, ample research shows that humans are inherently loss averse, and are more sensitive to losses and disadvantages than to gains and advantages (Tversky & Kahneman, 1991). We will therefore directly test whether a financial message framed as a potential imminent loss may promote pro-environmental behavioural compliance.

1.3.2. Type of self-interest

Furthermore, while research has predominantly focused on the role of financial self-interest for promoting or inhibiting environmental responses, there are other types of self-interest beyond wealth and resources. For example, consistent with

the evolutionary assumption of basic motivation for survival, it may be possible to promote pro-environmental behaviour by highlighting impacts on one's own health. Correlational research by [Baldassare and Katz \(1992\)](#) revealed that people who perceived higher health threat were also more likely to engaged in a range of pro-environmental behaviours (e.g., recycling, limiting driving). Moreover, the predictive effect of health threat on pro-environmental behaviour was stronger than those of demographics and political factors. Therefore, it is plausible that simply alerting people to a health threat encourages them to engage in actions to reduce their risk.

This hypothesis is also consistent with social psychological theory. Specifically, terror management theory (TMT, [Greenberg et al., 1990](#)) proposes that our awareness of death motivates us to (a) protect our cultural worldviews and (b) attain self-esteem by living up to our cultural worldviews. Therefore, if a person values environmentalism, then existential or health threats should increase their active engagement with this value. In line with TMT, research shows that, when pro-environmental norms are salient, existential threats significantly enhance pro-environmental behaviours ([Fritzsche, Jonas, Kayser, & Koranyi, 2010](#)).

People's tendency to prioritize and protect their own kin is also a type of self-interest. According to kin selection theory it is in human nature to ensure the survival and replication of one's genes ([Hamilton, 1964](#)). Individuals are more likely to share resources with relatives than with non-relatives and with close relatives more than with distant relatives ([Burnstein et al., 1994](#); [Ostrom, 1990](#)). Kin selection theory would therefore suggest that environmental campaigns should be effective if they emphasize the interests of relatives. [Neufeld, Griskevicius, Ledlow, Li, & Neel, 2013](#) showed that messages emphasizing conserving the environment for one's kin (vs. for future generations) increased environmental volunteerism among people with and without children, but most strongly among the former. Importantly, some theorists have proposed that even indirect kin labels (e.g., "helping Mother nature") may foster greater pro-environmental behaviour by activating a psychological sense of kinship ([Van Vugt et al., 2014](#)).

The hypothesis that a kin-focused message would promote greater behavioural compliance is also consistent with social psychological research on people's desire to help and protect children. Specifically, while mammalian parents do have inherent nurturing tendencies in order to provide care for their dependent offspring, these nurturing tendencies can generalise to promote empathy and care for others' offspring also ([Batson et al., 2005](#)). Indeed, research shows evidence for the idea that people are more likely to feel empathy for, help, and protect children than adults ([Batson et al., 2005](#); [Bleske-Rechek et al., 2010](#); [Burnstein et al., 1994](#)).

To our knowledge, no research has attempted to systematically evaluate the impacts of distinct types of self-interest appeals on pro-environmental behaviour. The current research will compare the behavioural impact of a control (no message) condition with that of a financial-focused message, a health-focused, and a kin-focused message. It is plausible that any appeal to self-interest is effective in promoting behavioural compliance. However, it is also plausible that their effectiveness may vary depending on the particular focus within a context. The health related damage from exhaust fumes is relatively intangible and remote, but does affect both the self and others. The impact on children may carry with it a stronger moral imperative to behave responsibly as an adult, but the consequences of behaviour change may not be visible, immediate or easy to imagine and may not involve one's own children, thus limiting the effectiveness of this type of self-interest (see [Van Vugt et al., 2014](#)). In contrast, the financial impact of using more fuel than necessary has relatively little direct or short to medium term impact on others but its effect on the driver is quite imminent because the driver will incur higher direct personal cost in the short term (when next refuelling).

1.4. The current research

We report the results of a field experiment conducted to test whether specific types of self-interest appeals can encourage drivers to turn off their engines while waiting at a railway level crossing. Traffic and vehicle pollution generally and idling traffic specifically are considered as major contributors to poor air quality ([WHO, 2016](#)). Level crossing sites are particularly vulnerable to engine idling. The level-crossing selected for this study was situated in Canterbury, UK. The crossing is located close to the city center and is a busy route for pedestrians as well as vehicle users. Official figures for the typical annual mean concentration of nitrogen oxide at this site ($39 \mu\text{g}/\text{m}^3$, [Medway Council, 2013](#)) is at the threshold of those regarded as safe by the European Commission ($40 \mu\text{g}/\text{m}^3$, [European Commission, 2014](#)). Canterbury City Council placed a permanent sign at the site to encourage drivers to turn off their engines (see [Fig. 1](#)). However research had established its impact on engine idling was minimal ([Meleady et al., 2017](#)).

2. Method

2.1. Sample and design

Data were collected from 565 vehicles (including cars, public transportation, taxis, motorcycles, trucks, and delivery vehicles) during a 6-month period (October 2012 to March 2013). The analysis reported in this paper focuses on the behaviour of car drivers because they can be largely assumed to have responsibility for their own vehicles, while this is more difficult to assert for other types of vehicle. A total of 455 car drivers were sampled ($n_{\text{control}} = 93$, $n_{\text{financial}} = 121$; $n_{\text{health}} = 128$; $n_{\text{kin}} = 113$). We employed an experimental design in which vehicles were randomly assigned to one of four conditions (Type of Message:



Fig. 1. Level crossing context. The white placard depicts the financial intervention. The blue placard depicts the permanent local authority sign. The permanent local authority sign reads: “please switch off your engine when barriers are down to help improve air quality”. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Financial, Health, Kin, Control) across barrier drop and direction of approach to the barrier. Barrier drops lasted on average 2.63 min ($SD = 0.79$ min), barriers dropped approximately four times per hour during the day, and a mean of 30 cars were sampled per barrier drop. Across days of testing, we randomly varied the time that data collection took place in order to reduce the chance that the same driver would be sampled more than once (e.g., while commuting to work), and so that intervention conditions would not be confounded with the time of testing. We also coded the weather condition (rainy or clear) on each trial.

2.2. Materials and procedure

The intervention signs were presented on a 420×594 mm (A2) (16.5×23.4 in.) placard 2 m high at the curbside (see Fig. 1). The specific intervention messages are shown in Table 1. In the control condition there was no sign. Each condition was designed to only affect one motivation but all three reminded drivers to turn off their engines when the barriers were down (note that Meleady et al., 2017 found that reiteration of the instruction per se was not sufficient to affect idling). In the Financial condition the (slightly longer) message focused on financial loss from leaving the engine running. In the Health condition the message focused on the threat to health from pollution. In the kin condition, the message asked drivers to think of children. The placard was positioned approximately 5 m from the existing council sign. To ensure that that all vehicles would pass the sign on their approach to the level crossing, the sign was placed 75 m before the barrier. While the barrier was down and the vehicles were stationary, a single research assistant walked along the sidewalk from the barrier as far as the sign recording whether each vehicle's engine was on (coded as 1) or off (coded as 2). The outcome variable (whether the vehicle's engine was on or off) was measured discreetly by viewing exhaust activity and listening for engine noise emitted from each vehicle (see Meleady et al., 2017 for details of interrater reliability).

3. Results

Logistic regression was used to analyse the effect of condition (control, financial-interest, health-interest, kin-interest) on whether people turned their engine off at the level crossing site. Type of weather (clear versus rainy) and duration of barrier drop were included as covariates. Results revealed a significant omnibus test of model coefficients, $\chi^2(5, N = 455) = 35.27, p < .001$, Nagelkerke $R^2 = 0.10$. There was a significant effect of condition on whether people turned off their engine ($Wald = 9.97, p = .019$). More importantly, regardless of weather conditions or barrier drop duration, all three types of self-interest led to higher behavioural compliance than the control condition (see Table 2 and Fig. 2).

4. Discussion

The current paper tested whether different types of self-interest appeals can encourage drivers to turn off their engines at a long-wait stop. Results showed that three distinctive types of self-interest cues (financial, health, and kin) all led to greater

Table 1
Intervention messages.

Financial	You throw away your money by leaving your engine on when the barriers are down
Health	Warning – pollution: When barriers are down close vehicle windows
Kin	Think of the children. When barriers are down switch off your engine

Table 2
Results of the Logistic Regression.

Omnibus Model: $\chi^2 (5, N = 455) = 35.27, p < .001$, Nagelkerke $R^2 = 0.10$					
	<i>B (SE)</i>	<i>Wald</i>	<i>p</i>	<i>Exp(B)</i>	<i>95CI Exp(B)</i>
Financial self-interest vs. control	0.88 (0.33)	7.15	0.008	2.42	[1.27/4.62]
Health self-interest vs. control	0.83 (0.33)	6.48	0.011	2.29	[1.21/4.32]
Kin self-interest vs. control	0.98 (0.33)	8.78	0.003	2.66	[1.39/5.10]

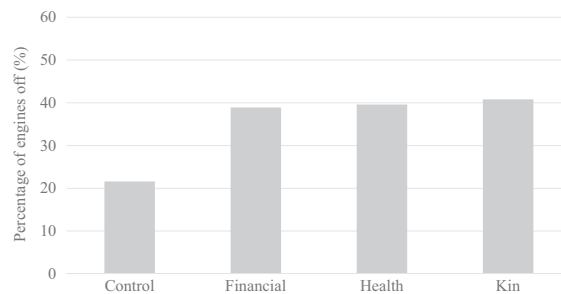


Fig. 2. Results demonstrating the effect of each self-interest message on behavioural compliance.

behavioural compliance compared to the control condition. Specifically, drivers were approximately twice as likely to turn off their engines in the experimental conditions (39–41% compliance) compared to drivers in the control condition (22% compliance).

4.1. Theoretical implications

Research testing the effectiveness of self-interest cues for promoting pro-environmental behaviour has been relatively mixed, with some studies showing that these cues work well (e.g., [De Dominicis et al., 2017](#)) and some showing that they do not (e.g., [Asensio & Delmas, 2015](#); [Bolderdijk et al., 2013](#)). We proposed that these inconsistent findings may reflect the particular relevance of self-interest cues to the specific context, and we underlined the importance of systematically investigating the conditions under which they are and are not effective.

The majority of studies that have examined the impact of self-interest cues on pro-environmental behaviour have employed financial incentive frames (see [Delmas et al., 2013](#)). However, financial incentive frames may only be effective when the incentive is sufficiently profitable and in the present research there was no way to directly reward drivers for switching off their engines. Therefore, we applied a financial loss frame that would highlight imminent loss. We found that a very broad financial loss message (“you throw away your money”) doubled the rate of pro-environmental behavioural compliance.

Some drivers may not be motivated by financial cost, and such costs or gains could also vary according to fluctuations in fuel prices. Thus we considered other types of self-interest that may be equally or more effective for promoting behavioural compliance. We found that cues to either kin-related self-interest (“think of the children”) or health-related self-interest (“warning - pollution”) were equally effective, doubling the rate of pro-environmental behavioural compliance. Thus, drawing on evolutionary models of pro-environmental behaviour, the results of this field experiment provide empirical support for the hypothesis that humans’ inherent self-interest can be harnessed to inform strategies to induce behaviour change ([De Dominicis et al., 2017](#); [Van Vugt et al., 2014](#)). Nevertheless, we also propose that the effects of self-interest appeals on pro-environmental behaviour are nuanced and will vary by context, frame, and type of self-interest.

While our findings are consistent with broad evolutionary principles, they are also consistent with specific social psychological theories, which focus on understanding proximal motivations for behaviour. Specifically, the effectiveness of the financial message is consistent with people’s cognitive bias to avoid material loss ([Tversky & Kahneman, 1991](#)). The effectiveness of the health message is consistent with terror management theory which shows that existential threats encourage people to live up to their cultural worldviews ([Greenberg et al., 1990](#)). The effectiveness of the kin message is consistent with people’s tendency to feel greater empathy for and motivation to protect children than adults ([Batson et al., 2005](#)).

4.2. Applied implications

Air pollution has a huge and negative impact on society, directly affecting both individuals’ health, wellbeing, and environment, and the collective costs of dealing with these effects. The UK Royal College of Physicians (RCP) have recently reported that around 40,000 deaths are attributable to air pollution exposure ([Royal College of Physicians, 2016](#)), and have

called for greater action and tougher regulations from political leaders. In the current paper we show that very minimal and low-cost cues grounded in psychological theory can have substantial effects on a major contributor to air pollution – levels of engine idling, in a location where direct impacts on others are also likely to be high. If these types of low-cost interventions were implemented on a larger scale, the positive impacts on driver behaviour, and therefore on the health of those in the immediate vicinity could be substantial. Moreover, it may reduce dependence on potentially unpopular legislation or costly technological interventions as the sole avenues for influence.

4.3. Limitations and future directions

It is possible that the mere presence of a researcher holding a placard of any sort could prompt some sort of behaviour change and that this explains the greater behavioural compliance in the experimental versus control conditions. However, this account lacks plausibility for a number of reasons. First, analyses of data collected at the same field site as the current study has demonstrated that a range of signs with other messages or images, as well as blank signs, have no effect on behaviour change, ruling out the possibility that the presence of a person holding a sign per se could account for the effects (see [Meleady et al., 2017](#)). Second, the presence of the particular research assistants seems irrelevant because they were also present in the control condition, in which rates of pro-environmental behaviour were nevertheless low. Thus, neither the presence of research assistants nor a person standing with a placard were sufficient to alter behaviour. Only conditions with specific theoretically-grounded behavioural cues increased pro-environmental behavioural compliance.

It is interesting to consider the potential scope of persuasive message interventions to increase pro-environmental behavioural choices. We cannot be sure whether a common subset of drivers from the overall population are those who were amenable to all three types of message (i.e., whether only some individuals are susceptible to self-interest motivation per se). It is possible that the different messages may have impacted some non-overlapping parts of the population. Understanding more about this issue would enable us to anticipate the potential benefit of the serial or combined use of different messages. If all three messages affect the same subset of drivers then the 45% levels achieved by any one experimental condition represents the maximum achievable. However, in principle, if the three types of self-interest engaged non-overlapping sets of drivers, the additive or cumulative effects of different messages used in the present research could potentially result in compliance reaching 80%.

We hope that this experiment will stimulate further research into testing and understanding the targeted use of self-interest appeals. Although all messages retained the key exhortation to switch off engines, the formulations of the different parts of the three messages in this study were not identical in terms of word count. This was necessary in order to ensure that the messages were engaging and accessible while also maintaining the semantic distinctions necessary to manipulate the specific concept of interest. However, it would be valuable for future research to test different variants of messages for each type of self-interest in order to establish the generalizability of the effects. Rigorous and systematic research to understand the most effective linkages between type self-interest and the particular context is vital in order to further develop theoretical models of pro-environmental behaviour, and to therefore more effectively inform policy-makers and decision makers. Important avenues for future research include: testing whether these effects generalize to other types of pro-environmental behaviours; testing whether highly profitable financial cues are as effective as loss-averse financial cues, testing the use of multiple cues, and testing the long-term effects of self-interest cues on pro-environmental behaviour.

Acknowledgments

We acknowledge research assistance with data collection or coding from Andrew Henson, Becky Kent, Nicole Knight-Stevenson, Claire Powell, Sophie Razzel, John Sabo, Estefanea Santos, and Hannah Swift and members of GroupLab.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The research was supported by the Economic and Social Research Council [ES/J500148/1]. Data were collected whilst all authors were at the University of Kent.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.trf.2018.01.015>.

References

- Asensio, O. I., & Delmas, M. A. (2015). Nonprice incentives and energy conservation. *Proceedings of the National Academy of Sciences*, 112(6), E510–E515. <https://doi.org/10.1073/pnas.1401880112>.
- Baldassare, M., & Katz, C. (1992). The personal threat of environmental problems as predictor of environmental practices. *Environment and Behavior*, 24(5), 602–616. <https://doi.org/10.1177/0013916592245002>.
- Batson, C. D., Lishner, D. A., Cook, J., & Sawyer, S. (2005). Similarity and nurturance: Two possible sources of empathy for strangers. *Basic and Applied Social Psychology*, 27, 15–25. https://doi.org/10.1207/s15324834basps2701_2.
- Bleske-Rechek, A., Nelson, L. A., Baker, J. P., Remiker, M. W., & Brandt, S. J. (2010). Evolution and the trolley problem: People save five over one unless the one is young, genetically related, or a romantic partner. *Journal of Social, Evolutionary, and Cultural Psychology*, 4, 115–127. <https://doi.org/10.1037/h0099295>.
- Bolderdijk, J. W., Steg, L., Geller, E. S., Lehman, P. K., & Postmes, T. (2013). Comparing the effectiveness of monetary versus moral motives in environmental campaigning. *Nature Climate Change*, 3(4), 413–416. <https://doi.org/10.1038/nclimate1767>.
- Burnstein, E., Crandall, C., & Kitayama, S. (1994). Some neo-Darwinian decision rules for altruism: Weighing cues for inclusive fitness as a function of the biological importance of the decision. *Journal of Personality and Social Psychology*, 67(5), 773–789. <https://doi.org/10.1037/0022-3514.67.5.773>.
- De Dominicis, S., Schultz, P., & Bonaiuto, M. (2017). Protecting the environment for self-interested reasons: Altruism is not the only pathway to sustainability. *Frontiers in Psychology*, 8, 1–13. <https://doi.org/10.3389/fpsyg.2017.01065>.
- Delmas, M. A., Fischlein, M., & Asensio, O. I. (2013). Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012. *Energy Policy*, 61, 729–739. <https://doi.org/10.1016/j.enpol.2013.05.109>.
- European Commission (2014). Air quality standards Retrieved from <<http://ec.europa.eu/environment/air/quality/standards.htm>>.
- Evans, L., Maio, G. R., Corner, A., Hodgetts, C. J., Ahmed, S., & Hahn, U. (2013). Self-interest and pro-environmental behaviour. *Nature Climate Change*, 3, 122–125. <https://doi.org/10.1038/nclimate1662>.
- Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature*, 415(6868), 137–140. <https://doi.org/10.1038/415137a>.
- Fritzsche, I., Jonas, E., Kayser, D. N., & Koranyi, N. (2010). Existential threat and compliance with pro-environmental norms. *Journal of Environmental Psychology*, 30, 67–79. <https://doi.org/10.1016/j.jenvp.2009.08.007>.
- Greenberg, J., Pyszczynski, T., Solomon, S., Rosenblatt, A., Veeder, M., Kirkland, S., & Lyon, D. (1990). Evidence for terror management theory II: The effects of mortality salience on reactions to those who threaten or bolster the cultural worldview. *Journal of Personality and Social Psychology*, 58, 308–318. <https://doi.org/10.1037/0022-3514.58.2.308>.
- Hamilton, W. D. (1964). The genetical evolution of social behaviour. II. *Journal of Theoretical Biology*, 7, 17–52. [https://doi.org/10.1016/0022-5193\(64\)90039-6](https://doi.org/10.1016/0022-5193(64)90039-6).
- Hopthrow, T., & Abrams, D. (2010). Group transformation: How demonstrability promotes intra-group cooperation in social dilemmas. *Journal of Experimental Social Psychology*, 46, 299–803. <https://doi.org/10.1016/j.jesp.2010.04.002>.
- Komorita, S. S., & Parks, C. D. (1994). *Social dilemmas*. Madison, WI, England: Brown & Benchmark.
- Medway Council (2013). Kent and Medway air quality monitoring network, annual review 2012 Retrieved from <http://www.kentair.org.uk/documents/KMAQMN_2012%20Annual_Report_Final_Issue_1.pdf>.
- Meleady, R., Abrams, D., Van de Vyver, J., Hopthrow, T., Mahmood, L., Player, A., ... Leite, A. C. (2017). Surveillance or self-surveillance? Behavioral cues can increase the rate of drivers' pro-environmental behavior at a long wait stop. *Environment and Behavior*. <https://doi.org/10.1177/0013916517691324>.
- Neufeld, S.L., Griskevicius, V., Ledlow, S. E., Li, Y. J., & Neel, R. (2013). *Going green to help your genes: The use of kin-based appeals in conservation messages*. Working paper, Global Institute for Sustainability, Arizona State University. Retrieved from <https://climateaccess.org/system/files/Neufeld_Going%20Green.pdf>.
- Nolan, J. M., & Schultz, P. W. (2015). Prosocial behavior and environmental action. In D. A. Schroeder & W. G. Graziano (Eds.), *The Oxford handbook of prosocial behaviour* (pp. 626–652). Oxford: Oxford University Press.
- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge: Cambridge University Press.
- Player, A., Abrams, D., Van de Vyver, J., Meleady, R., Leite, A., Randsley de Moura, G., & Hopthrow, T. (2018). "We aren't idlers": Using subjective group dynamics to promote prosocial driver behaviour at long wait stops. Unpublished manuscript, University of Kent.
- Royal College of Physicians (2016). Every breath we take: The lifelong impact of air pollution Retrieved from <<https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>>.
- Tversky, A., & Kahneman, D. (1991). Loss aversion in riskless choice: A reference-dependent model. *The Quarterly Journal of Economics*, 106(4), 1039–1061. <https://doi.org/10.2307/2937956>.
- Van Lange, P. A. M., Balliet, D. P., Parks, C. D., & van Vugt, M. (2013). *Social dilemmas: The psychology of human cooperation*. Oxford: Oxford University Press.
- Van Vugt, M., Griskevicius, V., & Schultz, P. (2014). Naturally green: Harnessing stone age psychological biases to foster environmental behavior. *Social Issues and Policy Review*, 8, 1–32. <https://doi.org/10.1111/sipr.12000>.
- WHO (2016). Ambient air pollution: A global assessment of exposure and burden of disease Retrieved from <<http://apps.who.int/iris/bitstream/10665/250141/1/9789241511353-eng.pdf>>.