
Article:
Kaklamanou, D., Jones, C.R., Webb, T.L. et al. (1 more author) (2013) Using Public Transport Can Make Up for Flying Abroad on Holiday: Compensatory Green Beliefs and Environmentally Significant Behavior. Environment and Behavior, 47 (2). 184 - 204. ISSN 0013-9165

https://doi.org/10.1177/0013916513488784

Environment
and Behavior

"Using Public Transport Can Make up for Flying Abroad on Holiday": Compensatory Green Beliefs and Environmentally Significant Behavior

Journal:	*Environment & Behavior*
Manuscript ID:	E&B-12-0034.R2
Manuscript Type:	Original Manuscript
Keywords:	conservation < Academic Field, ecological behavior < Research Setting / Place Type, Envrionmental attitudes, energy < Content Areas, Environment
Abstract:	Compensatory Green Beliefs (or CGBs) refer to beliefs that the negative effects of energy inefficient or unsustainable behaviors (e.g., flying abroad on holiday) can be compensated for by engaging in energy efficient or sustainable practices (e.g., using public transport). The present research developed and validated a scale to measure endorsement of CGBs. This scale formed part of an online survey, which investigated the relationship between endorsement of CGBs and how people think and behave in relation to energy and environmental issues. Factor analysis confirmed the reliability of a 16-item, single-factor scale measuring CGBs. Endorsement of CGBs was found to correlate negatively with measures of pro-ecological behavior, environmental values, 'green' identity, concern with climate change, age, and education level. These findings offer an insight into the possible cognitive antecedents of 'rebound effects' that are known to limit the effectiveness of interventions designed to reduce energy consumption and promote sustainable behavior.

COMPENSATORY GREEN BELIEFS

Running head: COMPENSATORY GREEN BELIEFS

"Using Public Transport Can Make up for Flying Abroad on Holiday": Compensatory Green Beliefs and Energy-Related Behavior

Daphne Kaklamanou, Christopher R. Jones, Thomas L. Webb, & Stuart Walker

University of Sheffield, UK

Acknowledgements

The authors gratefully acknowledge the support of the European Regional Development Fund (second and third authors) and the EPSRC E-futures programme (fourth author). We are also grateful to Christopher Spencer for comments on an earlier draft of this manuscript.

Direct correspondence to:

Christopher Jones or Thomas Webb

Department of Psychology

University of Sheffield

Western Bank

Sheffield, S10 2TP

c.r.jones@sheffield.ac.uk or t.webb@sheffield.ac.uk

COMPENSATORY GREEN BELIEFS

Abstract

Compensatory Green Beliefs (or CGBs) refer to beliefs that the negative effects of energy inefficient or unsustainable behaviors (e.g., flying abroad on holiday) can be compensated for by engaging in energy efficient or sustainable practices (e.g., using public transport). The present research developed and validated a scale to measure endorsement of CGBs. This scale formed part of an online survey, which investigated the relationship between endorsement of CGBs and how people think and behave in relation to energy and environmental issues. Factor analysis confirmed the reliability of a 16-item, single-factor scale measuring CGBs. Endorsement of CGBs was found to correlate negatively with measures of pro-ecological behavior, environmental values, 'green' identity, concern with climate change, age, and education level. These findings offer an insight into the possible cognitive antecedents of 'rebound effects' that are known to limit the effectiveness of interventions designed to reduce energy consumption and promote sustainable behavior.

Keywords: Conservation, environmental attitudes, energy, environment, ecological behavior.

"Using Public Transport Can Make Up for Flying Abroad on Holiday": Compensatory Green Beliefs and Energy-Related Behavior

Climate change has been suggested to be the biggest peril to humanity this century (Oxfam, 2009) and, as such, the international community is under increasing pressure to make rapid and substantial reductions in greenhouse gas emissions (see IPCC, 2007; UNFCCC, 2009). In recognition of this need, the European Union has, for example, committed to reduce emissions by 20% by 2020 (compared to 1990 levels) and has produced a roadmap to an 80% reduction by 2050 (http://www.roadmap2050.eu). In a similar move, the United States has committed to reduce greenhouse gas emissions by 17% and 83% by 2020 and 2050, respectively (compared with 2005 levels) (see US Climate Action Report, 2010). However, while such cuts are necessary, achieving these targets will require substantial changes not only in the way that energy is generated and supplied but also in the manner and extent of its use in powering homes, business, industry and transportation.

These changes are recognised to hinge, in part, on shifts in the way that people think about and use energy, and their willingness to adopt or facilitate interventions and policies aimed at reducing energy demand. For example, the UK government has committed to a nationwide rollout of smart-meters (see DCLG, 2010; DECC, 2011) and there are similar smart-metering schemes planned (or in place) in other countries (e.g., Australia, Italy, United States, France, Ireland). It is hoped that the real-time energy-use feedback that householders receive from in-home display units (or smart-monitors) linked to smart-meters, should not only decrease household energy-use but also increase energy literacy (see Darby, 2006).

The extent to which smart-metering (and other interventions) will be successful in producing the intended energy savings, however, may depend on the extent to which such interventions lead to 'spillover' versus 'rebound' effects. Spillover effects occur when energy savings in one domain prompt people to try to conserve energy in another domain (e.g.,

Thøgersen & Olander, 2003). For example, smart metering may promote energy literacy that, in turn, leads people to consider using their car less. Rebound effects are more ominous, however, and occur when an intervention that reduces energy demand (e.g., cavity wall insulation, fuel-efficient cars, etc.) leads people either to use the services more (e.g., leaving the heating on while not at home) or to spend any financial savings in energy inefficient ways (e.g., by flying abroad on holiday). Thus, rebound effects can reduce the overall benefits realised by the intervention (see Sorrell, 2007; Sorrell, Dimitropoulos, & Sommerville, 2009). However, while rebound effects are well-documented (e.g., Greene, 1992; Greening & Greene, 1998; Milne & Boardman, 2000) and efforts have been made to quantify the impact that rebound effects have on the effectiveness of energy-efficiency interventions (e.g., Sorrell et al., 2009), much less is known about the psychological processes that lead to these ostensibly paradoxical effects.

One such process could be the invocation of compensatory beliefs relating to energy-use and environmental behavior. Compensatory beliefs refer to the belief that the positive consequences of pro-environmental behaviors (e.g., switching to a 'green' energy tariff) can somehow compensate for the negative consequences of energy inefficient or unsustainable behaviors (e.g., leaving the heating on while not at home) and/or the reverse belief that engaging in energy inefficient behaviors can be compensated for by engaging in energy-efficient behaviors (e.g., using public transport). If people do endorse and act on such beliefs – here termed 'compensatory green beliefs' or CGBs – then this could reduce the effectiveness of interventions designed to reduce energy consumption or promote pro-environmental behaviour. As such, endorsement of CGBs might explain why energy-use and efficiency interventions and policies do not always perform as predicted (e.g., Geller & Attali, 2005) and why people might act in a pro-environmental way in one domain (e.g.,

recycling) while behaving in a less environmentally friendly way in others (e.g., transport) (e.g., Gatersleben, Steg & Vlek, 2002; see also Steg & Vlek, 2009).

Ideas about compensation and atonement are not new. For example, there is a substantial literature on forgiveness and justice (e.g., Exline, Worthington, Hill & McCullough, 2003) and accumulating evidence suggests that people often believe that the negative effects of unhealthy behaviors can be compensated for by engaging in healthy behaviors (e.g., "I can eat this piece of cake now because I will exercise this evening"; Knäuper, Rabiau, Cohen, & Patriciu, 2004). Such 'compensatory health beliefs' (or CHBs) have, in turn, been found to influence people's likelihood of engaging in health risk behaviors (Knäuper et al., 2004; Rabiau, Knäuper, & Miquelon, 2006; Radtke, Scholz, Keller, Knäuper, & Hornung, 2011), responses to dietary temptations (Kronick & Knäuper, 2010), and health-related outcomes like obesity (Knäuper et al., 2004). There is also evidence that interventions designed to promote health behaviors can inadvertently promote unhealthy behaviors in other domains (e.g., Albarracin, Leeper, & Wang, 2009; Nigg, Lee, Hubbard & Min-Sun, 2009).

To date, however, the presence and influence of compensatory beliefs pertaining to energy-use and environmental behavior has received relatively little attention; the only study to our knowledge was conducted by Bratt in 1999. Bratt asked a large sample of Norwegian participants to indicate the extent to which they agreed or disagreed with three statements: (i) *If I deliver paper and glass to recycling bins instead of throwing them out along with other garbage, I'm already doing something for the environment. Then it doesn't matter that much if I use my car to some extent*; (ii) *If I do not drive a car, I'm already doing something for the environment. Then it doesn't matter that much if I throw out glass and paper in the ordinary garbage*; and (iii) *If one doesn't drive a car to work, one is already doing something for the environment. Then it doesn't matter that much if one travels by airplane on holiday, even though the airplane uses a lot of fuel and possibly harms the environment*. The findings

indicated some evidence of compensatory beliefs, but only 13%, 4%, and 17% of participants agreed with each of the statements, respectively, and the correlations between endorsement of the beliefs and environmental behaviors were relatively small ($-0.10 < r\text{s} < 0.15$), albeit significant in some cases.

Bratt's (1999) study is, however, now over a decade old and there is good reason to believe that matters may have changed. For example, there have been a number of technological and policy interventions aimed at reducing energy consumption in recent years and an increasing pressure on citizens to act in an environmentally responsible fashion. Therefore, it is possible that the use of compensatory beliefs has increased. Indeed, the concept of compensation is now readily advertised as a means of atoning for unsustainable activities (e.g., air travel) through, for example, voluntary carbon-offsetting schemes (e.g., Gössling, Broderick, Ceron, Dubois, Peeters & Strasdas, 2007). Bratt's study also revealed little about, for example, the characteristics of those individuals who are more or less likely to employ such compensations or how the endorsement of such beliefs might relate to other beliefs or aspects of a person's identity.

The Present Research

The growing number of interventions and policies that aim to encourage people to conserve energy and act more sustainably, coupled with a lack of research on compensatory beliefs pertaining to energy and environmental issues, means that there is an urgent need to examine whether – and to what extent – people endorse CGBs. If, like has been shown in the health domain, such beliefs are readily endorsed and influence behavior, then CGBs might offer a valuable insight into the cognitive basis of the rebound effects that can limit the effectiveness of energy demand-reduction interventions and other pro-environmental policies. The present research, therefore, aimed to develop a measure of the extent to which people

endorse CGBs and to investigate the relationship between endorsement of CGBs and how people think and behave with respect to energy and environmental issues.

First, we generated and refined an initial pool of items designed to measure participants' endorsement of CGBs. Following examination of the conceptual structure of these items, we examined the relationship between endorsement of CGBs and participants' environmental beliefs and behaviors. Given that CGBs might be seen as a justification for energy-inefficient or unsustainable behavior, we predicted that participants who endorsed CGBs would be less likely to act pro-environmentally. Additionally, on the basis that endorsement of CGBs would be difficult to reconcile with a green identity (e.g., Sparks & Shepherd, 1992; Mannetti, Pierro & Livi, 2004; Whitmarsh & O'Neill, 2010), ecological worldview, and concern for climate change, we predicted negative correlations between endorsement of CGBS and these variables.

Method

Participants and Design

Participants were recruited in two ways: (i) by email from a volunteer list maintained by the University of Sheffield in the UK, and (ii) by leaflet distribution in a local Sheffield newspaper. A total of $N = 940$ people began an online questionnaire with $N = 770$ completing all the questions. The responses of these $N = 770$ participants comprise the data set for all the following analyses. Participants' ranged from 18 to 79 years of age ($M = 29.47$, $SD = 11.80$), the majority (63%) were female, and 77.6% ($N = 581$) of the participants had a higher education degree.

Procedure

Participants were asked to complete an online questionnaire that took between 15 and 30 minutes to complete and offered the chance to win a £50 Amazon voucher as an incentive for taking part. The questionnaire included measures designed to assess participants'

endorsement of CGBs, their pro-ecological behavior, their ecological worldviews, their green identity and beliefs about climate change. We also recorded basic demographic details and participants' tendencies to act in social desirable ways. Details of each of the measures are provided below.

Measures

Compensatory green beliefs (CGBs). An initial pool of CGBs was developed following two focus groups, each conducted with 8 volunteer graduate students from the University of Sheffield. Participants were first introduced to the concept of compensatory beliefs, using compensatory health beliefs as an example, before being asked to report any CGBs that they could think of. Forty-two beliefs were identified in domains such as transport (e.g., 'I use public transport sometimes, so it is okay to drive on other occasions'), energy (e.g., 'I have low energy light bulbs, so it is okay to leave the lights on'), food (e.g., 'I eat in-season food most of the time, so it is okay if sometimes I buy out-of-season food'), water (e.g., 'I do not often use a dishwasher, so it is okay to have longer showers'), in addition to some cross-domain beliefs (e.g., 'I try to limit the car journeys I make, so it is okay to drink bottled water').

Following the focus groups, the list of beliefs generated by the participants was refined. Two of the statements were removed as they did not represent compensations (e.g. 'My water use is included in my rent, so it doesn't matter how much I use'); while a further 14 statements were removed due to their close resemblance to other items. Of the remaining 26 statements, it was decided to retain those that had been suggested by more than one participant (or suggested and seconded by other participants), leaving a final list of 20 statements reflecting different CGBs. In order to ensure the applicability of the statements to future participants, statements were reworded where necessary and phrased in the third

person. For example, the statement 'I recycle, so it is okay to drive my car' became 'Recycling compensates for driving a car', such that it was applicable to people without cars.

The final set of statements was then incorporated in the online survey. These included: 'Walking to the supermarket can compensate for buying highly packaged food', 'Limiting your household water consumption can compensate for not better insulating your home', and 'It is okay to have lots of electrical items if you turn them off when not in use' (for a full list of statements, see Table 1). In the online survey, participants were asked to indicate how closely each statement reflected their own beliefs using a 5-point Likert scale anchored by 'strongly disagree' and 'strongly agree'.

Pro-Ecological Behavior. Participants completed a modified version of Kaiser and Keller's (2001) General Ecological Behavior (GEB) scale (see also Kaiser, Wölfing, & Fuhrer, 1999; Kaiser, Frick, & Stoll-Kleemann, 2001; Kaiser, Doka, Hofstetter, & Ranney, 2003). The GEB scale consists of 65 items, each reflecting a different type of ecological behavior (e.g., 'I use a compost bin'; 'I drive a fuel efficient automobile'). Participants indicated whether or not they engaged in the behavior on a dichotomous yes / no scale. In the present study, seven of the items were removed from the scale as they were not deemed appropriate for the UK sample (e.g., 'after meals, I dispose of leftovers in the toilet'). Also, where necessary, items were converted from metric to imperial (e.g., kilometres were converted to miles) as most people in the UK are more familiar with imperial measures. Responses on the remaining 58 items were summed, with higher scores indicating a greater tendency to engage in pro-ecological practices. The 58-item measure proved internally reliable (Cronbach's alpha = 0.77).

Ecological Worldview. The revised version of Dunlap and Van Liere's (1978) New Ecological Paradigm (NEP; see Dunlap, van Liere, Mertig, & Jones, 2000) was included to assess the degree to which participants endorsed an ecological worldview (i.e., the belief that

human-beings are part of nature rather than separate from it). The NEP asks participants to respond to 15 statements relating to human-environment interactions (e.g., 'we are approaching the limit of the number of people the earth can support') on a 5-point scale anchored by 'strongly disagree' and 'strongly agree'. Responses were summed with higher scores equating to a more ecological worldview. Scores on the NEP proved internally consistent (Cronbach's alpha = 0.81).

Green Identity. To measure pro-environmental identity, we included 4-items from Whitmarsh and O'Neill (2010) who, in turn, had adapted them from Cook, Kerr, and Moore (2002) and Sparks and Shepherd (1992): (1) 'I think of myself as someone who is very concerned with environmental issues'; (2) 'I think of myself as an environmentally friendly consumer'; (3) 'I would not want my family or friends to think of me as someone who is concerned about environmental issues'; and (4) 'I would be embarrassed to be seen as having an environmentally friendly lifestyle'. The 4-items were measured on a 5-point scale (anchored by 'strongly agree' and 'strongly disagree') and were combined to form a short, measure of pro-environmental (or 'green') identity (Cronbach's alpha = 0.72).

Beliefs about Climate Change. To assess participants' beliefs about climate change, two items were adapted from Spence, Venables, Pidgeon, Poortinga, and Demski (2010). First, participants were asked 'Do you think that the world's climate is changing?' (yes / no / don't know). Second, in order to measure concern about climate change we asked participants 'How concerned are you about climate change?' (5-point: not at all concerned / not very concerned / fairly concerned / very concerned / don't know).

Social Desirability. To control for social desirability we incorporated the short-form of the Marlowe-Crowne Social Desirability scale (Ray, 1984), which consists of 8 items with a binary response of 'truth' of 'false' (e.g., 'Are you quick to admit making a mistake?' and 'Do you sometimes try to get even rather than forgive and forget?'). Responses to the items

were summed, with higher values indicative of a greater need for social approval (Cronbach's alpha = 0.58).

Demographics. The final section of the survey contained questions about participants' age, gender, annual household income, car-ownership, home-ownership, level of education, and number of household occupants. We also asked participants whether they were the primary bill payer and if they had any personal means of renewable energy generation (e.g., solar panels).

Results

Development of a Measure of CGBs: Factor Structure and Reliability

The 20-items designed to measure CGBs were entered into a principal axis factor analysis with direct quartimax rotation using SPSS Version 20. Missing values (10% of responses) were treated with multiple imputations. The Kaiser-Meyer-Olkin measure of sampling adequacy (0.95) and Bartlett's test of sphericity (38950.41, $df = 190$, $p < .001$) indicated that the correlation matrix was appropriate for such analysis. Three factors were extracted with eigenvalues greater than 1 (Factor 1 = 7.91, Factor 2 = 1.74, and Factor 3 = 1.18). The first factor explained 39.56% of the variance and the other factors explained 8.68% and 5.89% of additional variance, respectively. Seventeen items had loadings > 0.40 on Factor 1. However, two of these items also loaded to a similar extent on Factor 3 and one item loaded to a greater extent on Factor 2. The remaining three items loaded on Factor 2 only. Factor 1 included the majority of the CGB items and was labelled 'compensation'. Factor 3 comprised two items specifically relating to 'electricity use' and was labelled accordingly. The four items loading primarily on Factor 2 did not pertain to a particular domain of compensation. However, there were similarities in how they were phrased. Specifically, whereas the items loading on Factors 1 and 3 tended to be fairly definitive (i.e., action X *will* compensate for action Y), Factor 2 comprised less definitively worded items

(e.g., 'if the *majority* of food that you buy is produced locally then it is okay if the rest is imported').

Given that the small number of items loading on Factor 2 were qualitatively different in their phrasing to the other statements, the decision was taken to remove the four items that loaded primarily on Factor 2 from the scale. We then re-ran the principal axis factor analysis with direct quartimax rotation on the remaining 16-items (see Table 1). Missing values (10% of responses) were treated with multiple imputations (Graham, 2009). The Kaiser-Meyer-Olkin measure of sampling adequacy (0.96) and Bartlett's test of sphericity (33399.62, $df = 120$, $p < .001$) indicated that the correlation matrix was appropriate for such analysis. One factor solution (Factor 1 = 7.35) was extracted that explained 45.95% of the variance. An overall measure of endorsement of CGBs was derived by the sum score of the 16 items. The 16-item scale was internally consistent ($\alpha = 0.92$).

Endorsement of CGBs and Social Desirability Concerns

Table 1 shows the proportion of participants who agreed with, chose the mid-point, or disagreed with each of the CGB statements, respectively. Agreement with individual CGBs was relatively low (M = 8.13%, range 3.50% - 16.20%). Participants tended to select the mid-point of the scale (M = 16.49%, range 8.80% - 31.40%) or the response options indicative of a disagreement with the CGB (M = 75.36% range 61.20% - 84.40%).

Table 2 presents the means and standard deviations for all of the measures incorporated in the survey, along with correlations between endorsement of CGBs and the other measures. There was a small, but significant negative correlation between endorsement of CGBs and scores on the social desirability scale, $r = -0.12$, $p < .001$, suggesting that endorsement of CGBs is, in part, influenced by social desirability concerns. We therefore controlled for social desirability where possible in subsequent analyses.

Demographic Differences in Endorsement of CGBs

There were no significant differences in the proportion of males and females endorsing CGBs, $t(756) = 1.32$, *ns* ($M = 15.78$ and 14.77, $SDs = 10.76$ and 9.73, for males and females, respectively). However, there were significant negative correlations between endorsement of CGBs and education level ($r = -0.13$, $p < .001$), age ($r = -0.26$, $p < .001$), and annual income ($r = -.11$, $p < .05$). More educated participants, those who were older or had a higher mean income, were less likely to endorse CGBs. By contrast, there was a significant positive correlation between endorsement of CGBs and the number of people living in the house ($r = 0.12$, $p < .05$), with greater endorsement of CGBs with increasing house occupancy.

Participants without cars were significantly more likely to endorse CGBs ($M = 16.41$, $SD = 10.68$) than participants with cars ($M = 14.32$, $SD = 9.67$), $F(2, 753) = 6.57$, $p < .05$, $\eta^2 = .009$. However, controlling for age (in addition to social desirability) eliminated this difference, $F(3, 701) = 0.36$, *ns*, $\eta^2 = .001$. There were no significant differences in the endorsement of CGBs between participants who own their own home ($M = 12.43$, $SD = 9.24$) and those who rent ($M = 15.77$, $SD = 9.86$), $F(2, 600) = 0.84$, *ns*, $\eta^2 = .001$. There were also no significant difference in endorsement of CGBs between participants that had household renewables ($M = 12.93$, $SDs = 9.09$) versus those without household renewables ($M = 14.71$, $SD = 10.10$), $F(1,449) = 0.02$, *ns*, $\eta^2 = .001$ and no significant difference between bill payers ($M = 14.53$, $SD = 10.27$) and non-bill payers ($M = 15.87$, $SD = 9.95$), $F(1, 755) = 2.91$, *ns*, $\eta^2 = .004$.

Relationship between Endorsement of CGBs and Other Measures

Endorsement of CGBs was negatively correlated with ecological behavior ($r = -0.39$, $p < .001$), ecological worldview ($r = -0.44$, $p < .001$) and green identity ($r = -0.41$, $p < .001$). That is, participants who endorsed more CGBs were less likely to engage in ecological

behaviors, and tended to have a weaker pro-ecological worldview and a weaker green identity.

Endorsement of CGBs among participants who were skeptical about the existence of climate change ($N = 55$) was compared with the remaining participants ($N = 723$) using a Mann-Whitney U test. Participants who were skeptical about climate change endorsed more CGBs (*Median* = 0.55, *Range* = -1.48 – 4.41) than participants who believed in climate change (*Median* = -0.04 *Range* = -1.48 – 4.72; U (778) = 13519.00, $p < .001$, $r = 0.07$). Concern about climate change was also found to correlate with endorsement of CGBs; participants who expressed greater concern about climate change endorsed fewer CGBs, $r = -0.20$, $p < .001$.

In order to confirm that articulating CGBs was not merely another way for participants to express their (lack of) ecological worldview or green identity, we conducted a hierarchical regression analysis to see whether endorsement of CGBs predicted ecological behavior over and above social desirability concerns, green identity, and ecological worldview (see Table 3). The regression confirmed that endorsement of CGBs (entered at Step 2) significantly predicted responses to the General Ecological Behavior scale ($\beta = -.11$, t (775) = -3.18, $p < .001$) over and above social desirability concerns (entered at Step 1; $\beta = .07$, t (775) = 2.53, $p < .05$), green identity (entered at Step 1; $\beta = .40$, t (775) = 11.51, $p < .001$) and ecological worldview (entered at Step 1; $\beta = .20$, t (775) = 5.61, $p < .001$), $R^2 = 0.36$, F (4, 775) = 108.35, $p < .001$ (F change = 9.96).

Discussion

The present research investigated whether people endorse the idea of compensation in behaviors relating to energy-use and the environment. For example, do people believe that switching to a green energy tariff permits them to use more energy or do people believe that it is okay to leave electrical goods turned on if they are modern and efficient? We refer to

such beliefs as 'compensatory green beliefs' or CGBs due to their relationships to ostensibly 'green' or pro-environmental actions (e.g., conservation of energy). The first stage of our research developed a measure of peoples' endorsement of CGBs. We then investigated how endorsement of CGBs related to key demographic variables (e.g., age, gender, and education), aspects of identity (i.e., ecological worldview, green identity), beliefs about and concern with climate change, and engagement in pro-ecological behaviors.

Endorsement of Compensatory Green Beliefs

Overall, endorsement of CGBs among our sample was quite low (average agreement with the statements was 8.13%, see Table 1) and roughly consistent with the findings of Bratt (1999). While the CGB measure did contribute significantly to the regression model predicting pro-ecological behaviour, its impact above and beyond the measures of green identity and ecological worldview was small, accounting for only an additional 1% of the variance. Further, the statistical significance of this finding should also be considered in the context of our fairly large sample size ($N = 770$). While surprising – recall that we had anticipated that increasing societal pressure to act sustainably might have increased the endorsement and use of such beliefs over the last decade – this finding is encouraging as it suggests that, in general, the public do not feel that engaging in ostensibly pro-environmental acts will necessarily absolve them of, or undo, the negative effects of engaging in environmentally unsustainable behaviors. That said, it is important to note that participants did not reject outright the idea of compensation and there are a number of reasons to think that the findings of the present research may provide a conservative estimate of real-world use or endorsement of such beliefs.

First, the negative correlation between social desirability and endorsement of CGBs suggests that participants may underreport their endorsement of CGBs because of social desirability concerns. Second, the self-selected nature of the sample might have meant that

there was lower endorsement of CGBs compared to the level that might be expected within a more representative sample of the UK population. That is, to the extent to which participants knew that they would be asked to complete a questionnaire about energy and environmental issues, it is possible that a disproportionate number of people with interests in environmental issues volunteered to take part. Future research might usefully investigate endorsement of CGBs in other samples.

The use of third person phrasing for the scale items might have also reduced participants' tendencies to endorse them. All the items were phrased in the third person in order to increase the overall relevance of the statements to the general population (e.g., to make the transport related items applicable to all participants, even those without a car). However, research into health compensations suggests that personally relevant items are more likely to be endorsed (e.g., Radtke et al., 2011). As such, it could be reasonably assumed that rephrasing the statements reflecting CGBs in order to make them more personally relevant might lead to greater endorsement.

Finally, the definitive nature of the CGB scale items might have reduced participants' tendencies to endorse them. Our analysis suggested that statements phrased less definitively were more likely to be endorsed by participants than statements that were more definitive. Evidence from a 'think aloud' study conducted on a scale designed to measure endorsement of compensatory health beliefs (see Kaklamanou, Armitage & Jones, 2013) indicated that, while people sometimes disagree with the specific tenet of a compensatory statement (i.e. that action A *will* atone for action B), they might see some general value to the compensation (e.g., it is better than doing nothing) or deem that the compensation is justifiable in certain situations (e.g., not in general but on rare occasions). In the present research it is possible that items that were phrased in less definitive terms permitted participants to endorse these items despite holding reservations over their more general efficacy. The same argument might

explain why participants favoured the mid-point option (i.e. 'not sure') when responding to the more definitively phrased statements. Such a non-committal response could be taken to indicate that the participant was entertaining the idea that the compensation might be at least partially effective or justifiable on some occasions (i.e., the mid-point became an 'it depends' option).

Relatedly, it is possible that the specific coupling of certain compensatory actions within the scale affected participants' tendencies to endorse them. Specifically, for the objectively double-barrelled statements within the scale (e.g., not driving a car compensates for flying on holiday) a failure to endorse the statement could mean one of two things: (a) that a respondent formally disagreed with a statement; or (b) the respondent disagreed with the specific combination of elements within the statement, while not necessarily disagreeing with the concept in general. For instance, while they might disagree with the idea that by not driving a car they can compensate for flying on holiday, they might still agree that not driving a car compensates for other environmentally significant behaviors (e.g., having a greater number of electrical appliances in the home).

In short, for the reasons outlined above, it is possible that people may be more likely to endorse CGBs than the present research would suggest. Future research could helpfully investigate how changes to the definitiveness, specificity and personal relevance of CGB statements, influences the extent to which people endorse them. That said, even if 8.13% is a fair reflection of the average proportion of people that endorse CGBs; then in a UK population of around 62 million people and a world population of around 6.84 billion people (The World Bank, 2010), this clearly represents a large group of individuals. Given the identified links between endorsement of CGBs and pro-ecological behavior, we contend that at a population level endorsement of CGBs could have a significant impact on the effectiveness of interventions and initiatives intended to, for example, reduce energy

consumption and increase more sustainable practices (for evidence of the impact of compensatory beliefs on the efficacy of healthcare interventions, see Ernsting, Schwarzer, Lippke & Schneider, 2012).

Correlations between Endorsement of CGBs and Other Measures.

Consistent with our hypotheses, endorsement of CGBs was negatively related to pro-ecological behavior, environmental worldview, and green identity. These correlations confirm the validity of our measure of CGBs by illustrating how endorsement of compensations pertaining to energy and environmental issues is predictably related to a number of key constructs that are known to influence the extent to which someone will act in a pro-environmental manner (e.g., Kaiser & Keller, 2001; Stern, 2000; Whitmarsh & O'Neill, 2010). Below, we outline three explanations for the emergence of these trends.

Environmental literacy explanation: It is possible that the negative correlations between endorsement of CGBs and pro-ecological behavior, environmental worldview, and green identity are indicative of differences in the 'environmental literacy' of pro-environmental compared to less pro-environmental people. Environmental literacy is a multi-faceted concept comprising environmental awareness, knowledge, attitudes, and a capacity and willingness to act on environmental issues (see Scholz, 2011). It is likely that people with a pro-environmental worldview and a stronger green identity are more environmentally literate and therefore less likely to endorse CGBs on the grounds that they are more aware of potential inaccuracies in the compensatory beliefs and/or are more skeptical of the value or morality of compensation (more so than those with less pro-environmental worldviews and less green identities).

This explanation suggests that educational strategies designed to improve environmental literacy (e.g., by highlighting the inaccuracy of many compensatory beliefs and improving environmental awareness) might reduce the tendency of people to employ

compensatory beliefs. There are many examples of interventions aimed at improving the environmental literacy of individuals, particularly within educational settings (e.g., Basile & White, 2000; Pe'er, Goldman & Yavetz, 2007; St. Clair, 2003). However, while their might be value in these interventions in enhancing environmental literacy, care should be taken not to assume that endorsement of CGBs is necessarily a product of a knowledge deficit that can be amended with the simple provision of 'correct' information, as research increasingly calls into question the validity of such deficit models of public understanding of science and technology (e.g., Brunk, 2006; Durant, 1999; Hansen, Holm, Frewer, Robinson & Sandøe, 2003; see also Steg & Vlek, 2009).

Lifestyle explanation: Correlations between endorsement of CGBs and pro-ecological behavior, environmental worldview, and green identity could also be explained by differences in the number of opportunities that people have to evoke CGBs. In short, because people with a pro-environmental worldview and a green identity are likely to participate in fewer unsustainable behaviors (e.g., Kaiser & Keller, 2001; Stern, 2000; Whitmarsh & O'Neill, 2010), they would have less need to endorse CGBs than people who are less pro-environmental.

Cognitive Dissonance Reduction: Endorsement of compensatory beliefs might reduce the cognitive dissonance (e.g., Festinger, 1957) associated with performing a behavior (e.g., flying on holiday) that is inconsistent with personal or social goals (e.g., a desire to reduce one's carbon footprint). According to this explanation, however, endorsement of CGBs should have been greater among participants with more pro-environmental worldviews and stronger green identities, seeking to atone for engaging in less pro-environmental behavior. However, this was not the case in the present study. While we do not rule out the possibility that people use CGBs in situations of conflict between identity and action, the present findings are inconsistent with the idea that compensatory beliefs are the product of cognitive

dissonance. In sum, while future studies should assess the impact that lifestyle and cognitive dissonance explanations might offer for the trends observed within this study, we suggest that the 'environmental literacy' explanation provides the best account for the correlations between endorsement of CGBs, ecological worldviews, pro-ecological behavior and green identity observed in the present study.

Conclusion

The present research developed a measure of the extent to which people endorse CGBs that we hope will be used to understand more about the nature of compensatory beliefs pertaining to energy and environmental issues. We also demonstrated how these beliefs relate to certain demographic, lifestyle, and identity factors, and how they impact on peoples' energy-use and environmental behaviors. While the present research offers an initial insight into the cognitive factors that might give rise to the emergence of rebound effects (e.g., Sorrell, 2007), future research might usefully adopt longitudinal designs that can identify the direction of causation (e.g., does the endorsement of CGBs promote energy inefficient behaviors or vice versa?) and further elucidate the mechanisms underlying such effects (e.g., differences in knowledge about environmental issues, cognitive dissonance, etc.). In short, compensatory beliefs may provide a useful window into the psychological processes underlying decisions to engage or abstain from environmentally significant issues.

Highlights

- We develop a measure of the extent to which people endorse 'compensatory green beliefs' (CGBs).
- We show that endorsement of CGBs predicts pro-ecological behavior over and above environmental values and identity.

- We propose that endorsement of CGBs could help to explain reactions to energy efficiency interventions.

References

Albarracin, D., Leeper, J., & Wang, W. (2009). Immediate increases in eating following exercise promotion messages. *Obesity*, *17*, 1451–1452. doi:10.1038/oby.2009.16

Basile, C., & White, C. (2000). Environmental literacy: Providing an interdisciplinary context for young children. *Contemporary Issues in Early Childhood*, *1*, 201-208.

Bratt, C. (1999). Consumers' environmental behaviour: Generalised, sector-based or compensatory? *Environment and Behaviour, 31*, 28-44. doi:10.1177/00139169921971985

Brunk, C. G. (2006). Public knowledge, public trust: Understanding the 'knowledge deficit'. *Public Health Genomics, 9*, 178-183.

Cook, A. J., Kerr, G. N., & Moore, K. (2002). Attitudes and intentions towards purchasing GM food. *Journal of Economic Psychology*, *23*, 557-572. doi:10.1016/S0167-4870(02)00117-4

Darby, S. (2006). *The effectiveness of feedback on energy consumption: A review for DEFRA of the literature on metering, billing and direct displays. Oxford, UK: Environmental Change Institute*. Retrievable from: http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf

Department of Communities and Local Government [DCLG] (2010). *Focus on behaviour change – reducing energy demand in homes*. London, UK: Crown Copyright.

Department of Energy and Climate Change [DECC] (2011). *Smart metering implementation programme: A consultation on the detailed policy design of the regulatory and*

commercial framework for DCC. London, UK: Crown Copyright. Retrievable from: http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx

Dunlap, R., & Van Liere, K. (1978). The new environmental paradigm: A proposed instrument and preliminary results. *The Journal of Environmental Education, 9*, 10-19.

Dunlap, R., Van Liere, K., Mertig, A., & Jones, R. E. (2000). Measuring endorsement of the New Ecological Paradigm: A revised NEP scale**.** *Journal of Social Issues, 56***,** 425-442. doi:10.1111/0022-4537.00176

Durant, J. (1999). Participatory technology assessment and the democratic model of the public understanding of science. *Science and Public Policy, 26*, 313-319.

Ernsting, A., Schwarzer, R., Lippke, S., & Schneider, M. (2012). "I Don't Need a Flu Shot Because I Lead a Healthy Lifestyle": Compensatory health beliefs make vaccination less likely. *Journal of Health Psychology*, 0, 1-12. doi: 10.1177/1359105312455076

Exline, J. J., Worthington, E. L., Hill, P., & McCullough, M. E. (2003). Forgiveness and justice: A research agenda for social and personality psychology. *Personality and Social Psychology Review, 7*, 337-348. doi: 10.1207/S15327957PSPR0704_06

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1991). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, *4*, 272-299. doi:10.1037/1082-989X.4.3.272

Festinger, L. (1957). *A theory of cognitive dissonance.* Evanston, IL: Row, Peterson.

Geller, H., & Attali, S. (2005*). The experience with energy efficiency policies and programmes in IEA countries: Learning from the critics (IEA information paper)*. Paris, France: International Energy Agency.

Gatersleben, B., Steg, L., & Vlek, C. (2002). Measurement and determinants of environmentally significant consumer behaviour. *Environment and Behavior*, *34*, 335-362. doi: 10.1177/0013916502034003004

Gössling, S., Broderick, J., Upham, P., Ceron, J-P., Dubois, G., Peeters, P., & Strasdas, W. (2007). Voluntary carbon offsetting schemes for aviation: Efficiency, credibility and sustainable tourism. *Journal of Sustainable Tourism, 15*, 223-248.

Graham, J.W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549-576.

Greene, D. L. (1992). Vehicle use and fuel economy: How big is the "rebound" effect? *Energy Journal, 13*, 117–143.

Greening, L. A., & Greene, D. L. (1998). *Energy use, technical efficiency, and the rebound effect: A review of the literature.* Denver, CO: Hagler Bailly and Co.

Hansen, J., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: Recent research into lay and expert attitudes to food risks. *Appetite*, *41*, 111-121. doi: 10.1016/S0195-6663(03)00079-5

International Panel on Climate Change [IPCC] (2007). *Climate Change 2007: Synthesis Report*. Contribution of Working Groups I, II and III to the Fourth Assessment. Geneva, Switzerland: IPCC.

Kaiser, F. G. (1998). A general measure of ecological behaviour. *Journal of Applied Social Psychology*, *28*, 395-422. doi:10.1111/j.1559-1816.1998.tb01712.x

Kaiser, F. G., & Keller, C. (2001). Disclosing situational constraints to ecological behavior: A confirmatory application of the mixed Rasch model. *European Journal of Psychological Assessment*, *17*, 212-221. doi:10.1027//1015-5759.17.3.212

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology*, *19*, 1-19. doi:10.1006/jevp.1998.0107

Kaiser, F. G., Frick, J., & Stoll-Kleemann, S. (2001). Zur Angemessenheit selbstberichteten Verhaltens: Eine Validitätsuntersuchung der Skala Allgemeinen Ökologischen Verhaltens [Accuracy of self-reports: Validating the General Ecological Behavior scale]. *Diagnostica*, *47*, 88-95.

Kaiser, F. G., Doka, G., Hofstetter, P., & Ranney, M. A. (2003). Ecological behavior and its environmental consequences: A life cycle assessment of a self-report measure. *Journal of Environmental Psychology*, *23*, 11-20. doi:10.1016/S0272-4944(02)00075-0

Kaklamanou, D., Armitage, C. J., & Jones, C.R. (2013). A further look into compensatory health beliefs: a think aloud study. *British Journal of Health Psychology,18,* 1, 139-154. doi:10.1111/j.2044-8287.2012.02097.x

Knäuper, B., Rabiau, M., Cohen, O., & Patriciu, N. (2004). Compensatory health beliefs scale development and psychometric properties. *Psychology and Health*, *19*, 607-624. doi:10.1080/0887044042000196737

Kronick, I., & Knäuper, B. (2010). Temptations elicit compensatory intentions. *Appetite*, *54*, 398-401. doi:10.1016/j.appet.2009.12.011

Mannetti, L., Pierro, A., & Livi, S. (2004). Recycling: Planned and self-expressive behaviour. *Journal of Environmental Psychology, 24*, 227-236. doi:10.1016/j.jenvp.2004.01.002

Milne, G., & Boardman, B. (2000). Making cold homes warmer: The effect of energy efficiency improvements in low-income homes. *Energy Policy*, 28**,** 411–424.

Nigg, C. R., Lee, H-R., Hubbard, A. E., & Min-Sun, K. (2009). Gateway health behaviors in college students: Investigating transfer and compensation effects. *Journal of American College Health*, *58*, 39-44. doi:0.3200/JACH.58.1.39-44

Pe'er, S., Goldman, D., & Yavetz, B. (2007). Environmental literacy in teacher training: attitudes, knowledge, and environmental behavior of beginning students. *The Journal of Environmental Education*, *39*, 45-59.

Rabiau, M., Knäuper, B., & Miquelon, P. (2006). The external quest for optimal balance between maximizing pleasure and minimizing harm: The compensatory health beliefs model. *British Journal of Health Psychology*, *11*, 139-153. doi:10.1348/135910705X52237

Radtke, T., Scholz, U., Keller, R., Knäuper, B., & Hornung, R. (2011). Smoking-specific compensatory health beliefs and the readiness to stop smoking in adolescents. *British Journal of Health Psychology*, *16*, 610-625. doi:10.1348/2044-8287.002001

Ray, J. J. (1984). The reliability of short social desirability scales. *The Journal of Social Psychology, 123*, 133-134.

Scholz, R. W. (2011). *Environmental Literacy in Science and Society*. New York, NY: Cambridge University Press.

Sorrell, S. (2007). The rebound effect: An assessment of the evidence for economy wide energy savings from improved energy efficiency. London: UK Energy Research Centre.

Sorrell, S., Dimitropoulos, J., & Sommerville, M. (2009). Empirical estimates of the direct rebound effect: A review. *Energy Policy, 37*, 1356-1371. doi:10.1016/j.enpol.2008.11.026

Sparks, P., & Shepherd, R. (1992). Self-identity and the theory of planned behavior: Assessing the role of identification with "green consumerism". *Social Psychology Quarterly, 55*, 388-399.

Spence, A., & Venables, D., Pidgeon, N., Poortinga, W., & Demski, C. (2010). *Public perceptions of climate change and energy futures in Britain: Summary findings of a survey conducted from January to March 2010. Understanding Risk Working Paper 10-01*. Cardiff University. Retrievable from: http://www.ipsos-mori.com/Assets/Docs/Polls/climate-change-public-perceptions-of-climate-change-report.pdf

St. Clair, R. (2003). Words for the world: Creating critical environmental literacy for adults. *New Directions for Adult and Continuing Education*, *2003*, 69-78.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology, 29*, 309-317. doi:10.1016/j.jenvp.2008.10.004

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues, 56*, 407-424. doi: 10.1111/0022-4537.00175

Thøgersen, J., & Olander, F. (2003). Spillover of environment-friendly consumer behaviour. *Journal of Environmental Psychology, 23*, 225–236. doi:10.1016/S0272-4944(03)00018-5

United Nations Framework Convention on Climate Change [UNFCCC] (2009). *Report of the conference of the parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009. Addendum. Part Two: Action taken by the conference of the parties at its fifteenth session*. Retrievable from: http://unfccc.int/meetings/copenhagen_dec_2009/items/5262.php

U.S. Climate Action Report (2010). United States Department of State (June 2010). *Washington: Global Publishing Services*. Retrievable from: http://www.state.gov/g/oes/rls/rpts/car/index.htm

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. *Journal of Environmental Psychology, 30*, 305-314. doi:10.1016/j.jenvp.2010.01.003

The World Bank (2010). *World development indicators*. Retrievable from: http://www.google.co.uk/publicdata/home

Compensatory green beliefs 28

Table 1

Principal Axis Factoring and Percentage of Participants Agreeing with 16 Statements reflecting Compensatory Green Beliefs

Item	Factor 1	Disagree	Midpoint	Agree
If you have a low flush toilet, then it is okay to use more water in other ways	0.76	75.00	15.50	9.50
Recycling compensates for driving a car	0.72	79.20	14.50	6.30
Not driving a car compensates for not recycling	0.72	84.40	11.90	3.70
You do not need to worry about which country your food comes from if you use energy efficient appliances in the home	0.71	79.60	15.00	5.40
It does not matter how much energy you use if you are on a green energy tariff	0.70	80.90	15.60	3.50
Limiting your household water consumption can compensate for not better insulating your home	0.69	79.10	15.90	5.00
It is okay to drink bottled water if you limit the number of car journeys that you make	0.69	73.70	21.80	4.50
Composting food waste can make up for buying imported food	0.68	64.60	23.20	12.20
Walking to the supermarket can compensate for buying highly packaged food	0.68	77.30	14.20	8.50
Having a water butt can compensate for using the oven	0.67	61.90	31.40	6.70
It is okay to leave electrical goods turned on if they are modern and efficient	0.62	82.80	11.50	5.70
Not driving a car compensates for flying on holiday	0.59	61.20	22.70	16.20
Flying abroad can be made up for by being a vegetarian (i.e. not eating meat)	0.56	84.20	12.20	3.60

Compensatory green beliefs 29

If you have energy efficient electrical equipment, then it is okay to leave it on standby	0.55	78.80	10.10	11.00
Not using a dishwasher can compensate for taking longer showers	0.55	64.70	19.60	15.60
It is okay to leave the lights on if you use low energy light bulbs	0.48	78.50	8.80	12.70

Notes: Items are ordered by size of factor loading and loadings < 0.30 are suppressed

Compensatory green beliefs 30

Table 2

Descriptive Statistics and Partial Correlations Between Compensatory Green Beliefs (CGBs) and Other Measures

	M	*SD*	CGBs	*N*
Compensatory Green Beliefs	15.17	10.21		780
General Ecological Behavior	33.72	6.67	-0.39**	780
Ecological Worldview[a]	56.09	8.36	-0.44**	780
Green Identity	11.95	2.79	-0.41**	780
Concern about Climate Change	3.03	0.79	-0.20**	780
Social Desirability	5.13	1.92	-0.12**	780
Age	29.47	11.79	-0.26**	707
Number of People in Household	3.27	1.70	0.12*	701
Education	Undergraduate degree[b]		-0.13**	749
Annual Income	20,000 - 30,000[d]		-0.11*	611

Notes: * $p < .05$, ** $p < .001$

[a] assessed using the New Ecological Paradigm scale (Dunlap et al., 2000)

[b] indicates median rather than mean value.

Compensatory green beliefs 31

Table 3
Summary of Hierarchical Regression Analysis for Variables Predicting Ecological Behavior (N = 939)

Variable	Model 1			Model 2		
	B	SE B	β	B	SE B	β
Social Desirability	0.29	0.10	0.13*	0.26	0.10	0.07*
Green Identity	1.03	0.08	0.43**	0.96	0.08	0.40**
Ecological Worldview[a]	0.18	0.03	0.22**	0.16	0.03	0.20**
Compensatory Green Beliefs[b]				-0.07	0.02	-0.11*
R^2		0.35			0.36	
F for change in R^2		138.65**			9.96*	

*$p <$. 05, ** $p <$ .001

[a] assessed using the New Ecological Paradigm scale (Dunlap et al., 2000)

[b] weighted compensatory green beliefs