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Original research article

I did my bit! The impact of electric vehicle adoption on compensatory beliefs and norms in Norway

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ABSTRACT

The conception that undertaking a certain *pro-environmental behaviour* may encourage people to adopt other pro-environmental behaviours is appealing, but the evidence is inconsistent. Based on the literature, we propose that the relative strength of relevant *personal norms* and *compensatory beliefs* following an initial pro-environmental behaviour are decisive for whether people are more, less, or equally likely to perform other pro-environmental behaviours. Using survey data ($N = 217$) collected in Norway among 'to-be owners' of battery electric vehicles and recent owners of plug-in hybrid electric vehicles regarding their performance of pro-environmental behaviours, we tested a multiple indicators and multiple causes model where intrinsic normative process and compensatory beliefs predict a behavioural score obtained by a Rasch model. The analysis showed that the personal norm was the strongest predictor of pro-environmental behaviours, while compensatory beliefs exert a significant *negative* influence on both personal norm and behaviours. Further, a significant difference in compensatory beliefs was found between 'to-be owners' of battery electric vehicles and recent owners of plug-in hybrid vehicles. Some background variables included in the model as covariates were also found to influence certain constructs in the model. Implications for theory and policy and limitations of the study are discussed.

1. Introduction

The Norwegian government has set the goal to reduce greenhouse gas (GHG) emissions by at least 40% by 2030 (compared to GHG levels in 1990) and to achieve full carbon neutrality by 2050 [1]. As about 10% of total Norwegian GHG emissions are due to road traffic [2], the Norwegian government has implemented policy measures to encourage the adoption of new, climate-friendly and energy-efficient, transport modes; for example, fuel-efficient internal combustion engine vehicles, vehicles with a hybrid powertrain (e.g., hybrid electric vehicles (HEV), plug-in hybrid vehicles (PHEV)), zero-emissions vehicles (e.g., battery electric vehicles (BEV), and hydrogen vehicles) [3]. Among other things, these policy measures provide large monetary incentives (including tax reductions) to adopters of these new vehicle technologies [4].

Besides direct climate benefits, an additional argument used to justify the expenses of these incentives is that the adoption of climate-friendly transport modes may act as a "catalyst behaviour" [5], increasing the likelihood that adopters engage in further environmentally friendly behaviours [6], which would then further contribute to decreasing GHG emissions [7,8]. There is mounting theoretical and empirical evidence (e.g., [6,9,10]) backing the existence of such a pro-environmental behavioural "spillover"; i.e., that following pro-environmental behaviour, people are more likely to undertake further pro-environmental behaviours [11], in turn increasing the likelihood of them undertaking further pro-environmental behaviours in a 'rippling' manner. However, behavioural spillover assumes the existence of a common motivational basis underlying the different pro-environmental behaviours an individual undertakes [12,13], leading to some researchers questioning the durability and "rippling power" of pro-environmental behaviours created by external rewards [14,15]. Others have argued that undertaking a pro-environmental behaviour may sometimes create *negative* spillover [8], where other pro-environmental behaviours are deterred or inhibited [16–18]. For example, individuals may feel justified in giving themselves some "slack" after a good deed [19], or they may feel depleted and therefore that they lack the resources needed to undertake a second pro-environmental behaviour [20]. Further, people may believe that what they have already done has solved the problem [18], or that the problem is a collective one, and that

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therefore A) it is too big for them to solve alone, and/or B) their existing pro-environmental behaviours are a fair contribution to solving the issue [8,11]. Subsequently, these feelings and beliefs may make individuals less inclined to secondary pro-environmental behaviours to solve the problems of GHG emissions and climate change [21,22].

As the performance of pro-environmental behaviour can lead to both positive and negative behavioural spillover [8], it is important to examine how this occurs. The suggested common motivational root underlying pro-environmental behaviours, such as pro-environmental goals and values [12,23–25], makes it intuitively appealing to study general environmental behaviour patterns instead of focusing on isolated behaviours [26]. Despite a common motivational root, variations in behavioural difficulty can lead to variations in pro-environmental behaviours [26,27], as frequently documented across domains [28]. It is arguably rational to choose the easiest, or least costly, approach to reach one's goals, including environmental goals [29].

While the vast majority of the spillover literature focuses on positive spillover and its underlying motivational roots, less research has been conducted on the psychological processes that underlie negative spillover; specifically, what motivational roots leads to people feeling morally "off the hook" following pro-environmental behaviour, allowing them to justify not doing more and/or not engaging in other pro-environmental activities [30,31]. There is especially a lack of research on the self-regulation processes that may make people who have undertaken substantial efforts to protect the environment feel less morally obliged to do more. The objective of the present article is, therefore, to examine if (and, if so, the extent to which) previous substantial pro-environmental behaviour – buying a climate-friendly car – may reduce a person's moral motivation to act pro-environmentally in other ways.

2. Literature review and conceptual approach

2.1. Pro-environmental behaviour and motivation

Researchers have identified a variety of factors that affect pro-environmental behaviour [24,32–34]. Given that pro-environmental behaviour can also be characterised as pro-social or altruistic [24,34,35], personal values and moral norms are assumed to be a key driving force [36,37]. Moreover, trans-situational and stable value orientations [38], and feelings of moral obligation to act in accordance with one's own values [36,39], create a common motivational root for an individual's performance of different behaviours that are perceived as pro-environmental [12].

People are more likely to help others if they feel morally obliged to do so, based on their own value system [39]. Such a felt moral obligation is called a personal norm. According to Schwartz [39], personal norms can also be internalised social norms, which are commonly understood and accepted rules and standards of a group, and that guide social behaviour without external forces [40]. The internalization process is elaborated in Thøgersen's [41] extended taxonomy of norms, which describes a continuum of increasing levels of internalization and integration into the self; starting from *external* descriptive norms (i.e., how people normally act), through *injunctive* subjective social norms (i.e., how people perceive others expect them to act), then through *introjected* personal norms, where expected guilt or pride are the motivators, and finally to internalised *integrated* personal norms, which are completely aligned with and integrated into the person's own value system. Personal norms are activated, and therefore are able to guide, pro-social behaviour when an individual (a) is *aware of the consequence* of performing (or not performing) an action; (b) *accepts a responsibility* to act; (c) believes her/his actions have an effect on mitigating the problem and can, therefore, make a difference (*response efficacy*); and (d) believes he/she has personal *ability* to perform the required actions [39,42]. Among many others, Stern and his colleagues found strong support for the core proposition that personal norms guide pro-environmental behaviour. Stern et al. integrated this finding into their value-belief-norm-theory, which views personal norms as the outcome of a chain of antecedents including value priorities, environmental worldview, awareness of consequences, and ascription of responsibility [34,36].

Numerous studies employing Schwartz's norm-activation-theory, Stern's values-belief-norm-theory, or a mixed framework [33,43] have confirmed that personal norms account for a substantial share of variation in pro-environmental behaviour in various domains (e.g., [33,43–47]). Both the norm-activation theory and the values-belief-norm theory highlight the importance of overarching and stable values and environmental beliefs, which act as the basis for personal norms that eventually predict pro-environmental behaviour. At the same time, it has been observed that many people do not act in a consistently pro-environmental manner across behavioural domains [28,48]. This has made some scholars question the normative behavioural theories' assumptions about a common, intrinsic, motivational root for different pro-environmental behaviours [13]. Other researchers have attempted to build a more nuanced understanding of the motivation behind pro-environmental behaviour, acknowledging that such behaviour is rarely fun and enjoyable in and of itself, but is rather extrinsically motivated [41]. Further, pro-environmental behaviour is usually a social dilemma, as, while everyone would be better off if everyone cooperated, the individual could often improve their own private situation by not doing so [49]. Bicchieri [50] argues that most people find norms for cooperating justified, and prefer to comply with them, but that in specific situations some specific individuals may be excused, and that, when excused, most people prefer not to cooperate. If acting in a pro-environmental way in one situation excuses people from doing so in other situations, this might explain some apparent inconsistencies in pro-environmental behaviour [11]. One possible explanation for this is moral licensing.

2.2. Moral licensing

Research on "psychological licensing" suggests that a person's past "good deeds" can grant them some slack concerning future behaviour without harming their self-image or social image [51]. According to this research, past good deeds can give a person moral *credits* or moral *credentials,* which can justify diverging from moral norms in a future situation. According to Miller and Effron [51], "moral credits provide license by offsetting the negative impact of a transgression on one's moral self-concept, whereas moral credentials provide license by making a behaviour appear as if it were not a transgression at all" (p. 128).

As moral credits increase the sense of morality that an individual may experience after doing something positive (e.g., a pro-social or pro-environmental act), this may lead to a decrease in felt obligation to act virtuously when the next chance occurs [6]. For example, a person may be less likely to behave in a pro-environmental way when their "moral balance sheet" has been heightened by a recent pro-environmental action [6,16,19,52]. In one of the few demonstrations of moral credit gained from pro-environmental action, Mazar and Zhong [16] found that making choices in a "green" (vs. a "conventional") online store made participants more likely to cheat and steal afterwards. This careful study has obtained a lot of attention, but a later study was not able to replicate its findings in a different national context [53]. Other research has found that the generation and impact of moral credits depend on the characteristics of the trigger action as well as the personal characteristics of the actor. Gneezy et al., [54] found the expected effect of moral credit only when the triggering moral behaviour was costless. A similar moral act that had personal costs, as most pro-environmental behaviours do, was found to create the opposite effect, that is, to *increase* the likelihood of acting morally in a subsequent task. Note that this does not necessarily imply that costly moral acts do not produce moral credits, but that other effects related to costly moral behaviours more than outweigh the moral licensing effect.

Gneezy et al. [54] suggest that another important effect of a costly moral act is a strengthening of the person's moral self-identity (e.g.,

[55,56]). This was supported by Meijers et al. [57], who found that making choices in a "green" (vs. conventional) store, and scrutinizing "green" (vs. conventional) advertisements, only had a negative effect on environmental concern (Study 1) and intentions to act in a pro-environmental way (Study 2) for participants with a weak (vs. strong) environmental self-identity.

As discussed above, moral *credentials* make it possible for a person to make a decision that could seem morally suspect without "taking a 'hit' to one's moral self-concept" [51] (p. 128). When a behaviour is not explicitly amoral (e.g., racism, sexism) but is ambiguous enough that it *could* be construed as such, "it is disambiguated in line with past behaviour" [58] (p. 349). Research suggests that just increasing the *salience* of moral credentials can be sufficient to create a licensing effect [59,60].

Moral credentials effects have primarily been demonstrated in the area of racial prejudice [61], with only a few published applications involving pro-environmental behaviour. Noblet and McCoy [17] found that participants whose pro-environmental credentials were made salient by answering a series of questions about their past behaviour were subsequently less likely than those whose credentials had not been made salient to accept a governmental policy aimed at expanding renewable energy in their home state (the state of Maine, USA). Similarly, Truelove et al. [22] found that participants who helped the experimenter clean the desk before an experiment were subsequently less willing to accept a new "tax" to support a local nature preserve, but only if they were registered Democrats (i.e., no effects for registered Republicans or Independents). The reporting of results in this study is incomplete, but a possible interpretation is that helping the experimenter made Democrats' moral credentials more salient, which reduced their felt obligation to support the tax. A third study found that participants who were reminded of frequent pro-environmental behaviours in the past *and* had strong pro-environmental attitudes were less likely to seek information about their carbon footprint [59].

2.3. Single action bias and contribution ethics

The types of moral licensing discussed above are not necessarily the result of conscious reasoning [51]; indeed, they likely mostly rely on automatic processes [62]. However, deliberate reasoning processes that may lead to the same behavioural outcomes have also been suggested. In a study of American farmers, Weber [18] found that those that had undertaken one action in response to climate change (e.g., adapting one's production practices) made participants less likely to take other, sensible action towards the same goal. In this case, it appeared that single ameliorative action was perceived as sufficient to reduce the risk to a tolerable level; a phenomenon Weber called "single-action bias". Somewhat similar reasoning has been identified in the context of collective action problems [63,64]. Environmental problems, such as climate change or pollution of lakes and rivers, are collective action problems in the sense that no individual is responsible for the problem or can solve it alone. This implies that people may perceive their past pro-environmental behaviour as having been a fair contribution to solving the environmental problem, leading to a negative relationship between their past pro-environmental behaviour and their felt obligation to do specific things for the environment in the future [8,11]. Hence, both single-action bias and a contribution ethic can make individuals less inclined to do more to reduce a problem [8], such as GHG emissions and climate change. For example, Klöckner et al. [65] found that Norwegians who had bought an electric car (vs. a conventional car) believed that their driving had fewer negative consequences, and therefore felt less obliged to reduce their driving. Further, Catlin and Wang [66] found that providing an environmentally friendly option (e.g., paper recycling receptacle) led to more detrimental use (e.g., higher paper use) behaviour in laboratory and 'field' settings (i.e., paper towels in a men's room) compared to when it wasn't provided. Catlin and Wang's findings are consistent with earlier research finding a negative relationship between recycling and feeling an obligation to avoid packaging waste while shopping [11].

2.4. Compensatory beliefs

A contribution ethic implies that an individual doing something (that they feel is "enough") that contributes to solving an environmental problem liberates the person from an obligation to do (some) other things. In this respect, prior actions can compensate for subsequent inaction. Studies in developed, western, countries, asking directly whether specific pro-environmental actions can compensate for taking other actions that have detrimental consequences for the environment have found widespread disagreement [67–69]. However, in-depth qualitative research suggests that the disagreement is mostly with the blatant, calculative language used when describing trade-offs between very specific behaviours; language that is not used when people reference pro-environmental actions they have previously taken when justifying actions they have taken that have negative environmental consequences (such as vacation travelling by airplane) [68]. Research using more general statements to frame the issue found higher levels of agreement with compensatory beliefs [70]. Consistent with the basic proposition linking compensatory beliefs and a contribution ethic, the latter study (which covered seven countries in three different continents) found that the endorsement of compensatory beliefs is significantly and positively related to inconsistencies between (self-reported) pro-environmental behaviour in different domains.

It has been consistently found that people's endorsement of compensatory beliefs is negatively related to their environmental attitudes, identity, and sometimes behaviour [67–72]. This further suggests that compensatory arguments are generally accepted as justifications for not acting in pro-environmental ways in specific situations. Further, research indicates that people grant others "vicarious licensing" when they have acted in an environmentally friendly way [73]. As noted by Byrka and Kaminska [74], the negative relationship between compensatory beliefs and behaviour reduces the practical implications of such beliefs, since those that strongly endorse compensatory beliefs are less likely to act in a pro-environmental way anyway.

2.5. Behavioural difficulty

Only a few of the reviewed studies investigated situations where the initial pro-environmental behaviours were difficult and/or costly [65,71,75]. In this context, difficulty refers to the amount of effort required to perform the behaviour [27], such as the difficulty of making the initial decision, and/or the need for cognitive processing, and/or learning afterwards. These studies found that adopters of difficult and costly pro-environmental behaviour, such as buyers of a new eco-innovative and eco-efficient vehicle, are less likely than non-adopters to limit their environmentally detrimental everyday behaviour, such as car use (e.g., [65]). A possible contributing reason might be that the initial, difficult, pro-environmental behaviour created a feeling of either having solved the problem, or of having done one's "fair share", and in either case, therefore, being entitled to some "slack" concerning (at least some types of) future environmentally relevant behaviour [30,31]. The reviewed research also suggests that difficult pro-environmental behaviour can boost a person's moral credentials, which may also liberate the person (to a higher or lower extent) from demands on future pro-environmental behaviour. In sum, it seems likely that performing a difficult and/or costly pro-environmental behaviour makes compensatory beliefs more salient and/or convincing, and therefore results in a weakening of personal norms (i.e., felt obligations) to undertake other pro-environmental actions. That is, a person's heightened moral credentials, produced by a recent, costly pro-environmental action, would exert a negative impact on their personal norms for undertaking other pro-environmental behaviours.

3. Present research

As stated in the literature review, very few empirical studies focus on the potential negative impacts of past pro-environmental behaviour(s) on felt obligation towards secondary pro-environmental behaviours [11,65], and none of these studies explicitly modelled the moral reasoning (e.g., compensatory beliefs) assumed to liberate an individual from their engagement in further pro-environmental behaviours. Contributing to filling this knowledge gap, the present study tests these assumptions about the moral self-regulation of pro-environmental behaviour through the framework of norm-activation theory [39]. Specifically, we test the previously stated propositions about the effects of compensatory beliefs on subsequent environmental behaviours after a costly and/or difficult pro-environmental behaviour: the adoption of a BEV or a PHEV.

According to norm-activation theory [39], an activated personal norm guides pro-social and pro-environmental behaviour. Meta-analyses of the empirical evidence support the idea that personal norms have a significant impact on pro-environmental behaviour in various domains [33,43]. Hence, we hypothesise that:

Hypothesis 1. *The likelihood that a person will perform additional pro-environmental behaviours after an initial, costly/difficult, action increases with the person's pro-environmental personal norms.*

An individual's personal norms must be *activated* in order to guide the relevant behaviour [39]. Prior research indicates that the activators of a personal norm most likely to change as a result of the investment in an energy-efficient product include perceived or subjective social norms (i.e., descriptive and injunctive norms) and response efficacy [76]. Changes in these activating constructs are most likely in a positive direction, triggering and strengthening the personal norm. Hence, we hypothesise that:

Hypothesis 2. *Pro-environmental personal norms increase with pro-environmental response efficacy and subjective (descriptive and injunctive) social norms.*

Also, as outlined above, the concept of moral credit holds that investment in an energy-efficient vehicle may change an individual's moral self-regulation of pro-environmental behaviour [51,77]. It is assumed that a more difficult initial behaviour leads to a stronger endorsement of compensatory beliefs, which may influence the likelihood of performing other pro-environmental behaviours, both directly and indirectly, through personal norms. Hence, we hypothesise that:

Hypothesis 3. *Endorsement of compensatory beliefs exerts a negative impact on both pro-environmental personal norms and the subsequent performance of other pro-environmental behaviours.*

As socio-demographic characteristics (e.g., gender, age, education level, etc.) have been found to be related to some pro-environmental behaviours [78,79], the research in this paper controls for effects of gender, age, and education level. We summarize and illustrate the hypothesised directions and strengths of relationships between constructs in the model in Fig. 1. In addition to the hypothesised relationships, we control for the effects of various covariates using a Multiple Indicators Multiple Causes (MIMIC) modelling approach.

Note that the two types of eco-innovative vehicles examined in this paper differ in terms of the costs and behavioural difficulty related to their adoption (but within a range that qualifies as "costly" and "difficult", as described earlier). Although the differences between BEVs and PHEVs may influence consumers' reasons for adopting them [80,81], both types of cars are considered eco-innovative relative to traditional internal combustion engine (ICE) vehicles, and both types are categorized as environmentally friendly in political documents, the popular press, and marketing materials (e.g., [78]). Further, prior research suggests that their superior environmental performance relative to the traditional ICE vehicles is among the most important reasons why consumers adopt a BEV or a PHEV [82,83]. Hence, we assume this is also the case for most of the participants in this study. However, it is important to remember that there are also differences between BEVs and PHEVs, which may have implications for compensatory beliefs, including their impact on subsequent environmental behaviours. Therefore, we control for this factor when we test the above-mentioned hypotheses.

4. Method

4.1. Participants and procedures

To examine the relationship between norms, compensatory beliefs, and the performance of other pro-environmental behaviours after an eco-innovation adoption decision, a cross-sectional online survey was undertaken between May 2018 and early June 2018 among Norwegian residents, who were waiting for the delivery of an ordered BEV for private use (i.e., BEV "to-be owners" who had paid a deposit for the BEV order). Hence, they had bought a BEV, which had not yet been delivered. Since there was no public information available regarding the target population, a convenience sampling approach was used to recruit study participants via social networking sites, through Nissan Customer Services Norway, and using online newspaper advertisements. A web address (i.e., URL) to the online survey using SelectSurvey at the Norwegian University of Science and Technology (NTNU) was provided. At the beginning of the online survey, information about the confidentiality of responses, anonymity, right to withdraw from the study, secure data storage, and approval from the Norwegian Centre for Research Data

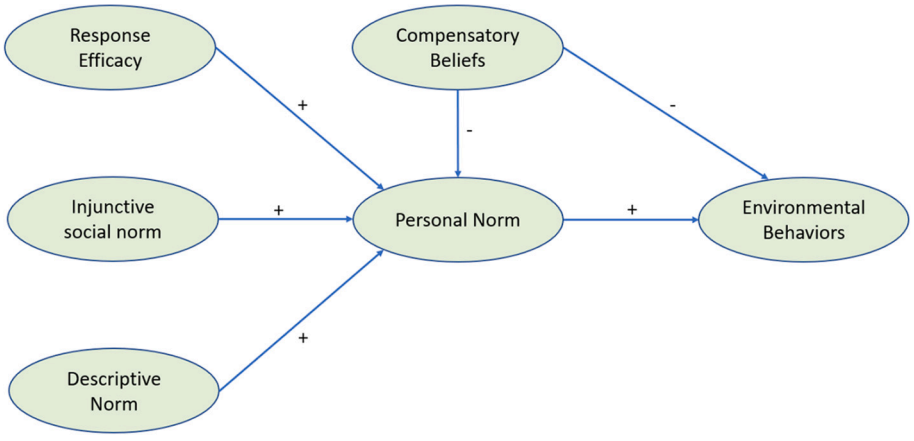

Fig. 1. The role of norms, response efficacy and compensatory beliefs for explaining other pro-environmental behaviours after an initial costly pro-environmental behaviour.

were presented. Participants were asked to give informed consent if they wished to participate in the study. A total of 197 participants began the survey, but only 135 participants completed the survey sufficiently (i.e., to the point where their responses for the variables under investigation were free of missing values and could hence be included in the final sample).

To expand and enrich the target population of the study, another sample of car owners who had recently bought a PHEV for private use was taken between April 2019 and May 2019. In this sample, 591 randomly selected PHEV owners were invited by mail to participate in an online survey. This group was drawn from the Norwegian Public Roads Administration database, new vehicle registers of January – February 2019. The invitation letter contained information about the study procedure and a web address (i.e., URL) to the online survey using SelectSurvey at NTNU. The online survey was identical to the one used among BEV "to-be owners", including in the privacy and consent procedures described previously. In total, 84 PHEV owners started to fill out the online survey (response rate: 14.21%). Two records were omitted because of missing values, which left 82 PHEV records in the final sample.

The BEV and PHEV samples were merged and constitute the dataset ($N = 217$) for this study. The basic demographic characteristics of the sample are presented in Table 1. There is a significant age difference between the two subsamples ($t(184.86) = 8.70$, $p < .001$), with BEV "to-be owners" being significantly younger ($M = 46.53$, $SD = 12.46$) than PHEV owners ($M = 60.98$, $SD = 10.75$). Females comprise only about 12% of the total sample and of both subsamples. Further, the majority of participants were in higher education and higher income brackets. Compared to BEV "to-be owners", PHEV owners lived in more sparsely populated areas. These demographic characteristics reflect the characteristics of new electric vehicle buyers in Norway [81,84].

4.2. Measures

The online survey contained questions about pro-environmental behaviours and psychological constructs assumed to influence the performance of these behaviours. It also included other issues not pertinent to the present study. The questionnaire concluded with a set of demographic questions (e.g., gender, age, education, etc.).

From Kaiser and Wilson's general ecological behaviour (GEB) scale [26], 28 items were adapted (Table 2) and translated into Norwegian. The rationale for not including all items from the original GEB scale was partly to reduce survey length, and partly because the exclusion of

Table 1
Selected demographic characteristics of the study sample.

	Total (n = 217)	BEV "to-be owners" (n = 135)	PHEV owners (n = 82)
Age (*Mean/SD), range*	*52.36/13.75, 24–80*	*46.53/12.46, 24–78*	*60.98/10.75, 35–80*
Sex			
Male (%)	172 (*79.26%*)	102 (*75.56%*)	70 (*85.37%*)
Female (%)	26 (*11.98%*)	16 (*11.85%*)	10 (*12.20%*)
Education			
Less than high school (%)	6 (*2.76%*)	2 (*1.48%*)	4 (*4.88%*)
High school (%)	37 (*17.05%*)	17 (*12.59%*)	20 (*24.39%*)
University (undergraduate) (%)	80 (*36.87%*)	56 (*41.48%*)	24 (*29.27%*)
University (graduate and higher) (%)	75 (*34.56%*)	43 (*31.85%*)	32 (*39.02%*)
Income (NOK)			
<100,000 (%)	3 (*1.38%*)	3 (*2.22%*)	0 (*0.00%*)
100,000–199,999	1 (*0.46%*)	1 (*0.74%*)	0 (*0.00%*)
200,000–299,999	5 (*2.30%*)	4 (*2.96%*)	1 (*1.22%*)
300,000–399,999	17 (*7.83%*)	4 (*2.96%*)	13 (*15.85%*)
400,000–499,999	21 (*9.68%*)	13 (*9.63%*)	8 (*9.76%*)
500,000–599,999	24 (*11.06%*)	20 (*14.81%*)	4 (*4.88%*)
600,000–699,999	33 (*15.21%*)	21 (*15.56%*)	12 (*14.63%*)
>700,000	75 (*34.56%*)	39 (*28.89%*)	36 (*43.90%*)
Live in an area with			
<2000 residents	20 (*9.22%*)	13 (*9.63%*)	7 (*8.54%*)
2000–19,999 residents	60 (*27.65%*)	27 (*20.00%*)	33 (*40.24%*)
20,000–100,000 residents	54 (*24.88%*)	28 (*20.74%*)	26 (*31.71%*)
>100,000 residents	63 (*29.03%*)	49 (*36.30%*)	14 (*17.07%*)

Note: percentages may not add up to 100 due to missing values.

Table 2
Item-total correlations and item difficulty for 28-item Rasch model ($N = 215$).

Environmental behaviours[a]		% agree	Item-total correlation	Item difficulty
Items (b01–b20) originally had a polytomous response format				
b01.	*I buy convenience foods*	85.05%	0.37	−1.63
b02.	I take shorter showers	50.14%	0.45	−0.01
b03.	I buy products in refillable packages	66.85%	0.44	−0.66
b04.	I collect and bring empty cans and plastic bottles to a container deposit	95.45%	0.33	−2.86
b05.	*I kill insects with a chemical insecticide*	94.27%	0.39	−2.63
b06.	I wait until the washing machine is full (within capacity limit) before I start it	84.95%	0.49	−1.62
b07.	In winter, I turn down the heater when I leave the apartment for more than 4 h	23.19%	0.40	1.12
b08.	I choose seasonal foods	86.65%	0.26	−1.76
b09.	*I use a clothes dryer*	48.09%	0.33	0.07
b10.	I collect and bring paper/ cardboard for recycling	97.08%	0.30	−3.29
b11.	I contribute financially to environmental organizations	10.38%	0.41	2.02
b12.	*If I am offered a plastic bag in a store, I take it*	24.60%	0.46	1.05
b13.	*I use an oven cleaning spray to clean my oven*	83.07%	0.37	−1.49
b14.	I talk with friends about environmental pollution, climate change, and/or energy consumption	55.14%	0.44	−0.19
b15.	I buy wooden furniture produced in Norway	20.52%	0.42	1.27
b16.	I buy meat and produce with an eco-label	48.48%	0.45	0.06
b17.	I read about environmental issues	76.01%	0.38	−1.08
b18.	I boycott companies with an unecological profile	10.60%	0.43	2.00
b19.	When I see others' unecological behaviour, I point that out	10.25%	0.36	2.04
b20.	*In winter, I leave the windows open to let in fresh air while the heater is still on*	77.34%	0.47	−1.15
Items (b21–b28) had a dichotomous response format				
b21.	I own solar panels	9.30%	0.26	2.14
b22.	I reuse my shopping bags	85.29%	0.46	−1.65
b23.	I am a member of an environmental organization	5.24%	0.36	2.72
b24.	*I use fabric softener when washing clothes*	56.46%	0.44	−0.24
b25.	*In hotels, I want the towels changed daily*	74.43%	0.50	−1.00
b26.	*When batteries are dead, I throw them in the garbage*	76.93%	0.51	−1.13
b27.	*I use chemical air fresheners in my bathroom*	92.21%	0.34	−2.32
b28.	*In winter, I keep the heater on maximum, so I don't need to wear a sweater*	86.16%	0.36	−1.72

Negatively formulated items are in italics.
[a] The discrimination coefficients were 1.07 for all 28 items.

mobility-related items allowed for a clear focus on the effects of compensatory beliefs on pro-environmental behaviour in domains separate from the initial behaviour. The 28 items taken from the GEB were asked before questions about psychological constructs. A five-point polytomous response format was used for 20 of the behaviour items (i.e., "never", "seldom", "often", "very often", and "always"). For the remaining 8 behaviour items, a dichotomous response format was used (i.e., "no"/"yes"). "Not relevant" was also offered as an alternative response, coded as missing values. Environmentally friendly behaviours that originally had a five-point polytomous response format (e.g., "I buy products in refillable packages") were recoded into a dichotomous format by categorizing "never" and "seldom" as negative, and "often", "very often", and "always" as positive responses. For behaviours with a negative impact on the environment (e.g., "I use a clothes dryer") "never" and "seldom" were recoded as positive and "often", "very often", and "always" as negative responses. Responses to negative behaviours that had a dichotomous response format (e.g., "I use chemical air fresheners in my bathroom") were also reversed.

The formulations of items used to tap into the psychological constructs are shown in Table 3. The items were adopted from previous studies on pro-environmental behaviour with some modifications [37,45,69,85,86]. Since they were intended to predict general pro-environmental behaviour across various domains (i.e., the 28-items GEB scale), these psychological constructs were operationalized at a generic, rather than a behaviour specific, level. Norms were operationalized as descriptive norms (e.g., "Most people I know contribute to environmental protection"), injunctive social norms (e.g., "People who are important to me could influence me to join activities to protect the environment"), and personal norms (e.g., "I feel morally obliged to act in an environmentally friendly manner"). The descriptive and injunctive social norms were measured by three items each, while the personal norm was measured by two items. Response efficacy was measured by three items aimed at capturing the belief that one's action has an effect and therefore can make a difference (e.g., "I personally feel that I can make a difference when it comes to protecting the environment"). Compensatory beliefs in terms of believing that doing something for the environment justifies other environmentally damaging behaviours were measured by four items (e.g., "I have invested in environmentally friendly technology; therefore, it does not matter if I take long-distance flights now and then"). All items were measured on a five-point Likert scale ranging from "strongly disagree" to "strongly agree". In addition, "not relevant" was also provided as an alternative response, coded as missing values.

Table 3
Descriptive of measurements ($N = 215$).

Measures	M	S.D.	α
Descriptive norm (DN)			0.74
dn1. Most people I know act in an environmentally friendly manner	3.08	1.07	
dn2. Most people I know contribute to environmental protection	3.16	0.96	
dn3. Most people I know participate in activities to protect the environment	2.75	1.05	
Response efficacy (RE)			0.77
re1. I personally feel that I can make a difference when it comes to protecting the environment	3.71	1.15	
re2. In daily life, I have many opportunities to contribute to environmental protection	3.71	1.07	
re4. I can personally contribute to environmental protection by changing my behaviour	3.86	1.00	
Injunctive social norm (ISN)			0.76
isn1. People who are important to me could influence me to join activities to protect the environment	3.55	1.08	
isn2. People who are important to me would support my efforts to protect the environment	3.69	0.93	
isn3. People who are important to me expect me to contribute to environmental protection	3.21	1.11	
Compensatory beliefs (CB)			0.76
cb1. I have invested in environmentally friendly technology. So, it does not matter if I take longer flights now and then	2.22	1.15	
cb2. I have invested in environmentally friendly technology. So, it does not matter if I drive more often now and then	2.25	1.08	
cb3. I have invested in environmentally friendly technology. So, it does not matter if I take vacations abroad more often now and then	1.98	0.94	
cb4. Since I have done much to protect the environment, I can now spoil myself with something I like	2.10	1.02	
Personal norm (PN)			0.71
pn1. I would feel guilty if I did not act in an environmentally friendly manner	3.47	1.17	
pn2. I try to make environmentally friendly decisions because environmental consideration is central to my core values	3.75	1.06	
Environmental behaviours (EB)			0.81[a]
FScoresEB _Rasch	−0.01	0.89	

M = mean, SD = standard deviations, α = standardised Cronbach's alpha.
[a] α for 28 environmental behaviour items.

4.3. Analytical procedures

R (Version 4.0.3; [87]) and the R-packages *psych* [88] and *tidyverse* [89] were used for data management and preliminary descriptive analyses. Missing data patterns for ecological behaviours and latent psychological constructs were examined by using the *mice* package [90]. For any of the latent constructs, cases with missing values for all items were excluded.

A Rasch model was applied to the 28 environmental behaviour items using the dichotomous data. The Rasch model is a special case within item response theory (IRT). When used to model GEB, the Rash model predicts a person's environmental performance as a function of the trade-off between his/her motivation and the behaviour's difficulty [91,92]. The Rasch model transforms a list of environmental behaviour items of varying difficulty into a one-dimensional scale [93,94]. The level of difficulty of a specific environmental behaviour is inferred from the number of people that perform it. Hence, commonly performed behaviours are assumed to have lower behavioural difficulty or costs than those performed by fewer people. Consequently, the strength of an individual's motivation to act in a pro-environmental way can be inferred from the number of performed environmental behaviours, relative to others [94]. The basic assumptions of item response theory (IRT), i.e., unidimensionality, local independence, monotonicity (item characteristics curve), and item invariance [91,92,95], are examined first.

The factors score for the Rasch model was obtained using the Empirical Bayes method with the *ltm* package. The Rasch model factor score is then used as a behavioural indicator in a measurement model that also defines relevant psychological constructs. The latent behavioural construct is defined by (1) fixing the observed indicator's factor loading to 1, and (2) fixing its unstandardised error term to a value δ based on the indicator's sample variance and known psychometric information (the reliability coefficient), using the function, $\delta_x = \text{VAR(X)} * (1 - \text{rho})$ [96], where VAR(X) is the variance and rho is the reliability of the observed indicator. Confirmatory factor analysis (CFA) was then used to determine whether the specified measurement model was reasonable, before the specification of the structural model. All model variables were examined for the assumptions of multivariate analysis [97] before performing the CFA.

After establishing a valid measurement model, MIMIC modelling [98,99] was used to test the hypotheses (see Fig. 1), controlling for the effects of covariates (i.e., sample group (BEV vs. PHEV), age, and education). MIMIC modelling is a specific case of Structural Equation Modelling (SEM), which consists of a measurement model (i.e., the relations between a latent variable and its indicators) and a structural model (i.e., the casual relationships among latent variables) [98]. A

MIMIC model further integrates additional variables or covariates assumed to influence the latent factors while testing hypotheses on the direction of effects between these latent factors [99]. The exogenous latent variables in the model are set to covary.

The *lavaan* package [100] is used for both the CFA and MIMIC modelling. Full information maximum likelihood estimation (FIML) is employed to deal with item nonresponse. With FIML, model parameters are estimated from all available data [101]. As such, FIML not only minimises the loss of information and statistical power but also produces unbiased parameter estimates [102], even in the case of non-normal data [103].

For both the measurement model and the MIMIC model, several criteria are used to assess model fit. A non-significant χ^2-test indicates an excellent fit of the theoretical model to the observed data. However, the χ^2-test is sensitive to sample size and therefore other fit indices were used as well [104], including the root mean squared error of approximation (RMSEA), where values under 0.06 indicate excellent fit [98,105], the comparative fit index (CFI), and the Tucker-Lewis Index (TLI), where values of 0.95 or greater suggest a very good fit [106,107].

5. Results

5.1. Rasch analyses of environmental behaviours

During the initial step of verifying the assumptions of IRT, Differential Item Functioning (DIF) detection in the *difR* package was performed to examine the assumption of item invariance (i.e., item parameters and the latent trait are independent of the sample characteristics) [108], using the subsample of BEV "to be owners" as a focal group. Several DIF detection methods were used (i.e., Mantel-Haensze, standardization, logistic regression, Lord's χ^2, and Raju's area), with a significance level = 0.01. None of the behaviour items was detected as DIF items. In other words, the item parameters estimated separately in the two groups (i.e., BEV "to-be owners" and PHEV owners) were equal for all 28 behaviour items, satisfying the assumption of item invariance.

The 28-item Rasch scale was then checked for unidimensionality using a modified parallel analysis (which tests if the second eigenvalue in the observed data is substantially larger than the average of second eigenvalues in 100 Monte Carlo bootstrap samples[1]) [110] through the *ltm* package [111]. The result confirms that the 28 behaviour items can be represented by one general dimension (2nd eigenvalue $_{\text{observed data}}$ = 3.01, average of 2nd eigenvalues $_{\text{Monto Carlo samples}}$ = 3.63, p = .91). Further, the item-characteristics curve (ICC) for each of the items indicated an S-shaped curve for all behaviour items, which increases from left to right, confirming that the probability of a respondent's positive answer increases monotonically as a function of the underlying latent trait (i.e., monotonicity). The assumption of local independence (i.e., that participants' responses to the separate items are not statistically related to each other given a certain level of the trait) was also verified given nonsignificant χ^2 -values (p > .01) for half of all possible pairs of behaviour items [111].

The Bootstrap goodness-of-fit measure of the 28-item Rasch model, using 100 bootstrapped Monte Carlo replications and Pearson chi-squared test, compared observed response patterns in the original data with the expected values under the model [112,113], and found a lack of fit (p = .01) [111]. Hence, item fit statistics (i.e., a measure of how closely the responses to test items aggregated across participants match predictions from the model) [112,114] and person fit statistics (i.e., a measure to assess whether a respondent's responses *aggregated across items* are improbable given the model) [114,115] were examined. Any items and/or participants revealed to misfit the Rasch model should be considered for exclusion in order to achieve an adequate model fit [114]. This examination revealed that two participants' responses aggregated across the items were significantly improbable given the Rasch model (p < .01). After excluding these two participants, an acceptable value for the Bootstrap goodness-of-fit (p = .63) emerged.

The estimated item parameters from the 28-item Rasch model (Table 2) indicate that b10 ("I collect and bring paper/cardboard for recycling") was the easiest behaviour, with a difficulty parameter of −3.29 and a predicted probability of a positive answer of 97.08%, and that b23 ("I am a member of an environmental organization") was the most difficult behaviour, with a difficulty parameter of 2.72 and a predicted probability of a positive answer of 5.24%. The estimated difficulty parameters are therefore within the typical range of −3 to +3 in practice [116]. The 28-items behaviour scale showed good internal consistency, standardised Cronbach's alpha = 0.81 [117]. The factor scores for the 28-items Rasch model (i.e., labelled as FScoresEB _Rasch) were therefore obtained and used as a single indicator of environmental behaviours in the measurement model.

5.2. Measurement model

All items in the measurement model were first examined for missing values and fit between their distributions and the assumptions of multivariate analysis. No extreme skewness or kurtosis was evident. Descriptive information about the items and the internal consistency of the measures are shown in Table 3. All measurements showed acceptable to good internal consistency, standardised Cronbach's alpha ranging between 0.71 and 0.81 [117].

In order to identify the measurement model, which includes a single indicator latent construct (i.e., environmental behaviours), the unstandardised error for FScoresEB _Rasch was constrained to *VAR*(FScoresEB _Rasch) * (*1* − Cronbach's alpha) = 0.7923945 * (1 − 0.81) = 0.150555. For all model constructs, one loading per construct was fixed to one for identification purposes. The measurement model fitted the data well (χ^2 = 163.579, df = 130, p = .025; CFI = 0.969; TLI = 0.956; RMSEA = 0.036). All standardised factor loadings were bigger than 0.50 and significant (p ≤ .001). The estimated covariance matrix indicated statistically significant relationships among model constructs in the expected direction. All latent constructs, except compensatory beliefs, had statistically significant and positive relationships with each other. Compensatory beliefs showed statistically significant and negative relationships with personal norm and performance of pro-environmental behaviours.

5.3. Multiple Indicators Multiple Causes (MIMIC) model

Establishing a measurement model with a good fit allows us to examine the hypotheses on the direction and strength of relationships between the constructs in the hypothesised model, controlling for the effects of covariates. The sample group (BEV vs. PHEV), gender, age, and education were included as covariates in the MIMIC model. Overall, the MIMIC analysis verified the hypothesised model structure and indicated that the model has a good fit for the data. Table 4 shows the results of the MIMIC analysis, and Fig. 2 displays the standardised structural coefficients of the model, including the effects of covariates on the constructs in the model, and explained variance (R^2) of the dependent variables.

As expected, the personal norm was the most significant predictor of performance of pro-environmental behaviour (β = 0.59, p ≤ .001), supporting Hypothesis 1 (i.e., the likelihood of performing additional pro-environmental behaviours after an initial, costly/difficult action increases with the person's pro-environmental personal norms). Compensatory beliefs were found to negatively impact pro-environmental behaviour (β = −0.19, p ≤ .05). Compensatory beliefs were also found to have a significant negative impact on the personal norm (β = −0.19, p ≤ .01), and thereby an additional negative, indirect

[1] Monte Carlo methods takes hundreds or thousands of bootstrap samples from the observed data and from these bootstrap samples estimates the precision of the statistic [109].

Table 4
Estimated path parameters of the Multiple Indicators Multiple Causes model ($N = 196$[a]).

	B	S.E.	p	β	R^2
Structural paths					
Environmental behaviours (EB)					0.602
<- Compensatory beliefs (CB)	−0.25	0.10	≤0.05	−0.19	
<- Personal norm (PN)	0.67	0.10	≤0.001	0.59	
Personal norm (PN)					0.850
<- Compensatory beliefs (CB)	−0.22	0.08	≤0.01	−0.19	
<- Response efficacy (RE)	0.29	0.10	≤0.01	0.36	
<- Injunctive social norm (ISN)	0.52	0.14	≤0.001	0.54	
<- Descriptive norm (DN)	0.10	0.07	n.s.	0.10	
Covariates					
Environmental behaviours (EB)					
<- Sample group[b]	0.04	0.12	n.s.	0.02	
<- Age	0.02	0.00	≤0.001	0.26	
<- Education	0.10	0.06	n.s.	0.10	
<- Gender[c]	−0.34	0.15	≤0.05	−0.14	
Personal norm (PN)					
<- Sample group	0.12	0.10	n.s.	0.08	
<- Age	0.01	0.00	n.s.	0.11	
<- Education	0.00	0.05	n.s.	0.00	
<- Gender	−0.06	0.12	n.s.	−0.03	
Compensatory beliefs (CB)					0.052
<- Sample group	−0.25	0.12	≤0.05	−0.19	
<- Age	0.01	0.01	n.s.	0.12	
<- Education	−0.11	0.06	n.s.	−0.15	
<- Gender	0.05	0.15	n.s.	0.02	
Response efficacy (RE)					0.035
<- Sample group	−0.33	0.17	≤0.05	−0.19	
<- Age	0.00	0.01	n.s.	0.06	
<- Education	0.01	0.09	n.s.	0.01	
<- Gender	−0.26	0.21	n.s.	−0.10	
Injunctive social norm (ISN)					0.058
<- Sample group	−0.21	0.14	n.s.	−0.14	
<- Age	0.00	0.01	n.s.	0.05	
<- Education	0.18	0.07	≤0.05	0.20	
<- Gender	−0.07	0.18	n.s.	−0.03	
Descriptive norm (DN)					0.045
<- Sample group	−0.18	0.12	n.s.	−0.13	
<- Age	0.01	0.00	n.s.	0.10	
<- Education	−0.07	0.06	n.s.	−0.09	
<- Gender	−0.36	0.16	≤0.05	−0.18	
Covariances					
Compensatory beliefs (CB)					
<-> Response efficacy (RE)	−0.09	0.05	n.s.	−0.18	
<-> Injunctive social norm (ISN)	−0.06	0.04	n.s.	−0.14	
<-> Descriptive norm (DN)	0.02	0.04	n.s.	0.05	
Response efficacy (RE)					
<-> Injunctive social norm (ISN)	0.44	0.08	≤0.001	0.72	
<-> Descriptive norm (DN)	0.22	0.06	≤0.001	0.37	
Injunctive social norm (ISN)					
<-> Descriptive norm (DN)	0.20	0.05	≤0.001	0.41	
Measurement model					
Descriptive norm (DN)					
-> dn1	1.00			0.66	
-> dn2	1.34	0.17	≤0.001	0.97	
-> dn3	0.77	0.12	≤0.001	0.51	
Response efficacy (RE)					
-> re1	1.00			0.77	
-> re2	0.79	0.10	≤0.001	0.67	
-> re4	0.84	0.09	≤0.001	0.74	
Injunctive social norm (ISN)					
-> isn1	1.00			0.69	
-> isn2	0.81	0.11	≤0.001	0.66	
-> isn3	1.17	0.13	≤0.001	0.78	
Compensatory beliefs (CB)					
-> cb1	1.00			0.55	
-> cb2	1.30	0.19	≤0.001	0.77	
-> cb3	1.16	0.18	≤0.001	0.78	
-> cb4	0.91	0.17	≤0.001	0.57	
Personal norm (PN)					
-> pn1	1.00			0.62	
-> pn2	1.29	0.15	≤0.001	0.87	
Environmental behaviours (EB)					
-> FScoresEB _Rasch	1.00			0.90	

B = unstandardised coefficient; S.E = standard error; β = standardised coefficient; R^2 = % of variance explained. Model fit: $\chi^2 = 173.115$, df = 133, p = .011; CFI = 0.963; TLI = 0.949; RMSEA = 0.039.

[a] The sample size was reduced due to missing values.

[b] Sample group: BEV "to-be owners" = 0, PHEV owners = 1.

[c] Gender: females = 0, males = 1.

impact on pro-environmental behaviour (0.59 * −0.19 = −0.11). The results therefore also support Hypothesis 3 (i.e., the endorsement of compensatory beliefs exerts a negative impact on both pro-environmental personal norms and the subsequent performance of other pro-environmental behaviours). Finally, personal norm was significantly influenced by the injunctive social norm ($\beta = 0.54$, $p \leq .001$) and response efficacy ($\beta = 0.36$, $p \leq .01$). The impact of the descriptive norm on the personal norm does not reach significance ($\beta = 0.10$, $p = .15$), but is in the expected direction. Hence, the results also support Hypothesis 2 (i.e., that pro-environmental personal norms increase with pro-environmental response efficacy and subjective [at least injunctive] social norms). Note also that the descriptive norm correlates moderately with both the injunctive social norm ($r = 0.41$, $p \leq .001$) and response efficacy ($r = 0.37$, $p \leq .001$). The injunctive social norm and response efficacy are highly correlated as well ($r = 0.72$, $p \leq .001$).

Among the included covariates, age and gender were found to have a significant effect on the performance of environmental behaviours ($\beta = 0.26$, $p \leq .001$ and $\beta = -0.14$, $p \leq .05$). The results indicated that older participants and female participants perform more pro-environmental behaviours than younger participants and male participants. Education was found to have a significant positive effect on the injunctive social norm ($\beta = 0.20$, $p \leq .05$), and gender was found to have a significant positive effect on the descriptive social norm (females stronger than males; $\beta = -0.18$, $p \leq .05$). The sample group was found to have a significant influence on compensatory beliefs ($\beta = -0.19$, $p \leq .05$) and response efficacy ($\beta = -0.19$, $p \leq .05$); specifically, that BEV "to-be owners" endorse compensatory beliefs more strongly, and report lower levels of response efficacy, than PHEV owners. Overall, the MIMIC model accounts for a substantial share of the variation in personal norms ($R^2 = 0.85$) and pro-environmental behaviour ($R^2 = 0.60$). Significant standardised path coefficients and explained variance are shown in Fig. 2.

6. Discussion

6.1. Summary of findings

This study provides evidence for the importance of moral self-regulation (i.e., personal norms and compensatory beliefs) for a person's performance of secondary pro-environmental behaviours following a costly and/or difficult primary pro-environmental behaviour. Specifically, we found that both personal norms and compensatory beliefs are significant determinants of pro-environmental behaviour among adopters of costly eco-innovative vehicles. Costly and difficult behaviour usually involves an extensive, deliberate decision-making process [118], which may also result in changes in a range of psychological constructs of relevance for behaviour [76,119], including the person's self-perception [6], values, and norms [119]. Overall, our findings are consistent with previous research suggesting that engaging in a costly and difficult pro-environmental behaviour, such as buying an eco-innovative vehicle, can also activate a strong personal norm (e.g., [120,121]). However, our finding of the negative impacts of compensatory beliefs on both personal norms and pro-environmental behaviour is in line with previous research that indicated that undertaking costly and difficult pro-environmental behaviours can give an individual a heightened sense of having fulfilled one's moral obligations. As suggested by the moral balance model [122], adopters of eco-innovative

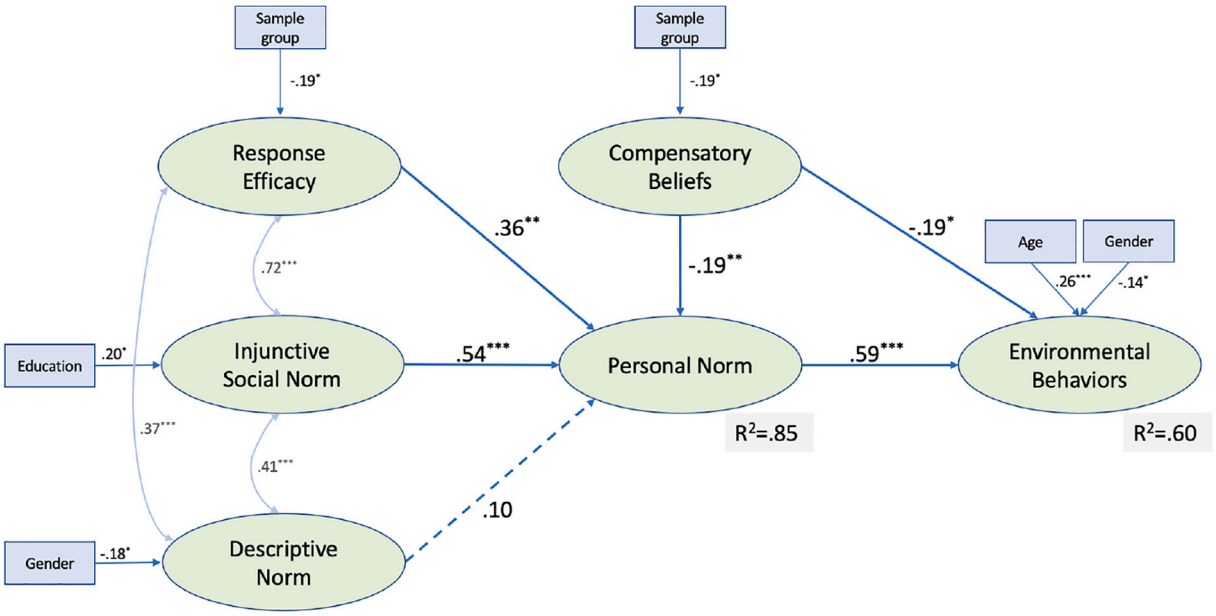

Fig. 2. Path diagram for the Multiple Indicators Multiple Causes (MIMIC) model examining the relationship between constructs controlling for impacts of covariates (* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$).

vehicles might strive for "a reasonable level of moral self-regard" [123]. This implies that the person's active moral self-regulation would account for the past performance of a substantial pro-environmental action, such as the adoption of an eco-innovative vehicle, which would therefore influence their implicit calculation of whether they have adequately fulfilled their moral obligations towards the environment and society. Hence, the moral balance model [122] can explain the negative effects of compensatory beliefs on pro-environmental behaviours and personal moral norms for such behaviour.

Our findings can also be interpreted in the light of the "commons dilemma" paradigm [124] and the responsibility dilution theory [125], which suggest that adopters of eco-innovative vehicles might diffuse some of the responsibility for pro-environmental actions to others in society, leading to a decrease in their personal sense of responsibility, and personal willingness to perform further pro-environmental actions. However, we note that in the present case these negative effects are relatively small and that other psychological factors dominate. Specifically, the results indicate that the impact of personal norms on pro-environmental behaviour is substantially stronger than the impact of the feeling that one has already done one's bit. This implies that, among people who have performed a costly and/or difficult pro-environmental behaviour, strong personal norms more than outweigh the negative effects of compensatory beliefs on further pro-environmental behaviours. This is consistent with previous research that found that a costly moral (including pro-environmental) act leads to a strengthening of the person's moral (or pro-environmental) self-identity [54–56]. As such, our results are also consistent with the assumption of a common motivational ground underlying the different pro-environmental behaviours, which are a prerequisite for pro-environmental spillover [12,13].

We also found that BEV "to-be owners" more strongly embrace compensatory beliefs about pro-environmental behaviour than PHEV owners. Although the adoption of both types of eco-innovative behaviour is a costly, and very similar, behaviour, at the time and context of our study, the premium for the same category of the car was higher and the technology is newer and more radical, for BEV compared to PHEV. Further, BEVs are considered more climate-friendly since they eliminate fossil fuels during operation. Finally, BEV "to-be owners" faced the extra difficulty of a substantial waiting time for the BEV delivery while PHEV owners already had their cars. Together, these differences can explain the more heightened sense of morality among BEV "to-be owners" than among PHEV owners.

In line with theoretical assumptions [41,126] and prior empirical research [32,127,128], we differentiated between three types of norms (i.e., *external* descriptive norm, *injunctive* social norm, and personal norm) along the continuum of internalization/integration, connected by strong, positive, and significant correlations. Given that environmental policy is heavily debated in Norway, participants may have complied with, identified with, or internalised significant others' viewpoints about sustainability and environmental issues. This is likely one of the reasons for the strong social-normative influence on participants' motivation to perform pro-environmental behaviours, observed in our study. Especially, the strong relationship between the injunctive social norm and the personal norm is consistent with the human inclination to internalise how significant others expect us to act [39]. Though the descriptive norm's direct impact on the personal norm failed to reach statistical significance at the conventional level, the positive relationship together with the moderate positive correlation between the descriptive and the injunctive social norm suggests a significant total effect, when including the probable indirect effect via injunctive social norms. The correlation between the two types of norms is consistent with the proposition that people partly infer significant others' expectations from their behaviour (i.e., *external* descriptive norms), and that, by observing referent others and imitating their behaviour, an individual learns relevant social beliefs and norms through compliance, identification, and internalization processes [129]. These findings are also consistent with Kelman's [130] social influence theory and Bandura's [129] social learning theory, both suggesting that social influence is a powerful process shaping an individual's beliefs, attitudes, and subsequent actions [129,130].

Our study also adds empirical support to the proposition that response efficacy is an important antecedent of personal norm activation [39,42]. It is widely accepted that individuals partly infer their attitudes from their behaviour [77]. Following an eco-innovative vehicle adoption decision, it is possible that people's attitudes and perceptions of themselves change. Subsequently, those changes may lead to changes in response efficacy and subjective social norms [131]. People who have carried out a costly and/or difficult pro-environmental behaviour are likely to feel their action has '*made a difference*' regarding the problem and are subsequently likely to more strongly believe that other pro-environmental behaviours also have an effect on mitigating the problem and making a difference. At the same time, they may feel heightened

social pressure from significant others or from groups to comply with expectations to carry out further pro-environmental behaviours. These changes are likely to facilitate the activation of a personal norm for pro-environmental behaviour.

The MIMIC modelling also identified sociodemographic characteristics that account for variation in pro-environmental behaviour or some of its antecedents. The significant impact of age on behaviour shows that participants' inclination to carry out more pro-environmental behaviours increases with age. Although our sample is not representative, we note that other researchers also found that older people are more inclined to engage in pro-environmental behaviour than young people [132–134]. We also found that the belief that others expect them to act in a pro-environmental way (i.e., injunctive social norm) increases with education. This could be a result of people's social circles largely being limited to people with a similar level of education, combined with people with a higher level of education being more conscious about environmental issues [135].

6.2. Implications

This study contributes to the limited but emerging literature on the impact of moral self-regulation and compensatory beliefs on pro-environmental behaviour. Our findings are consistent with the assumption of a common motivational ground underlying pro-environmental behaviour and behavioural spillover, both positive and negative. Specifically, we have studied the inclination to perform *other* pro-environmental behaviours among people who had recently performed a costly and difficult one. The purpose was to achieve a better understanding of underlying psychological processes influencing the impact of costly and difficult pro-environmental behaviours on an individual's inclination to undertake further pro-environmental behaviours in the future. Prior studies of the impact of possible "catalyst" behaviours on other pro-environmental behaviours have primarily focused on small and simple pro-environmental behaviours, and they have so far largely failed to identify these behaviours as "catalysts", as an entry point promoting a sustainable lifestyle [5]. As such, the finding that the costly and difficult pro-environmental behaviour of buying BEV or PHEV vehicles acts as a potential "catalyst". This has implications for the promotion of sustainability by means of rewards and incentives that make desired behaviours easier and less costly. Prior research has often found that rewards and incentives fail to bring long-lasting changes [14,15], at least partly due to ignoring the intrinsic motivations underlying behaviour [30,136]. At the same time, many studies have documented a negative effect of costs and difficulties on pro-environmental behaviour (e.g., [26,29]). However, when a person has overcome the costs and difficulties, this appears on balance to have positive effects on other pro-environmental behaviour. Part of the reason is that a costly moral act leads to a strengthening of the person's moral self-identity [54–56]. In the present study, we find evidence of a different effect in the *opposite* direction; specifically, that people who have performed costly and/or difficult pro-environmental behaviour(s) often believe they are entitled to some slack (i.e., compensatory beliefs), which negatively impacts their personal norms for pro-environmental behaviour and actual behaviour. When designing policy interventions to promote a more sustainable lifestyle, it is therefore important to take these opposite psychological forces into account. In the present case, the negative effect is not very strong. Hence, this study suggests that, on balance, an environmentally significant behaviour with substantial cost and/or difficulty is an effective catalyst of other pro-environmental behaviours [54]. Note that, in Norway, the adoption of BEVs is promoted by means of substantial tax reliefs and other external rewards and incentives, which are undoubtedly important for other costly or difficult pro-environmental behaviours, but that these rewards and incentives do not completely eliminate the difficulty and costs of the behaviour, which is probably essential for the catalyst effect on other pro-environmental behaviours.

6.3. Limitations and suggestions for future research

This study has the usual limitations of cross-sectional survey research based on self-reported measures. Especially, it is possible that participants overreported their engagement in pro-environmental behaviour due to social desirability bias [137]. Given the way pro-environmental behaviour was measured in the present study, empirical evidence showing a high correlation between self-report measures and actual behaviour [138,139], and the fact that we focus on relations between constructs rather than the level of reported action, this is not considered to be a serious threat to the validity of the present study. Also, given that we used multi-item constructs and a complex model, it is unlikely that participants would be able to guess a socially desirable response pattern that would systematically bias our findings. Other important limitations arise from the specific sample, the sample size, and data collection procedures. The BEV "to-be owners" were recruited through convenience sampling since there was no available Norwegian vehicle registry information about the group. Due to the growing number of PHEVs in the Norwegian vehicle registry, it was possible to sample this group using a more systematic approach. Still, the voluntary nature of the Internet-based survey implies a possible self-selection bias in both samples [140]. Also, due to availability at the time of data collection, study participants in the two groups were recruited nearly a year apart. We are not aware of any major events or changes in Norway in the intervening period that could have a major influence on variables in this study, but in principle, time of sampling could be a source of confounding influence on the difference between the two groups. In sum, the difference in the sampling procedure, the time lap between data collections, the combining of two subgroups, and the relatively small sample size warrant caution in interpretation and generalisation of the study results [141–143].

The cross-sectional survey provided only correlational data to map into psychological processes underlying the performance of pro-environmental behaviour. While we have identified the importance of, in particular, personal norms and compensatory beliefs for pro-environmental behaviour, to determine the implied causality there is a need for either experimental research, including a control group of people who have neither ordered a BEV nor purchased a PHEV, or longitudinal research providing evidence of change from before to after buying a BEV or PHEV in other environmental behaviours. Also, to reinforce the argument of the present paper and its findings, future research should study a larger pool of individuals making adoption decisions and should also examine other costly eco-innovative products. To substantialise the findings of moral self-regulation concerning pro-environmental behaviour, regulation of such behaviours should be investigated both at the pre-and post-adoption stages.

6.4. Conclusions

This paper investigates the moral normative processes underlying the performance of other pro-environmental behaviours after having performed an initial, substantial, pro-environmental action. Drawing on literature from different fields, we argue that pro-environmental behavioural spillover is at least partly the result of the interplay between the person's personal norms and moral self-regulation. Our findings show that people who have performed a difficult pro-environmental action, such as buying a BEV or a PHEV, hold compensatory beliefs that can justify not doing other things for the environment. However, these beliefs are in general not strong enough to make them abstain from other pro-environmental behaviours. Their inclination to perform other pro-environmental behaviours depend considerably more on the strength of their personal norms regarding environmentally responsible behaviour than on their compensatory beliefs.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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