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Factors influencing the acceptability of energy policies: A test of VBN theory

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Abstract

This paper examines factors influencing the acceptability of energy policies aimed to reduce the emission of CO_2 by households. More specifically, it is studied to what extent the value–belief–norm theory of environmentalism (VBN theory; Stern, [(2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, 56(3), 407–424.]) is successful in explaining acceptability judgements. In contrast to previous studies, we test the full VBN theory. A questionnaire study was conducted among 112 Dutch respondents. Results confirmed the causal order of the variables in VBN theory, moving from relative stable general values to beliefs about human–environment relations, which in turn affect behaviour specific beliefs and norms, and acceptability judgements, respectively. As expected, all variables were significantly related to the next variable in the causal chain. Biospheric values were also significantly related to feelings of moral obligation to reduce household energy consumption when intermediate variables were controlled for. Furthermore, as hypothesized, personal norms mediated the relationship between AR and acceptability judgements, AR beliefs mediated the relationship between AC beliefs and personal norms, AC beliefs mediated the relationship between NEP and AR beliefs, and NEP mediated the relationship between values and AC beliefs.

1. Introduction

Despite international agreements, such as the Kyoto protocol, greenhouse gas emissions have steadily increased by about 1% per year during the last decade (e.g. EPA, 2004; RIVM, 2004). CO_2 is the most important greenhouse gas, responsible for about 84% of the total emissions of greenhouse gases (EPA, 2004). In 2001, more than 95% of CO_2-emissions could be attributed to the combustion of fossil fuels (EPA, 2004).

Household energy use significantly contributes to greenhouse gas emissions. For example, in the Netherlands, households are responsible for 23% of total energy use (Ministerie van EZ, 1999) by using electricity, natural gas and fuels. Many governments aim to reduce household energy use, and consequently, greenhouse gas emissions. However, despite their efforts, household energy consumption is still increasing. In the Netherlands, electricity and fuel use have increased steadily from 1990, due to increases in possession and use of electric appliances, and increases in car use (Steg, 1999). More effective energy policies seem to be warranted to reduce the emission of greenhouse gases by households. Pricing policies may be effective in this respect, by decreasing the price of energy-efficient products and services, and/or increasing the price of energy-intensive products and services. An important precondition for the successful implementation of such policies is public acceptability, i.e. without public support, energy policies, such as pricing policies, can hardly be implemented.

This study aims to examine which factors are related to acceptability of energy policies. Stern and colleagues (e.g. Stern, 2000) proposed the value–belief–norm theory (VBN theory) of environmentalism to explain environmental behaviour, among which the acceptability of public policies. This theory is explained below. Next, we report results of a study aimed to test whether VBN theory is successful in explaining acceptability of energy policies. In contrast to previous studies, we test the complete VBN theory. We start with an overview of factors influencing

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environmental behaviour and public acceptability of environmental policies.

1.1. Individual factors influencing acceptability of energy policies

Many proenvironmental behaviours, like limiting car use and energy conservation, require the individual to restrain egoistic tendencies to benefit collective interests (i.e. environmental quality; Samuelson 1990; Gifford, 1997; Joireman, Lasane, Bennett, Richards, & Solaimani, 2001; Nordlund & Garvill, 2003; Steg, 2003). People have to make short-term sacrifices in order to safeguard collective interests. Various studies have examined to what extent nonegoistic values and beliefs, like environmental and/or altruistic concerns, affect behaviour. Such concerns have been studied from different theoretical perspectives. First, scholars have studied the value-basis of environmental behaviour (e.g. Stern, Dietz, & Kalof, 1993; Stern & Dietz, 1994; Stern, Dietz, Kalof, & Guagnano, 1995; Van Vugt, Meertens, & Van Lange, 1995; Karp, 1996; Schultz & Zelezny, 1999; Joireman et al., 2001; Nordlund & Garvill, 2002; Garcia Mira, Real Deus, del Mar Durán Rodríguez, & Romay Martínez, 2003). It is believed that values placed on different targets (e.g. the person self, people in general, or the biosphere) direct attention toward value-congruent information which affects willingness to support environmental protection (Stern & Dietz, 1994; Stern, Dietz, & Kalof et al., 1995; Nordlund & Garvill, 2002, 2003). Typically, three general value orientations are distinguished: an egoistic value orientation, in which case people try to maximize individual outcomes, an altruistic value orientation, reflecting concern for the welfare of other human beings, and a biospheric (or ecocentric) value orientation, reflecting concern with nonhuman species or the biosphere (e.g. Stern, Dietz, & Kalof, 1993). Many studies have found that people who more strongly value concerns beyond a person's immediate own interests, i.e. self-transcendent, prosocial, altruistic or biospheric values, are more likely to engage in proenvironmental behaviour. However, in general, values do not have strong direct effects on behaviour; the relationship between general values and behaviour seems to be mediated by other factors like behaviour specific beliefs or personal norms (e.g. Nordlund & Garvill, 2003, 2004; Poortinga, Steg, & Vlek, 2004).

A second line of research focuses on the role of environmental concern. It is assumed that environmental behaviour results from worldviews, i.e. general beliefs on the relationship between humans and the environment. Such worldviews are less general and less stable than are values; worldviews deal with a specific domain of life and can be challenged in terms of their veracity, while values are more general and can be challenged only in terms of their desirability or appropriateness (Stern, Dietz, & Guagnano, 1995). A worldview that has been studied extensively is the New Environmental (or: Ecological) Paradigm (NEP, Dunlap & Van Liere, 1978; Dunlap, Van Liere, Mertig, & Jones, 2000). The relationship between worldviews and behaviour is generally not strong (e.g. Vining & Ebreo, 1992; Schultz & Zelezny, 1998; Poortinga et al., 2004) probably because behaviour-specific beliefs mediate the relationship between worldviews and behaviour (cf. Ajzen, 1980; Bamberg, 2003; Corral-Verdugo, Bechtel, & Fraijo-Sing, 2003; Nordlund & Garvill, 2003).

A third line of research focuses on the role of moral obligations to act in favour of the common good. These studies apply the norm-activation model (NAM; Schwartz, 1977; Schwartz & Howard, 1981) to understand environmental behaviour. The NAM was originally developed to explain altruistic behaviour, but has often been applied in the environmental context (e.g. Van Liere & Dunlap, 1978; Hopper & Nielsen, 1991; Vining & Ebreo, 1992; Bamberg & Schmidt, 2003). According to the NAM, behaviour occurs in response to personal norms that are activated when individuals are aware of adverse consequences to others or the environment (awareness of consequences or AC beliefs) and when they think they can adverse these consequences (ascription of responsibility or AR beliefs). The NAM appeared to be successful in explaining low-cost environmental behaviour, but has far less explanatory power in behavioural settings characterized by strong constraints on behaviour, e.g. when the behaviour is too costly in terms of effort, money or time (Guagnano, Stern, & Dietz, 1995; Hunecke, Blöbaum, Matthies, & Höger, 2001; Bamberg & Schmidt, 2003).

Stern and colleagues (Stern, Dietz, Abel, Guagnano, & Kalof, 1999; Stern, 2000) proposed the VBN theory, that links value theory (e.g. Schwartz, 1992, 1994; Stern & Dietz, 1994), NEP, and NAM. Like the NAM, they propose that environmental behaviour results from personal norms, i.e. a feeling of moral obligation to act proenvironmentally. These personal norms are activated by beliefs that environmental conditions threaten things the individual values (awareness of consequences, AC beliefs) and beliefs that the individual can act to reduce this threat (ascription of responsibility; AR beliefs). VBN theory proposes that AC and AR beliefs are dependent on general beliefs on human–environment relations (NEP) and on relatively stable value orientations. VBN theory links NEP to the NAM by postulating that NEP is 'a sort of 'folk' ecological theory from which beliefs about the adverse consequences of environmental changes can be deduced' (cf. Stern, 2000, p. 413). Fig. 1 gives a schematic representation of the variables in VBN theory. The causal chain proposed in VBN theory moves from relatively stable and general values to beliefs about human–environment relations (NEP), which in turn are believed to affect specific beliefs on consequences of environmental behaviour and the individual's responsibility for these problems and for taking corrective actions.

AC and AR beliefs have been defined differently in various studies. In some studies, AC and AR beliefs focus on general environmental conditions (e.g. Stern et al., 1999;

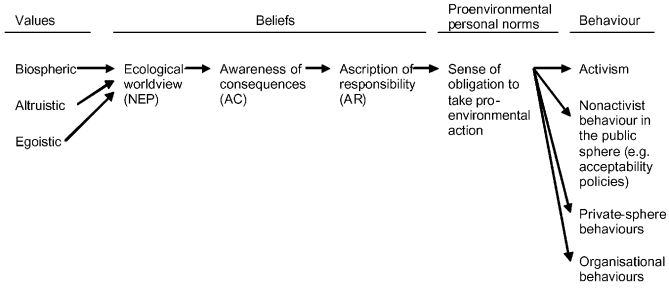

Fig. 1. A schematic representation of the VBN theory of environmentalism (adapted from Stern, 2000).

Gärling, Fujii, Gärling, & Jakobsson, 2003), while other studies included behaviour specific AC and AR beliefs (e.g. Van Liere & Dunlap, 1978; Hunecke et al., 2001; Nordlund & Garvill, 2003). Behaviour specific beliefs are generally more strongly related to behaviour than are general beliefs (e.g. Ajzen, 1985; Eagly & Chaiken, 1993; Nordlund & Garvill, 2003). This implies that the predictive power of VBN theory may be enhanced if AC and AR beliefs as well as PN are tuned toward the specific behaviour to be explained. This would also better reflect that the causal chain moves from general to specific beliefs.

According to Stern and colleagues (Stern et al., 1999; Stern, 2000), personal norms may influence all kinds of behaviours taken with proenvironmental intent. They distinguish four types of behaviour (see Fig. 1): environmental activism (e.g. active involvement in environmental organizations or demonstrations), nonactivist behaviours in the public sphere (e.g. environmental citizenship, support or acceptance of public policies), private-sphere environmentalism (i.e. the purchase, use and disposal of personal and household products that have environmental impact), and organizational actions (e.g. design environmentally benign products).

VBN theory was successful in explaining various environmental behaviours, among which are consumer behaviour, environmental citizenship, willingness to sacrifice, and willingness to reduce car use (Stern et al., 1999; Nordlund & Garvill, 2003). However, both of these studies did not test the full VBN theory, i.e. in both studies, AR beliefs were not included. Moreover, Nordlund and Garvill (2003) operationalized the key concepts in VBN theory somewhat differently from the concepts proposed by Stern and colleagues. The present study aims to test the complete VBN theory, by examining whether the theory is successful in explaining the acceptability of energy policies, which is a type of nonactivist behaviour in the public sphere. Such nonactivist behaviour affects the environment indirectly, by influencing public policies, which may have large effects on environmental qualities because public policies may change the behaviour of many people at once. In line with Stern (2000), we hypothesize that each variable in the causal chain is related to the next variable, and may also be directly related to variables further down the chain. However, we hypothesize that the latter relationships, if present, are rather weak. Further, we hypothesize that each putative intervening variable in the causal chain mediates the relationship between the distal variable and the outcome variable. More specifically, we hypothesize that personal norms mediate the relationship between AR beliefs and behaviour, AR beliefs mediate the relationship between AC beliefs and personal norms, AC beliefs mediate the relationship between NEP and AR beliefs, and NEP mediates the relationship between values and AC beliefs. We test this hypothesis within a mediation framework, following the procedure suggested by Baron and Kenny (1986).

2. Method

2.1. Respondents and procedure

In 2003, a total of 300 surveys were distributed at different locations and times in Groningen, a city in the north of the Netherlands, together with a reply paid envelope. Of these, 118 surveys were returned, representing a response rate of 39%. In total, 112 surveys were used in the analysis, since six surveys were not fully completed. Participants were 52 males and 58 females ranging in age from 19 to 81 years with a mean age of 39.8 years (SD = 16.35). 33% of participants indicated that their net salary per month was 'less than 1200 euro', 32% 'between 1200 and 2500 euro' and 34% 'more than 2500 euro', for one respondent these data were missing. The distribution of highest educational level attained showed 15% had completed primary, technical or vocational secondary school education, 39% had completed the highest level of secondary education, and 46% had attained a college or university degree or equivalent.

2.2. Measures

The questionnaire consisted of five parts. The first part included measures of values. In the second part, respondents evaluated the acceptability of energy policies. The third part comprised of items measuring personal norms, and AR and AC beliefs. In the fourth part, respondents were asked to complete the NEP scale. To reduce the chance of socially desirable answers (i.e. following a proenvironmental bias), measures of personal norms, AR, AC and NEP were included after the evaluation of the acceptability of energy policies. The final part focused on demographics. The main constructs were measured as follows.

2.2.1. Values

Participants' values in their own life were assessed using a short version of Schwartz's (1992) universal values scale. The short value scale was adapted from Stern, Dietz and Guagnano (1998), who developed a brief inventory of values based on Schwartz's original scale that comprises 56 values. They included two extra biospheric values because

Table 1
Corrected correlations between value items and components (multiple-group method)

Values	Egoistic values	Altruistic values	Biospheric values
Authority: the right to lead or command (Ego1)	**.50**	−.18	−.08
Social power: control over others, dominance (Ego2)	**.47**	−.19	−.09
Wealth: material possessions, money (Ego3)	**.46**	−.22	−.08
Influential: having an impact on people and events (Ego4)	**.33**	−.10	−.08
Social justice: correcting injustice, care for the weak (Alt1)	−.35	**.55**	.30
Helpful: working for the welfare of others (Alt2)	−.06	**.54**	.45
Equality: equal opportunity for all (Alt3)	−.23	**.53**	.26
A world at peace: free of war and conflict (Alt4)	−.09	**.45**	.44
Protecting the environment: preserving nature (Bio1)	−.19	.39	**.73**
Preventing pollution (Bio2)	−.22	.49	**.68**
Respecting the earth: live in harmony with other species (Bio3)	−.08	.34	**.65**
Unity with nature: fitting into nature (Bio4)	.10	.38	**.59**

Note: Ego: egoistic values; Alt: altruistic values; Bio: biospheric values. For each item, the highest correlation is printed in bold typeface. The correlations between values included in a scale and the specific scale itself were corrected for 'self correlations', i.e. in this case, corrected-item total correlations are printed.

these were underrepresented in Schwartz original scale. Since we were particularly interested in egoistic, altruistic and biospheric values, we selected values that are related to the dimension self-enhancement versus self-transcendence (cf. Nordlund & Garvill, 2003). In total 12 values were selected, of which four reflected egoistic values (authority, wealth, social power and influential), four altruistic values (social justice, equality, a world at peace, and helpful) and four biospheric values (preventing pollution, protecting the environment, respecting the earth and unity with nature; see Table 1). As suggested by Schwartz (1992), subjects were asked to rate the importance of these 12 values as a guiding principle in their lives on a eight-point scale, ranging from 0 'not at all important' to 7 'of supreme importance'. Participants also had the option of indicating that they are opposed to the value (−1). The multiple group method (MGM), a simple and effective type of confirmatory factor analysis (e.g. Guttman, 1952; Nunally, 1978; Ten Berge, 1986; Kiers, 1990; Hendriks & Kiers, 1999; Ten Berge & Siero, 2001; Stuive, Kiers, Timmerman, & Ten Berge, 2004) was used to verify whether the data supported the groupings of aspects into the three value orientations that were identified on theoretical grounds. Here, these components were egoistic values, altruistic values, and biospheric values. In the MGM, we first defined components (i.e. value scales) on theoretical grounds. For this purpose, we computed the mean score on value items supposedly related to the value scales. Next, correlations were computed between value items and the three components (i.e. value scales). For items included in a scale, the correlation coefficients were corrected for 'self-correlation', i.e. the fact that items automatically correlate high with components in which they take part. Finally, we verified whether the value items indeed correlated highest with the component (i.e. value scale) to which they are assigned on theoretical grounds. It is assumed that the factor structure (i.e. the grouping of value items into the three value orientations) is supported when items correlate highest with the component they are assigned to on theoretical grounds (see Nunnally, 1978). From the corrected correlations given in Table 1, it appeared that indeed, each item correlated strongest to the component with which it was associated, thus providing empirical support for the assignment made on theoretical grounds. Given this empirical support of the assignment, it was decided to indeed define the components in the a priori suggested way. For the thus constructed components, Cronbach's alpha values were .65 for the egoistic, .72 for the altruistic and .83 for the biospheric value orientation.

2.2.2. NEP

Respondents completed the revised NEP scale (Dunlap et al., 2000), on a scale ranging from 1 'fully disagree' to 5 'fully agree'. Cronbach's alpha was .73. The mean score on NEP items was used in the analyses ($M = 3.5$, $SD = .4$).

2.2.3. Awareness of consequences, ascription of responsibility and personal norm

Respondents indicated to what extent they agreed with 21 items reflecting awareness of consequences (AC), ascription of responsibility (AR) and personal norm (PN), on a scale ranging from 1 'fully disagree' to 5 'fully agree' (see Table 2). PN as well as AC and AR beliefs focused on problems related to energy use. Again, a MGM was carried out to verify the a priori classification of items empirically. Corrected correlations between items and components are reported in Table 2. Again, the a priori assignment of items into PN, AC and AR components appeared to be supported by the data. For these components, Cronbach's alpha values were .75 for AC beliefs, .80 for AR beliefs, and .84 for PN; mean scores were 3.8 for AC, 3.4 for AR and 3.4 for PN.

2.2.4. Acceptability of energy policies

Respondents evaluated 16 pricing measures aimed to reduce the emission of CO_2 by households (see Table 3) on

Table 2
Corrected correlations between AC, AR and PN items and AC, AR and PN components (multiple-group method)

Item	AC	AR	PN
Global warming is a problem for society (AC1)	**.61**	.26	.32
Energy savings help reduce global warming (AC2)	**.50**	.29	.28
The exhaustion of fossil fuels is a problem (AC3)	**.49**	.17	.23
The exhaustion of energy sources is a problem (AC4)	**.46**	.31	.36
Environmental quality will improve if we use less energy (AC5)	**.45**	.34	.44
It is not certain whether global warming is a real problem (AC6)[a]	**.45**	.28	−.01
I am jointly responsible for the energy problems (AR1)	.43	**.72**	.53
I feel jointly responsible for the exhaustion of energy sources (AR2)	.37	**.67**	.60
I feel jointly responsible for global warming (AR3)	.44	**.60**	.41
My contribution to the energy problems is negligible (AR4)	.25	**.57**	.43
Not only the government and industry are responsible for high energy consumption levels, but me too (AR5)	.21	**.49**	.37
In principle, individuals at their own cannot contribute to the reduction of energy problems (AR6)	.08	**.38**	.14
I feel personally obliged to save as much energy as possible (PN1)	.29	.51	**.77**
I feel morally obliged to save energy, regardless of what others do (PN2)	.21	.49	**.66**
I feel guilty when I waste energy (PN3)	.20	.44	**.65**
I feel morally obliged to use green instead of regular electricity (PN4)	.27	.48	**.62**
People like me should do everything they can to reduce energy use (PN5)	.32	.54	**.56**
If I would buy a new washing machine, I would feel morally obliged to buy an energy efficient one (PN6)	.34	.48	**.54**
I do not feel guilty at all when I buy vegetables and fruit from distant countries (PN7)[a]	.27	.33	**.46**
I feel obliged to bear the environment and nature in mind in my daily behaviour (PN8)	.06	.25	**.42**
I would be a better person if I saved energy (PN9)	.24	.22	**.41**

Note: AC: awareness of consequences; AR: ascription of responsibility; PN: personal norm. For each item, the highest correlation is printed in bold. The correlations between items included in a scale and the specific scale itself were corrected for 'self correlations', i.e. in this case, corrected-item total correlations are printed. Items were presented to respondents in random order.

[a]Scores were reversed as to make higher scores reflect higher awareness of consequences and stronger personal norm, respectively.

a scale ranging from 1 'not acceptable at all' to 5 'very acceptable'. These measures systematically varied on four dimensions.[1] First, a distinction was made between incentives and disincentives (Geller, 2002), i.e. measures that reward behaviour associated with low CO_2 emissions (so-called pull measures; decrease prices of products associated with low CO_2 emissions) versus measures that penalize behaviour associated with high CO_2 emissions (so-called push measures; higher prices for products that are associated with high CO_2 emissions). Second, a distinction was made between 'efficiency' and 'curtailment' behaviours (Gardner & Stern, 2002), i.e. half of the measures focused on the *purchase* of appliances that use energy ('one shot behaviour'), while the other half focused on changing the *use* of appliances, products and services (which requires repeated action). Third, half of the measures focused on direct energy use (i.e. the use of electricity, fuels and natural gas), while the other half focused on indirect energy use (i.e. energy used for the production, transportation and disposal of goods and services; e.g. Vringer & Blok, 1995). Fourth, the way revenues were used or funds were gathered differed: in half of the cases these were used or collected within the domain (e.g. energy related), while in the other cases they were not (i.e. used for or collected from general funds). A principal components analysis revealed that all acceptability ratings loaded high ($>.45$) on the first unrotated factor. Therefore, the mean score of the acceptability ratings of the 16 policy measures was used as the dependent variable in the analysis (Cronbach's alpha = .90; $M = 3.5$, SD = .7); scores on acceptability of energy policies could vary from 1 'not acceptable at all' to 5 'very acceptable'.

3. Analyses

VBN theory was tested by means of a series of regression analyses. Each variable in the causal chain was regressed onto the preceding variable in the causal chain. First, the variable directly preceding the dependent variable was entered in the regression analysis (model 1). Next, it was examined whether all other preceding variables explained additional variance in the dependent variable (model 2). This procedure makes it possible to test whether variables also directly affect variables further down the chain when intermediate variables are controlled for. To reduce capitalization of chance, a Bonferonni correction was used, resulting in a significance level for the 9 regression analyses of $p<.006$ (.05 divided by 9).

To test our mediation hypothesis, we followed Baron and Kenny's (1986) approach (see also Preacher & Leonardelli, 2005). Four conditions must hold true to establish meditation. First, the independent variable must significantly affect the mediator. Second, the independent

[1]By systematically varying these four dimensions, we were also able to examine to what extent the relative acceptability of energy policies is dependent on features of the policies. These results are reported elsewhere (Steg, Dreijerink, & Abrahamse, 2006).

Table 3
Overview of 16 pricing policies aimed to reduce CO_2-emissions by households

		Push/ pull	Efficiency/ curtailment	Direct/ indirect	Revenue use within/ outside domain
1.	Increase prices of appliances that are not energy efficient by 10%. Revenues are used to stimulate the further development of energy-efficient appliances.	Push	Efficiency	Direct	Within
2.	Increase prices of appliances that are not energy efficient by 10%. Revenues are used to reduce national debts.	Push	Efficiency	Direct	Outside
3.	Increase prices of appliances that have not been produced in an energy-efficient way by 10%. Revenues are used to develop techniques that reduce energy use for the production of appliances.	Push	Efficiency	Indirect	Within
4.	Increase prices of appliances that have not been produced in an energy-efficient way by 10%. Revenues are used to reduce national debts.	Push	Efficiency	Indirect	Outside
5.	Increase prices of regular electricity by 10%. Revenues are used to generate more green electricity, e.g. by building windmills.	Push	Curtailment	Direct	Within
6.	Increase prices of regular electricity by 10%. Revenues are used to reduce national debts.	Push	Curtailment	Direct	Outside
7.	Increase prices of imported and greenhouse vegetables and fruit by 10%. Revenues are used to stimulate farmers and market gardeners to grow seasonal vegetables.	Push	Curtailment	Indirect	Within
8.	Increase prices of imported and greenhouse vegetables and fruit by 10%. Revenues are used to reduce national debts.	Push	Curtailment	Indirect	Outside
9.	Subsidize energy-efficient appliances so as to make them 10% cheaper. Subsidies are funded from energy taxes charged on appliances that are not energy efficient.	Pull	Efficiency	Direct	Within
10.	Subsidize energy-efficient appliances so as to make them 10% cheaper. Subsidies are paid from general public funds.	Pull	Efficiency	Direct	Outside
11.	Subsidize appliances that are produced in an energy-efficient way so as to make them 10% cheaper. Subsidies are funded from energy taxes charged on appliances that are not energy efficient.	Pull	Efficiency	Indirect	Within
12.	Subsidize appliances that are produced in an energy-efficient way so as to make them 10% cheaper. Subsidies are paid from general public funds.	Pull	Efficiency	Indirect	Outside
13.	Decrease prices of green electricity by 10%. Subsidies are paid from an ecotax charged on regular energy.	Pull	Curtailment	Direct	Within
14.	Decrease prices of green electricity by 10%. Subsidies are paid from general public funds.	Pull	Curtailment	Direct	Outside
15.	Reduce prices of local seasonal vegetables and fruit (not raised in greenhouses) by 10%. The subsidies are paid from extra taxes on imported and hothouse vegetables and fruit.	Pull	Curtailment	Indirect	Within
16.	Reduce prices of local seasonal vegetables and fruit (not grown in greenhouses) by 10%. The subsidies are paid from general public funds.	Pull	Curtailment	Indirect	Outside

Note: pricing policy measures were presented to respondents in random order.

variable must significantly affect the dependent variable in the absence of the mediator. Third, the mediator must have significant unique effect on the dependent variable. Fourth, the direct effect of the independent variable on the dependent variable should weaken substantially or even disappear upon the addition of the mediator to the model. Therefore, four regression analyses were conducted to test whether each mediator carries the influence of an independent variable to a dependent variable; we report the Goodman (I) version of the Sobel test (*t*-test values; see Baron & Kenny, 1986; Preacher & Leonardelli, 2005).

4. Results

Table 4 shows the results of the series of regression analyses aimed to test VBN theory. Personal norm explained 29% of the variance in acceptability judgements (effect size $f^2 = .41$). When all variables further up in the causal chain were entered in the regression analysis as well, 32% of the variance in acceptability judgements was explained ($f^2 = .47$). Only personal norm contributed significantly to this model: the stronger the personal norm, the more people supported policies aimed at reducing CO_2

Table 4
Multiple regression analyses to test the causal chain of VBN theory

	ß	95% ci	*t*	*p*	Adj. R^2	*F*	*df*	*p*	f^2
DV: acceptability									
Model 1:					.29	41.59	1, 101	.000	.41
PN	.54	.37, .70	6.45	.000					
Model 2:					.32	7.87	6, 95	.000	.47
PN	.37	.14, .61	3.17	.002					
AR	.11	−.10, .32	1.07	.289					
AC	.03	−.18, .24	.32	.747					
NEP	.21	−.01, .42	1.91	.060					
Egoistic values	−.08	−.26, .10	−.89	.376					
Altruistic values	.01	−.19, .21	.10	.918					
Biospheric values	−.02	−.25, .21	−.15	.880					
DV: PN									
Model 1:					.32	48.36	1, 101	.000	.47
AR	.57	.41, .73	6.95	.000					
Model 2:					.49	17.45	5, 96	.000	.96
AR	.30	.13, .47	3.52	.001					
AC	.10	−.08, .28	1.09	.277					
NEP	.06	−.13, .24	.59	.556					
Egoistic values	−.00	−.16, .15	−.05	.961					
Altruistic values	.16	−.01, .33	1.86	.065					
Biospheric values	.35	.17, .53	3.82	.000					
DV: AR									
Model 1:					.21	27.44	1, 101	.000	.27
AC	.46	.29, .64	5.24	.000					
Model 2:					.29	9.49	4, 97	.000	.41
AC	.36	.16, .56	3.52	.001					
NEP	−.02	−.23, .20	−.15	.878					
Egoistic values	−.08	−.27, .10	−.90	.370					
Altruistic values	.13	−.07, .33	1.30	.198					
Biospheric values	.25	.04, .46	2.39	.019					
DV: AC									
Model 1:					.28	40.96	1, 104	.000	.39
NEP	.53	.37, .70	6.40	.000					
Model 2:					.29	11.95	3, 101	.000	.41
NEP	.50	.31, .70	5.23	.000					
Egoistic values	−.10	−.28, .08	−1.07	.286					
Altruistic values	.17	−.03, .36	1.70	.093					
Biospheric values	−.05	−.26, .15	−.49	.623					
DV: NEP					.25	12.74	3, 102	.000	.33
Egoistic values	−.32	−.49, −.14	−3.63	.000					
Altruistic values	−.20	−.40, −.00	−2.02	.046					
Biospheric values	.47	.28, .65	4.89	.000					

Note: DV = dependent variable; 95% ci: 95% confidence interval around ß. If the confidence interval excludes zero, the ß is considered to be statistically significant by conventional standards (e.g. Smithson, 2003). f^2 = population effect size index for multiple correlation. For multiple correlation, f^2 of .35 is considered to be large, and f^2 of .15 is considered to be medium (see Cohen, 1992).

emissions ($ß = .37$, $p = .002$); the population value of ß (95% ci) is rated to be between .14 and .61. Since the population value of 95% confidence interval excluded zero for personal norm, we may conclude that personal norm is statistically significant by conventional standards (Smithson, 2003). All other confidence intervals included zero.

AR beliefs explained 32% of the variance in personal norm ($f^2 = .47$). The full model, including all variables preceding personal norm, explained 49% of the variance in personal norm ($f^2 = .96$). Apart from AR ($ß = .30$, $p = .001$, 95% ci: .13, .47), the biospheric value orientation made a significant contribution to this model ($ß = .35$, $p < .001$, 95% ci: .17, .53). The 95% confidence intervals did not include zero for both AR and biospheric value orientation, which again reveals that AR and biospheric value orientation significantly contributed to the explanation of personal norm.

AC beliefs explained 21% of the variance in AR beliefs ($f^2 = .27$). Values, NEP and AC together explained 29% of the variance in AR beliefs ($f^2 = .41$). Only AC beliefs ($ß = .36$, $p = .001$, 95% ci: .16, .56) made a significant contribution to this model; the 95% confidence interval did not include zero. The contribution of biospheric value orientation ($ß = .25$, $p = .019$, 95% ci: .04, .46) was not significant because a Bonferonni correction was applied (i.e. $p < .006$; see the Analysis section).

NEP explained 28% of the variance in AC beliefs ($f^2 = .39$), while the model including NEP and value orientations explained 29% of the variance in the AC beliefs ($f^2 = .41$). Only NEP made a significant contribution to this model ($ß = .50$, $p < .001$, 95% ci: .31, .70); the 95% confidence interval of NEP did not include zero. Confidence intervals of all other predictor variables included zero, suggesting that these variables did not significantly contribute to the explanation of AC, as also emerged from the *t*-tests.

Finally, the three value orientations explained 25% of the variance in NEP ($f^2 = .33$). Egoistic and biospheric value orientations made a significant contribution to this model; 95% confidence intervals of egoistic and biospheric values did not include zero. The higher the scores on the biospheric value orientation, the higher NEP ($ß = .47$, $p < .001$, 95% ci: .28, .65). In contrast, egoistic values were negatively related to NEP ($ß = -.32$, $p < .001$, 95% ci: $-.49$, $-.14$, respectively). The contribution of altruistic values is not significant because a Bonferonni correction was applied ($p < .006$): $ß = -.20$, $p = .046$, 95% ci: $-.04$, $-.00$. Moreover, the confidence interval around altruistic values included zero (exactly, by rounding of). This suggests that altruistic values are not significantly related to NEP, as also became apparent from a bivariate correlational analysis, which revealed that altruistic values were not significant related with NEP ($r = .10$, $p = .295$).

To test the mediation effects we followed Baron and Kenny's (1986) approach. Below, for each mediation analysis, we report *F*-values of the four regression models and ß's of predictors that significantly contributed to the regression model in case multiple predictors were included in the model. Also, results of the Sobel tests (*t*-tests) are reported.

As expected, the relationship between AR and acceptability judgements was mediated by personal norms: $t = 3.71$, $p < .001$. The regression of PN on AR was significant: $F(1, 104) = 50.37$ $p < .001$. Moreover, the regression of acceptability judgements on AR was significant: $F(1, 106) = 20.06$, $p < .001$. Also, the regression of acceptability judgements on PN was significant: $F(1, 107) = 19.43$, $p < .001$. Finally, in the regression of acceptability on AR beliefs and PN ($F(2, 103) = 22.66$, $p < .001$), only PN ($ß = .44$, $p < .001$, 95% ci: .26, .70) significantly contributed to the regression model, while AR did not have a significant unique relationship with acceptability of energy policies when PN was controlled for ($ß = .17$, $p = .089$, 95% ci: $-.03$, .39), pointing to a mediating role of PN.

Second, we tested whether AR mediated the relationship between AC and PN. AC beliefs contributed significantly to the explanation of the variance in AR beliefs: $F(1, 106) = 20.82$, $p < .001$, as well as to the explanation of the variance in PN: $(1, 107) = 19.42$, $p < .001$. Also, the regression of PN on AR beliefs was significant: $F(1, 104) = 50.37$, $p < .001$. In the regression of PN on AR and AC beliefs, $F(2, 103) = 27.36$, $p < .001$, only AR ($ß = .50$, $p < .001$, 95% ci: .32, .67) contributed significantly to the regression model, while AC did not have a significant unique relationship with PN when AR was controlled for ($ß = .16$, $p = .074$, 95% ci: $-.02$, .34). Again, according to Baron and Kenny (1986), mediation holds in this case (Sobel test: $t = 3.13$, $p = .002$).

Third, we examined whether AC mediated the relationship between NEP and AR. The regression of AC on NEP was significant: $F(1, 109) = 42.50$, $p < .001$. Also, the regression of AR on NEP ($F(1, 106) = 8.61$, $p = .004$) and the regression of AR on AC ($F(1, 106) = 20.82$, $p < .001$) were significant. In the regression of AR on NEP and AC, $F(2, 105) = 10.67$, $p < .001$, only AC ($ß = .36$, $p = .001$, 95% ci: .17, .62) contributed significantly to the regression model. NEP did not have a significant unique relationship with AR when AC was controlled for ($ß = .08$, $p = .443$, 95% ci: $-.13$, .31). Again, mediation was shown: $t = 3.71$, $p < .001$.

Fourth, we tested whether NEP mediates the relationship between values and AC. Egoistic, altruistic and biospheric values contributed significantly to the explanation of the variance in NEP: $F(3, 102) = 12.74$, $p < .001$ (as reported in Table 4). Also, the regression of AC on values was significant: $F(3, 102) = 5.41$, $p = .002$: egoistic values were negatively related to AC ($ß = -.26$, $p = .008$), while biospheric values were positively (although marginally) related to AC ($ß = .19$, $p = .08$). Altruistic values were not significantly related to AC. Further, the regression of AC on NEP was significant: $F(1, 109) = 42.50$, $p < .001$. Finally, in the regression of AC on value orientations and NEP, $F(4, 101) = 11.95$, $p < .001$, only NEP ($ß = .50$, $p < .001$, 95% ci: .32, .69) contributed significantly to the regression

model. Values did not have a significant unique relationship with AC when NEP was controlled for (egoistic values: ß = . − .05, $p = .286$, 95% ci: −.28, .09; altruistic values: ß = .10, $p = .09$, 95% ci: −.03, .36; biospheric values: ß = . − .02, $p = .623$, 95% ci: −.26, .16). To test whether NEP indeed carries the influence of values on AC, Sobel tests were conducted for each value orientation separately. It was shown that NEP indeed mediated the relationship between AC and egoistic values ($t = -2.98$, $p = .002$) and biospheric values ($t = 3.55$, $p < .001$), but not the relationship between AC and altruistic values ($t = 1.05$, $p = .293$).

5. Discussion

The study results suggest that VBN theory is successful in explaining judgements of acceptability of energy policies. As expected, all variables were significantly related to the next variable in the causal chain. Moreover, in most cases, the explanatory power of the model hardly increased when other predictor variables further up the causal chain were entered into the regression model. Only biospheric values were also significantly related to feelings of moral obligation to reduce household energy consumption when intermediate variables were controlled for. Especially the variance in personal norms could be better explained when other predictor variables (notably: biospheric values) were entered into the regression model, next to AR beliefs. These results confirm the causal order of the variables in the chain, moving from relative stable general values to beliefs about human–environment relations (NEP), which in turn are related to behaviour specific beliefs and norms for taking corrective actions, and acceptability judgements, respectively. Of course, the correlational nature of this study does not allow to draw definitive conclusions on causal relationships between variables in VBN theory.

Our hypothesis on mediational effects was also confirmed, which provides further support for the causal structure of VBN theory. As expected, personal norms mediated the relationship between AR beliefs and behaviour, AR beliefs mediated the relationship between AC beliefs and personal norms, AC beliefs mediated the relationship between NEP and AR beliefs, and NEP mediated the relationship between values and AC beliefs. The mediating role of personal norms is in line with results reported by Nordlund and Garvill (2002, 2003).

As hypothesized, a strong moral obligation to reduce household energy use was associated with higher acceptability levels. Personal norm explained almost 30% of the variance in the acceptability judgements; effect size was large. The amount of variance explained by personal norms is relatively high compared to other studies e.g. Nordlund and Garvill (2002, 2003) reported that personal norms explained about 20% of the variance in willingness to reduce car use and general proenvironmental behaviour, respectively, while personal norms explained only 14% of the variance in car use (Bamberg & Schmidt, 2003) and 17% of the variance in subway use (Hunecke et al., 2001). However, a study by Vining and Ebreo (1992) revealed that personal norms explained 35% of the variance in recycling behaviour. The complete VBN model explained 32% of the variance in acceptability judgements. This is comparable with findings reported by Stern et al. (1999), in which a subset of VBN variables were used to explain a different set of environmental behaviours (e.g. consumer behaviour, willingness to sacrifice, environmental citizenship). Our results suggest that VBN theory can be generalized to other behavioural domains. However, the variance explained by personal norms, and more generally, VBN theory, seems to differ for different behaviour domains. This may well be dependent on how costly (in terms of money, effort and time) proenvironmental behaviour is (see the Introduction section). The results discussed above suggest that relatively costly behaviour, e.g. the use of a car or subway, are less strongly related to personal norms than is less costly behaviour, such as recycling and acceptability of energy policies. As described in the Introduction section, VBN theory has been developed to explain behaviour taken with proenvironmental intent. It may well be that behaviours such as car and subway use are hardly taken with proenvironmental intent. Future studies should clarify whether VBN theory can explain behaviour in different domains, relative to other behavioural models, like the theory of planned behaviour (Ajzen, 1985).

Almost 50% of the variance in personal norms could be explained by the remaining variables of VBN theory; again effect size was large. As expected, personal norms were especially strong when people felt responsible for energy problems. However, biospheric value orientation also contributed significantly to the explanation of personal norms, which implies that those who highly value the quality of the environment feel more obliged to reduce their household energy consumption. Again, these results are in line with previous studies (Stern et al., 1999; Hunecke et al., 2001; Nordlund & Garvill, 2002, 2003). For example, a study by Nordlund and Garvill (2003) revealed that more than 40% of the variance in behaviour specific personal norms could be explained by values (especially ecocentrism, comparable to biospheric values), and general and specific problem awareness.

The perceived responsibility for the problems resulting from energy use was higher among respondents who were aware of these problems. Awareness of consequences was highest among those having a high environmental concern (as indicated by NEP). Finally, egoistic and biospheric value orientations were significantly related to NEP. Of course, we should be cautious in drawing conclusions about causality based on correlational data. However, the results are fully in line with the causal structure of the theoretical model.

Egoistic values were negatively related to NEP, implying that concerns about self are associated with lower environmental concern. Interestingly, only biospheric values were positively related to NEP. Altruistic values

did not make a significant contribution to the explanation of NEP when egoistic and biospheric values were controlled for. Moreover, the bivariate correlation between altruistic values and NEP was not significant. Thus, concern for the welfare of others appeared not to be related to NEP. These findings are in agreement with results reported by Grendstad and Wollebaek (1998) and Nordlund and Garvill (2002). Apparently, biospheric values are more important in stimulating proenvironmental behaviour than are altruistic values. This clearly suggests that it is indeed relevant and important to make a distinction between altruistic and biospheric values. Some earlier studies revealed that it may not be possible to empirically distinguish biospheric from altruistic values (e.g. Stern, Dietz, Kalof et al., 1995). One reason for this may be that in many studies, especially studies based on Schwartz's (1992) value taxonomy, only few biospheric values were included (cf. Stern, Dietz, Kalof et al., 1995). From the present study we may conclude that general biospheric and altruistic values can indeed be distinguished as separate value clusters, and only biospheric values seem to be related to NEP. Future research should further validate whether these values are differently related to specific beliefs and environmental behaviour.

A better understanding of factors influencing the acceptability of environmental policies is important for policy makers. This may have large effects on the quality of the environment because, when implemented, public policies may affect the behaviours of many people at once. The results of this study indicate that support for environmental policies may be enhanced by emphasizing biospheric values, increasing general environmental awareness, increasing the awareness of and responsibility for the problems resulting from high energy consumption patterns, and strengthening personal norms for taking corrective actions.

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