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Do Social Norms Trump Rational Choice

in Voluntary Climate Change Mitigation?

Multi-Country Evidence of Social Tipping Points

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Abstract: The rational choice model of voluntary public good provision predicts that an individual's contribution to climate change mitigation responds negatively to larger contributions by others whereas social norm theory maintains that one's own contribution is positively related to that of others. This paper tests the competing hypotheses empirically using representative data for about 30,000 individuals from 23 European countries. The paper finds that, up to a threshold percentage of others perceived to engage in mitigation, individuals' willingness to engage in mitigation themselves is lower the more other individuals are perceived to engage in such behavior, whereas the relationship is positive when the threshold is passed. Since the actual percentage of others perceived to engage in mitigation is lower than the estimated threshold (30 to 56 percent) in a number of countries, marginal increases in the percentage of others perceived to behave in a climate-friendly way may backfire by enhancing free-rider behavior. For the social norm to take grip, policy-induced non-marginal increases of perceptions may be warranted in such cases. Given that the actual level of the relevant behavior is large relative to the perceived level, informing people about the actual level constitutes a sufficiently large change to trigger an increase in the behavior studied.

1. **Introduction**

The past three decades have seen a departure from the standard rational choice model of pro-social and pro-environmental behavior. While the rational choice model is of a consequentialist nature, assuming that people do what yields the individually optimal (expected) *outcome*, alternative approaches are deontological, maintaining that individuals evaluate behaviors *per se* and choose among them based on conformity with *moral* norms – inner feelings of what is right or wrong – and *social* norms – what most people do (descriptive social norms) or approve of doing (injunctive social norms).[1]

Conformity to pro-social moral and social norms is generally understood as a mechanism that enhances the voluntary provision of public goods by countervailing the free-rider incentives highlighted by rational choice theory (e.g., Nyborg 2018). With respect to voluntary public good provision there is, however, an important difference between moral-norm and injunctive-social-norm accounts of behavior, on the one hand, and descriptive-social-norm accounts, on the other. While the former are logically independent of rational choice theory, descriptive-social-norm accounts are logically opposed to rational choice theory, that is, the two make opposite behavioral predictions: While rational choice theory predicts that an individual's contribution to the public good responds negatively to others' contributions (e.g., Buchholz and Sandler 2021), conformity to a descriptive social norm – what most others do – implies that an individual's contribution is positively related to the contributions provided by others.

Focusing on climate change mitigation, this paper tests the competing predictions empirically, using representative survey data for about 30,000 individuals from 23 European countries. Specifically, based on the idea of social tipping points (see below), the hypothesis will be explored that there are threshold levels of others' behavior that need to be passed for the descriptive social norm mechanism to dominate the rational choice mechanism.

The literature on the behavioral theory and empirical evidence on social norms as applied to pro-environmental behavior is concisely reviewed by Farrow et al. (2017). The review identified 42 studies, of which 11 referred to energy use, 11 referred to recycling, and 20 referred to green consumption, littering, water conservation, hotel guests' towel reuse, and pesticide use. These

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[1] For economic theories of moral norms see, e.g., Brekke et al. (2003), Bruvoll and Nyborg (2004), Nyborg et al (2006) and Bénabou and Tirole (2011). Farrow et al. (2017) discuss classifications of social norms. Economic theories of social norms are provided by, e.g., Holländer (1990), Rege (2004) and Bénabou and Tirole (2006). Nyborg (2018) provides a general account of moral and social norms in environmental economics.

studies covered both behaviors and behavior intentions and involved descriptive and injunctive norms. The behaviors studied were found to be significantly positively related to descriptive norms (others' actual or perceived pro-environmental behaviors) in 31 out of 39 studies. An early example where clues about others' behavior prompted pro-environmental behavior change refers to the reuse of bath towels in hotels (Schultz et al. 2008). Farrow et al. (2017) take such findings to suggest that people take information or beliefs about what others do (descriptive norms) as a signal of which behaviors are socially approved and which are not (injunctive norms).

While the evidence found in this literature is often context-specific and local in nature, Nyborg et al. (2016) note that recent history has seen large-scale changes of norms and behaviors, for instance with respect to fertility behavior or the cessation of smoking in public places. However, for such changes to be self-reinforcing, they argue, it is necessary that *social tipping points* are passed, that is, for social conformity to induce behavior changes a sufficiently large number of people must already have changed their behavior so that a "new" social norm emerges. Below such thresholds, social conformity implies vicious rather than virtuous circles.

Though fertility and smoking behaviors do not necessairily or to a large extent refer to public goods, the notion of threshold values or tipping points may be even more relevant when public goods are involved. In such cases "new" norms of behavior (e.g., environment-friendliness) do not only compete with "old" ones (e.g., "keeping up with the Joneses") but with incentives to free-ride on others' contributions to the public good. This makes it likely that public good provision by others may not only be *ineffective* in triggering an individual to behave similarly, but *counter-productive* unless a tipping point is passed where the "virtuous" conformity mechanism starts to dominate rational-choice free-rider considerations.

While the rational-choice/free-rider model is the standard framework that predicts a negative relationship between own mitigation behavior and that of others, non-standard mechanisms have been proposed that lead to the same prediction. One is so-called moral licensing. This involves the idea that people's sense of duty to contribute to a public good is inversely related to the level of the public good: When morally motivated people learn that the level of a public good increases, due to larger contributions by others, their sense of duty and the corresponding contribution may diminish, possibly in favor of other collective goals/goods (Mullen and Monin 2016). The notion of moral licensing combines consequentialist (outcome-focused) and deontological aspects since the (collective) outcome of behaviors (or perception of outcome) influences an individual's behavior (as in the rational choice framework) even though the

behavior's motivation may be of a deontological nature.[2]

Another mechanism that implies a negative relationship between own and others' behavior involves social distinction: Low overall levels of a desirable behavior may raise the adoption of this behavior through motivations to seek distinction (e.g., Bénabou and Tirole (2006). If, conversely, the overall level of the behavior increases (from a low level), the behavior becomes less attractive as a vehicle for attaining distinction and may thus be reduced.

Focusing on climate change mitigation – by means of buying the most energy efficient home appliances – this paper contributes to the literature by studying the potentially opposing effects of others' behavior in a large-scale multi-country representative sample, the European Social Survey. Controling for indicators of a *moral* norm of climate change mitigation, income, and a battery of sociodemographic correlates, the paper finds that, up to a threshold level of others perceived to engage in mitigation, individuals' willingness to engage in mitigation themselves is lower the more other individuals are perceived to engage in such behavior, whereas the relationship is positive when the threshold (tipping point) is passed. The u-shaped relationship between own and others' perceived behavior is found to exist in all of subgroups of the population (by age, gender, level of education, ideological position, and sense of moral duty), but the implied tipping points differ with respect to some of people's characteristics.

Since the percentage of others perceived to engage in mitigation is lower than the estimated threshold (30 to 56 percent) in a number of (but not all) countries, marginal increases in the percentage of others perceived to behave in a climate-friendly way may backfire by enhancing free-rider (or moral-licensing) behavior. For the social norm to take grip, policy-induced non-marginal increases may be warranted in such cases. Given that, in the data analyzed, the actual level of the relevant behavior is large relative to the perceived level, informing people about the actual level constitutes a sufficiently large change to trigger an increase in the behavior studied.

The remainder of the paper proceeds as follows. Section 2 discusses the conceptual framework and empirical approach and describes the data and variables used. Section 3 reports and section 4 discusses the results. Section 5 concludes.

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[2] Relevant evidence supposed to be related to moral licensing will be discussed in section 4.

2. **Method**

2.1 Conceptual Framework and Empirical Approach

We start by sketching a stylized analytical framework for climate change mitigation which adds social and moral norms to the standard model of voluntary public good provision.

The standard public good model consists of a utility function, an aggregator function and a budget constraint (e.g. Buchholz and Sandler 2021). Individual i's utility function $U_i(G, x_i)$ has two arguments, the overall level of the public good, G, and individualt i's consumption of a private numeraire good, $x_{i.}$. The utility from the public good may reflect that, in addition to the individual's self-interest, she values the public good for altruistic reasons (Andreoni 1989). The utility function has positive and decreasing marginal utility with respect to both arguments and, for simplicity, is assumed to be separable. The aggregator function specifies that the overall level of the public good is the sum of the individual's contribution, g_i, and the contributions of all others, $g_{-i} = \sum_{j \neq i} g_j$, hence $G = g_i + g_{-i}$. The budget constraint is stated as $x_i = e_i - g_i$, where e_i denotes the individual's endowment (income). By substituting the aggregator function and the budget constraint into the utility function, one obtains $U_i(g_i + g_{-i}, e_i - g_i)$.

The standard model can be augmented to include utility from conformity to a (descriptive) social norm and a moral norm:

$$V_i = U_i(g_i + g_{-i}, \ e_i - g_i) + S_i(g_{-i})g_i + M_i g_i . \qquad (1)$$

In this formulation, $S_i(g_{-i})$ is a positive and increasing function of the contributions of all other individuals ($S_i > 0$, $S_i' > 0$). The second term on the right hand side then says that an individual derives utility from her contribution, which is increasing in the level of others' contributions. This is the psychological benefit from social conformity, that is, doing what others do. The psychological benefit from doing what others do may not only increase in the level of others' activity ($S_i' > 0$), but increasingly so ($S_i'' > 0$). Likewise, with a positive parameter M_i, the third term on the right hand side gives the psychological beneft from contributing which arises from conformity to a moral (internal) norm.[3]

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[3] To account for moral licensing, the parameter M_i might be replaced with an expression $M_i + f(g_i + g_{-i})$, where f' < 0, which indicates that an individual's sense of duty to contribute decreases as the level of the public good increases due to increased contributions by others.

Maximizing V_i with respect to g_i and applying the implicit function theorem to the first-order condition yields the following comparative statics result for voluntary public good supply, where (dropping the index i), U_{GG} and U_{xx} denote second partial derivatives:

$$\frac{dg_i}{dg_{-i}} = -U_{GG}/(U_{GG} + U_{xx}) + (-S'/(U_{GG} + U_{xx})). \tag{2}$$

Given decreasing marginal utility of the public and private goods, the first term on the right hand side is negative (between -1 and 0), in line with the usual result that optimal response functions in rational-choice public good models are downward-sloping. The second term, by contrast, is positive, owing to the social-conformity effect. The overall expression is positive (negative) if S' > $-U_{GG}$ ($S' < -U_{GG}$). Thus, for social conformity to dominate rational choice, the influence of others' behavior on the marginal benefit from contributing, S', must be sufficiently large to outweigh free-rider incentives (and possibly moral licensing). Assuming that $S_i'' > 0$, chances that this is the case increase as the level of others' activity increases. Furthermore, it is clear that dg_i/de_i > 0 and dg_i/dM_i > 0.

In the empirical analysis a linear version of the supply function for climate change mitigation will be estimated:

$$g_i = const + \alpha \cdot g_{-i} + \beta \cdot M_i + \gamma \cdot e_i + \delta \cdot controls_i + error_i \tag{3}$$

where β and γ are expected to be positive, whereas the sign of the parameter of main concern, α, is indeterminate. In addition to this basic specification, versions will be considered in which g_{-i} enters in a non-linear fashion.

2.2 Data and Variables

The data for estimating equation (3) comes from the European Social Survey, Round 8, a representative survey of over 40,000 individuals in 23 countries which includes a special module on climate change.[4] The variables used are described in Table 1.

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[4] Round 8 of the European Social Survey (EuropeanSocialSurvey.org) was fielded in 2016/2017. The countries included are Austria, Belgium,Switzerland, Czechia, Germany, Estonia, Spain, Finland, France, the UK, Hungary, Ireland, Israel, Iceland, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, the Russian Federation, Sweden and Slovenia.

Table 1: Description of Variables

Theoretical Variable	Emprirical Variable	Survey Question and Coding	Mean	Standard Deviation
g_i	Willingness to Contribute	If you were to buy a large electrical appliance for your home, how likely is it that you would buy one of the most energy efficient ones? Not at all likely = 0 to Extremely likely = 10	7.77	2.29
g_{-i}	Others' Perceived Contribution	How likely do you think it is that large numbers of people will limit their energy use to try to reduce climate change? Not at all likely = 0 to Extremely likely = 10	4.10	2.16
M_i	Sense of Effectiveness	How likely do you think it is that limiting your own energy use would help reduce climate change? Not at all likely = 0 to Extremely likely = 10	4.35	2.65
M_i	Sense of Responsibility	To what extent do you feel a personal responsibility to try to reduce climate change? Not at all =0 to A great deal = 10	5.58	2.73
e_i	Income	Household's total income, after tax and compulsory deductions, from all sources. First decile = 1 to 10th decile = 10.	5.19	2.73
Controls	Gender	Male = 0, Female =1	0.52	0.50
Controls	Age	Years of age	49.14	18.61
Controls	Education	Highest level of education, ES – ISCED. Less than lower secondary = 1 to MA level or higher = 7.	4.11	2.93
Controls	Children	Respondent lives with children at household grid. No = 0, Yes = 1..	0.35	0.48
Controls	Unemployed	What have you been doing for the last 7 days? Unemployed and actively looking for a job: No = 0, Yes = 1.	0.04	0.20
Controls	Right	In politics people sometimes talk of 'left' and 'right'. Where would you place yourself on this scale, where 0 means the left and 10 means the right?	5.16	2.24

The dependent variable is *Willingness to Contribute*. It is based on the following question from the section "Climate Change": "If you were to buy a large electrical appliance for your home, how likely is it that you would buy one of the most energy efficient ones?", where respondents are told that "energy efficient" means "using less energy".[5] It is measured on a scale from "Not at all likely" = 0 to "Extremely likely" = 10, the mean being 7.77/10 (or 77.7 percent).

The explanatory variable of main interest is *Others' Perceived Contribution*. It is based on the question "How likely do you think it is that large numbers of people will limit their energy use to try to reduce climate change?".[6] It is also measured on a scale from "Not at all likely" = 0 to "Extremely likely" = 10, with mean value 4.10/10 (or 41.0 percent).

Following Blasch and Ohndorf (2015), the moral-norm effect is captured by invoking Norm Activation Theory (Schwartz 1968), according to which an internalized moral norm is activated if (i) an individual shows awareness of the effects (consequences) of her morally-relevant behavior

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[5] Buying the most energy efficient appliances is a costly mitigation option as their prices are higher and pay-back (in terms of reduced energy bills) is ambiguous (e.g., Andor et al. 2020).

[6] In the terminology of Farrow et a. (2017) this constitutes a perceived descriptive norm.

and (ii) a sense of responsibility for these effects. Awareness of behavior's effects is elicited with the question" "How likely do you think it is that limiting your own energy use would help reduce climate change?" (variable *Sense of Effectiveness*), again measured on a scale from "Not at all likely" = 0 to "Extremely likely" = 10, with mean value 4.35/10 (or 43.5 percent). Sense of responsibility is elicited with the question "To what extent do you feel a personal responsibility to try to reduce climate change? " (variable *Sense of Responsibility*), measured on a scale from "Not at all" = 0 to "A great deal" = 10, with mean value 5.58/10.

The variable *Income* is measured by the decile into which total household net income falls. Control variables are gender, age, the level of education, whether children live in the household, whether the respondent is unemployed, and the self-placement on the left-right scale (variable *Right*).

While most variables show very low correlations (typically not exceeding 0.1), the variable *Others' Perceived contribution* stands out by being correlated with *Sense of Effectiveness* at $r = 0.411$ and with *Sense of Responsibility* at $r = 0.228$. It is thus not only conceptually sound (subsection 2.1) that measures of individuals' sense of moral duty to help reduce climate change are included in the analysis, but important in order to minimize the risk of confounding social-norm effects with moral-norm effects.

3 Results

3.1 Basic Regression Results

Table 2 reports OLS regression results for equation (3), using *Willingness to Contribute* as the dependent variable. Column 1 shows that the variable *Others' Perceived Contribution* attracts a significantly negative coefficient, whereas, as expected, the two moral-norm variables (*Sense of Effectiveness* and *Sense of Responsibility*) attract significantly positive coefficients.[7] Income, age, being female, the level of education, and whether children live in the household attract significantly positive coefficients whereas political orientation towards the right attracts a significantly negative coefficient.

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[7] In an otherwise identical specification that fails to control for the moral-norm variables, the variable *Others' Perceived Contribution* attracts a significantly positive coefficient (available upon request).

Table 2: Regression Results for Linear Specification

	1 Whole sample	2 First quartile	3 Second quartile	4 Third quartile	5 Fourth quartile
Others' Perceived Contribution	-0.03*** (4.11)	-0.11*** (3.09)	-0.08* (1.92)	0.08** (2.04)	0.09*** (4.21)
Sense of Effectiveness	0.04*** (7.66)	0.06*** (4.72)	0.02* (1.73)	0.02** (2.04)	0.06*** (6.22)
Sense of Responsibility	0.15*** (29.47)	0.14*** (12.79)	0.17*** (19.33)	0.19*** (20.80	0.13*** (12.26)
Income	0.04*** (8.79)	0.05*** (4.52)	0.05*** (6.79)	0.04*** (5.30)	0.04*** (3.83)
Female	0.15*** (6.27)	0.28*** (4.67)	0.14*** (3.35)	0.12*** (3.09)	0.09* (1.89)
Age	0.02*** (25.81)	0.02*** (12.71)	0.02*** (17.51	0.02*** (15.86)	0.01*** (9.70)
Level of education	0.01** (2.32)	0.01 (1.21)	0.01 (1.48)	0.01 (1.37)	0.01 (1.11)
Unemployed	-0.03 (0.48)	0.02 (0.10)	0.12 (1.08)	-0.16 (1.51)	-0.09 (0.78)
Children in household (yes)	0.28*** (10.77)	0.30*** (4.80)	0.32*** (7.31)	0.29*** (6.61)	0.21*** (4.37)
Right	-0.02*** (2.85)	-0.03*** (2.64)	-0.02** (2.45)	-0.02* (1.70)	-0.01 (0.26)
Constant	5.47	5.36	5.41	4.84	5.10
Adj. R^2	0.068	0.067	0.078	0.079	0.055
Observations	30,286	6,845	10,222	10.271	7,646

OLS regressions with country-fixed effects. Dependent variable: *Willingness to Contribute*. Robust t-statistics in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01. Quartiles are approximated as follows: First quartile: *Others' Perceived Contribution* < 3 (23.7 percent). Second quartile: *Others' Perceived Contribution* = 3 to 4 (32.7 percent). Third quartile: *Others' Perceived Contribution* = 4 to 5 (33.5 percent). Fourth quartile: *Others' Perceived Contribution* > 5 (25.2 percent).

The significantly negative coefficient on *Others' Perceived Contribution* is consistent with a dominance of the rational choice calculus over the social norm mechanism when it comes to buying energy efficient appliances. The oefficient -0.03 suggests that am increase of *Others' Perceived Contribution* by 1 standard deviation (2.16 or 21.6 percentage points) goes with a decrease in *Willingnes to Contribute* by 0.065 on the 0-10 scale.

While the relationship between own willingness to engage in mitigation and others' perceived mitigation is significantly negative (though not strong), it is intuitive that the relationship might

not be constant because, as argued above, the social norm effect can be expected to be stronger at higher levels of others' behavior. Visual inspection of the data suggests that the relationship may indeed be u-shaped (Figure 1).[8] To check for this possibility, columns 2-5 of Table 2 report estimation results for subsamples that approximately correspond to quartiles of the variable *Others' Perceived Contribution*. As seen in columns 2 and 3, the coefficient on *Others' Perceived Contribution* is significantly negative in the first and second quarter and the magnitude is much greater than in column 1, particularly so in the first quartile. In the first quartile, an increase of *Others' Perceived Contribution* by one percentage point goes with a decrease in the likelihood to buy the most energy efficient appliances by 0.11 percentage points.

<Figure 1 about here>

In the third and fourth quartiles by contrast, the coefficient on *Others' Perceived Contribution* is significantly positive and sizeable (columns 4 and 5). In the fourth quartile, an increase in *Others' Perceived Contribution* by one percentage point goes with an increase in the likelihood to buy the most energy efficient appliances by 0.09 percentage points.

The relationship between own mitigation intentions and others' perceived mitigation behavior is thus fundamentally different at high and low levels of others' perceived behavior.

3.2 Tipping Points

To further explore nonlinearities in the relationship between own mitigation intentions and perceived mitigation of others, the linear specification, equation (3), was extended to include the squared values of the variable *Others' Perceived Contribution*. Table 3 displays the regression results of the quadratic model for the total sample and differentiated by the individual countries. In the total sample, the linear and quadratic *Others' Perceived Contribution* variables attract significantly negative and positive coefficients, respectively. This implies that the relationship considered is negative at low levels of *Others' Perceived Contribution* and positive at high values, consistent with columns 2-5 in Table 2. Results for the other variables (not shown) are not appreciably different from those in Table 2.

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[8] Figure 1 is for illustration. Note, in particular, that each of the two top levels of *Others' Perceived Contribution* accounts for only 1 percent of the observations.

At the level of countries, the coefficients on the linear and quadratic *Others' Perceived Contribution* variables are negative and positive, respectively, in 20 out of 23 cases, and significantly so in 14 cases. In the countries where results deviate from the negative-positive pattern for linear and quadratic terms, none of the pertinent coefficients is significant.

Below the regression results, Table 3 displays the calculated values of *Others' Perceived Contribution* at which the derivatives are zero, that is, the threshold values or tipping points above which own mitigation is positively related to others' mitigation. For the total sample the threshold value is 4.3.. Since the variable *Others' Perceived Contribution* is the perceived likelihood that "large numbers of people" engage in mitigation behavior, the value 4.3, on the 0-10 scale, can be taken to indicate the percentage of people – 43 percent – above which a further increase in that percentage is associated with an increase in one's own behavior intentions. The value 4.3 is slightly higher than the median of *Others' Perceived Contribution* (4.1).

For the individual countries, the threshold values range from 30 percent (Belgium) to 56 percent (Spain), and some of the thresholds are below the respective median values whereas others are above them. For instance, the 30 percent threshold value for Belgium compares to the median value of 44 percent. The derivative of the dependent variable with respect to *Others' Perceived Contribution*, evaluated at the median, amounts to 0.096 in the case of Belgium (-0.212 + 2*0.035*4.4). A one-percentage-point increase from the median is thus associated with an increase by about 0.10 percentage points in the stated likelihood to buy the most energy efficient home appliances. The 56 percent threshold value for Spain compares to the median value of 38 percent, and the derivative of the dependent variable with respect to *Others' Perceived Contribution*, evaluated at the median, amounts to -0.121 (-0.379 + 2*0.034*3.8). A one-percentage-point increase from the median is thus associated with a *decrease* by about 0.12 percentage points in the stated likelihood to buy the most energy efficient home appliances. To reach the upward-sloping part of the reaction function, the perceived percentage of others engaging in mitigation behavior would have to be raised almost by half (from 38 to 56 percent) by appropriate measures. Only then would the self-reinforcing social norm mechanism take grip.

Table 3: Regression Results for Quadratic Specification

	All countries	Austria	Belgium	Switzerland	Czech Republic	Germany	Estonia	Spain
Others' Perceived Contribution (OPC)	-0.366*** (12.60)	-0.101 (0.59)	-0.212*** (4.18)	-0.145* (1.71)	-0.510*** (5.96)	-0.175 (1.03)	-0.298*** (3.29)	-0.379*** (3.23)
OPC squared	0.043*** (15.99)	0.019 (1.12)	0.035*** (7.19)	0.023*** (2.80)	0.056*** (6.77)	0.015 (0.92	0.045*** (5.19)	0.034*** (3.01)
Constant	5.868	5.428	5.485	5.818	6.378	6.382	5.466	6.310
Adj. R^2	0.073	0.021	0.094	0.066	0.083	0.001	0.087	0.046
Observations	30,286	1,363	1,211	1,030	1,545	1,938	1,362	1,333
Tipping Point Level of OPC	4.3	n.a.	3.0	3.2	4.6	n.a.	3.3	5.6
Median OPC	4.1	4.1	4.4	3.8	3.4	3.6	3.5	3.8
Median Willingness to Contribute	8.2	8.4	8.3	8.7	8.5	9.0	8.2	8.5

	Finland	France	United Kingdom	Hungary	Ireland	Israel	Iceland	Italy
Others' Perceived Contribution (OPC)	0.014 (0.80)	-0.456*** (5.22)	-0.431*** (5.04)	-0.823*** (6.05)	-0.648*** (5.40)	-0.293*** (2.82)	0.312 (0.91)	-0.512*** (4.80)
OPC squared	0.002 (0.15)	0.055*** (6.57)	0.057*** (6.94)	0.085*** (6.47)	0.068*** (5.89)	0.039*** (3.90)	0.004 (0.11)	0.053*** (5.11)
Constant	2.719	5.983	5.354	6.600	6.206	5.857	2.956	6.702
Adj. R^2	0.051	0.085	0.089	0.080	0.077	0.072	0.096	0.071
Observations	1,302	1,423	1,332	1,090	1,878	1,757	606	1,545
Tipping Point Level of OPC	n.a.	4.1	3.8	4.8	4.8	3.8	n.a.	4.8
Median OPC	4.3	4.1	3.6	3.8	4.5	4.4	3.8	4.7
Median Willingness to Contribute	8.3	8.2	7.7	8.0	8.0	8.3	7.5	8.6

	Lithuania	Netherlands	Norway	Poland	Portugal	Russian Federation	Sweden	Slovenia
Others' Perceived Contribution (OPC)	-0.360*** (3.71)	-0.044 (0.27)	0.190 (1.13)	-0.489*** (5.95)	-0.126 (0.66)	-0.609*** (3.01)	-0.111 (0.51)	-0.259*** (2.53)
OPC squared	0.043*** (4.67)	0.017 (1.06)	-0.03 (0.19)	0.054*** (6.87)	0.01 (0.52)	0.079*** (4.17	0.020 (0.96)	0.036*** (3.63)
Constant	6.087	4.703	3.618	6.397	6.398	4.046	4.713	5.896
Adj. R^2	0.074	0.041	0.051	0.084	0.016	0.073	0.011	0.071
Observations	1,454	1,151	1,060	1,151	878	1,665	1,061	878

Tipping Point Level of OPC	4.2	n.a.	n.a.	4.5	n.a.	3.9	n.a.	3.6
Median OPC	4.4	4.3	4.5	4.0	3.7	4.2	4.8	3.3
Median Willingness to Contribute	8.5	7.9	7.4	8.6	9.2	6.2	7.7	8.6

OLS regressions. Dependent variable: *Willingness to Contribute*. Regressions control for moral norms, income and sociodemographic controls (see Table 2); n.a.= not applicable. Robust t-statistics in parentheses. $*p < 0.1$, $**p < 0.05$, $***p < 0.01$.

3.3 Heterogeneities

It has been found that climate-relevant behavior responds in heterogeneous ways to information on how others behave. For instance, Costa and Kahn (2013) found that liberals (people leaning towards the left) and environmentalists are more responsive to information about others' energy use than conservatives (people leaning towards the right). To check for such (and other) heterogeneities, quadratic models as in Table 3 were estimated for subgroups of the population that differ with respect to the climate-duty variables, ideological orientation, gender, age, and the level of education.

As displayed in Table 4, the coefficient on the linear term of *Others' Perceived Contribution* is significantly negative whereas the coefficient on the quadratic term is significantly positive without exception, implying that the overall relationship between own behavior and that of others is u-shaped with respect to all subgroups. The implied tipping points do not appreciably differ between adherents to the left and the right nor between individuals with and without tertiary education (BA degree or higher).

By contrast, considerable differences exist with respect to the moral-duty variables and with respect to gender and age. The tipping-point level is larger with respect to people whose sense of personal responsibility is greater than the median value than it is with respect to those below the median value (47 and 43 percent, respectively). Similarly, it is larger with respect to people with an above-median sense of own action's effectiveness than with respect to people below the median value (48 and 42 percent, respectively. Tipping-point levels are also found to be larger with respect to women than with respect to men (48 and 38, percent, respectively) and with respect to individuals above median age (47 years) than those below it (46 and 38 percent, respectively).

That older individuals are less responsive to "new" norms (implying a larger tipping-point level) than younger ones is probably not surprising. Women's larger tipping-point level compared to men is perhaps more unexpected. It is, however, consistent with the tendency of women to be later adopters of (and have lower willingness to pay for) "green" technologies, such as electric vehicles, than men (e.g., Rodriguez-Brito et al. 2018).

The results with respect to the moral-duty variables may also seem surprising. They will be discussed in the next section.

Table 4: Regression Results for Subgroups

	Low Sense of Responsibility	High Sense of Responsibility	Low Sense of Effectiveness	High Sense of Effectiveness	Left	Right
Others' Perceived Contribution (OPC)	-0.403***	-0.484***	-0.333***	-0.575***	-0.365***	-0.424***
	(9.39)	(10.77)	(4.49)	(16.45)	(10.87)	(9.57)
OPC squared	0.047***	0.051***	0.040***	0.060***	0.042***	0.050***
	(11.29)	(11.84)	(5.59)	(17.72)	(13.00)	(11.73)
Constant	5.536	6.400	5.622	6.522	5.945	5.880
Adj. R^2	0.094	0.094	0.080	0.097	0.095	0.095
Observations	15,146	15,140	15,150	15,136	15,139	15,147
Tipping Point Level of OPC	4.3	4.7	4.2	4.8	4.3	4.3

	Young	Old	Female	Male	Lower than BA	BA or higher
Others' Perceived Contribution (OPC)	-0.338***	-0.495***	-0.496***	-0.317***	-0.436***	-0.367***
	(7.47)	(10.46)	(12.62)	(7.04)	(10.86)	(6.16)
OPC squared	0.044***	0.054***	0.053***	0.042***	0.052***	0.042***
	(10.07)	(11.80)	(14.14)	(9.76)	(13.40)	(7.32)
Constant	5.409	6.392	5.512	6.280	5.845	6.093
Adj. R^2	0.094	0.094	0.095	0.095	0.096	0.086
Observations	15,146	15,140	15,930	14,356	22,896	7,390
Tipping Point Level of OPC	3.8	4.6	4.8	3.8	4.2	4.4

OLS regressions. Dependent variable: *Willingness to Contribute*. Regressions control for moral norms, income and sociodemographic controls (see Table 2). Except for gender and the level of education (lower than BA and BA or higher), subsamples approximately correspond to the lower and upper half of the sample. Robust *t*-statistics in parentheses. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

4. Discussion

4.1 Interpretation and Comparison with the Literature

Farrow et al. (2017) conclude from their review of social norms and pro-environmental behavior that "social norm interventions are effective at inducing significant changes in behavior" and discuss policy strategies for implementing such interventions. They note that, unlike injunctive norms, changes in descriptive norms seem to demonstrate particularly consistent effects in enhancing pro-environmental behavior changes. The findings of the present study imply a qualification of this conclusion as they suggest that interventions to increase the perception that many people engage in climate-friendly behavior may backfire unless a threshold level of the respective behavior is passed.

Warnings that social norm interventions should be used with care have been issued before (e.g., Corner, 2011). In energy studies, for example, informing people about the energy consumption of their neighbors has been found to have a boomerang effect for some individuals who learn that they outperform the norm (Allcott and Rogers, 2014, Schultz et al., 2007). It is, however, not clear what mechanisms trigger such effects. The mechanism highlighted in the present paper is rational choice: As is well known, when (people learn that) others' contributions to the public good of climate change mitigation are larger, it is individually rational to reduce one's own contribution and free-ride on others' efforts. In other words, mitigation activities by different agents are strategic substitutes (e.g., Buchholz and Sandler 2021) so that optimal response functions in public good settings are downward sloping (subsection 2.1).

While being consistent with rational choice, other (complementary) explanations of the boomerang effect are conceivable, in particular at low overall levels of mitigation. As noted in the introduction, one explanation may involve social distinction: While low overall levels of a desirable behavior may raise the adoption of this behavior through motivations to seek distinction (e.g., Bénabou and Tirole 2006), increases in the overall level may make the behavior less attractive as a vehicle for distinction. In line with such reasoning, Binder et al. (2020) found that, in contrast to individuals with an explicitly "non-green" identity, individuals with a "green" self-image derive psychological well-being from acting pro-environmentally, and more so when society is divided with respect to environmental attitudes and behaviors. When "green" behavior becomes more common, the effectiveness of (self-)signaling one's distinct green identity by acting pro-environmentally decreases. A loss of distinction based on "green" identity when green behavior becomes more common may explain why, as noted above, it is the "outperformers" who reduce pro-environmental behavior when the overall level of the behavior increases.

Moral licensing provides a further candidate explanation of why people's – and in particular outperformers' – contribution responds negatively to increasing overall contribution levels: Morally motivated individuals' sense of duty to contribute to a public good may diminish (and possibly be diverted to other collective goals/goods) when they learn that the level of the public good increases due to larger contributions by others (e.g., Mullen and Monin 2016). Similar to social distinction, a strong moral-licensing effect may explain why "outperformers" – on the presumption that they outperform due to a strong moral motivation – reduce their mitigation efforts as the overall effort level increases. With respect to the present findings, a strong moral-licensing effect may explain why the threshold level for the social-norm mechanism to become effective is particularly large with respect to people that are more morally motivated.

The moral-licensing and the rational-choice frameworks have in common that an individual's pro-environmental or pro-social behavior depends negatively on the (perceived) aggregate *outcome* of (others') behaviors, whether or not the individual's behavior is (in part) morally (deontologically) motivated. Both rational-choice and moral-licensing styles of behavior imply that for a social norm to become effective a threshold level must be passed where the social-norm effects trumps the rational-choice/moral-licensing effect.

4.2 Policy Conclusions

Irrespective of the mechanisms underlying a negative norm-behavior relationship, the analysis of this paper has provided evidence that at low levels of the (descriptive) norm (low levels of the perceived behavior of others) a negative relationship indeed exists. Thus, a tipping point needs to be passed for the beneficial social norm effect to take grip. The tipping-point level of perceived behavior was found to be about 43 percent overall, ranging from 30 to 56 percent in individual countries. While the estimated tipping-point level of others' perceived behavior is below the actual level in some countries, it is far above the actual level – by up to one half – in other countries.

When the tipping-point level is below the actual level, a self-reinforcing, virtuous norm-behavior cycle exists which needs no exogenous intervention: Any marginal increase from the actual level has a multiplier effect. When the tipping-point level of mitigation is above the actual level, however, non-marginal changes are required to shift the system past the tipping point. Nyborg et al. (2016) discuss ways how this can be achieved, e.g., by correcting incorrectly low

perceptions of the level of the desired behavior, changing the relative (material or psychological) costs of the desired and undesired behavior, or by outright regulation of behavior.

According to the findings of this paper, correcting false perceptions of the level of a desired behavior – reducing energy use – may in fact be an effective option for inducing an increase in the behavior: In the data studied here, people report a *Willingness to Contribute* of 8.2 whereas their estimate of *Others' Perceived Contribution* is 4.1, both measured on the 0-10 scale (Table 3). While the latter figure is slightly lower than the estimated tipping point level (4.3), the coefficient estimates reported in column 1 of Table 3 suggest that informing people that the actual (self-reported) level is 8.2 rather than 4.1 would trigger a social-norm effect which lifts the level to 8.87.[9] In plain language: Informing people that 82 percent (rather than 41 percent) are willing to reduce their energy use to help fighting global warming can be expected to trigger a social-norm effect that raises the willingness to almost 89 percent.

While the norm-behavior relationships and relevant data differ by country (Table 3), similar strategies are feasible for most individual countries: Actual (reported) levels of the *Willingness to Contribute* are large relative to *Others' Perceived Contribution*, so that informing people of actual levels triggers an upward shift of that willingness. In the case of Spain, for instance, informing people of the actual *Willingness to Contribute* can be expected to raise that willingness by 2 percentage points even though *Others' Perceived Contribution* is far below the tipping-point level.

5. Conclusion

Pro-environmental social norms have become a topical issue in environmental studies in recent years. As suggested by social-norm theory, information or perceptions that others behave in more pro-environmental ways (descriptive social norms) may prompt individuals to behave accordingly, due to a desire for social conformity. This proposition found considerable, but not universal, empirical support. It stands, however, in stark contrast to the standard rational-choice model of voluntary public good provision, which predicts that individuals reduce rather than increase their contributions to a (environmental) public good as others' contributions increase.

This paper has used representative multi-country data on individuals' intentions to contribute to climate change mitigation to test the competing hypotheses. It found that the relationship between individuals' intentions to engage in costly climate change mitigation is related

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[9] $8.98 - 0.366*8.2 + 0.043*8.2^2 = 8.87$, where 8.98 is the portion of the variable *Willingness to Contribute* accounted for by variables other than *Others' Perceived Contribution*.

to the corresponding perceived behavior of others in a u-shaped fashion, implying the existence of a tipping point that needs to be passed for the social-norm effect to dominate the rational-choice/free-rider effect. Since the tipping-point level of others' behavior was found to be larger than the actual level in some countries, interventions that increase the relevant perceptions marginally may backfire. Policies to exploit the social-norm effect may then need to induce non-marginal changes of perceptions. As the empirical results suggest, informing people of the actual (reported) level of the behavior intentions – which far exceeds the perceived level as well as the tipping point – may activate a social norm effect which results in a non-negligible boost in willingness to engage in voluntary climate change mitigation.

The paper has some strengths as well as limitations. A strength consists of using a representative large-scale multi-country dataset. In addition, the analysis controls for indicators of individuals' sense of moral duty to engage in the behavior studied, thus minimizing the risk that correlations between one's sense of duty and perceptions of others' relevant behavior may confound the analysis. The similarity of qualitative findings in many countries and subgroups of the population enhances the credibility of results.

A limitation of the analysis is that, given its reliance on cross-sectional survey data, the evidence found is of a correlational nature. The findings are, however, consistent with scattered experimental evidence of boomerang effects of social norm interventions, and suggest that such effects may be of general relevance when perceived behavior levels of others increase from low starting values without passing the relevant tipping points.

As many studies of social norms and pro-environmental behavior, this study is limited insofar as it focuses on one particular behavior, the intention to buy the most energy efficient household appliances in order to contribute to fighting climate change. Similarly, the variable used to measure the strength of a social norm is one of a set of measures that might plausibly be used (but are unavailable in the dataset employed). Future research might check the robustness of the findings obtained by using alternative measures.

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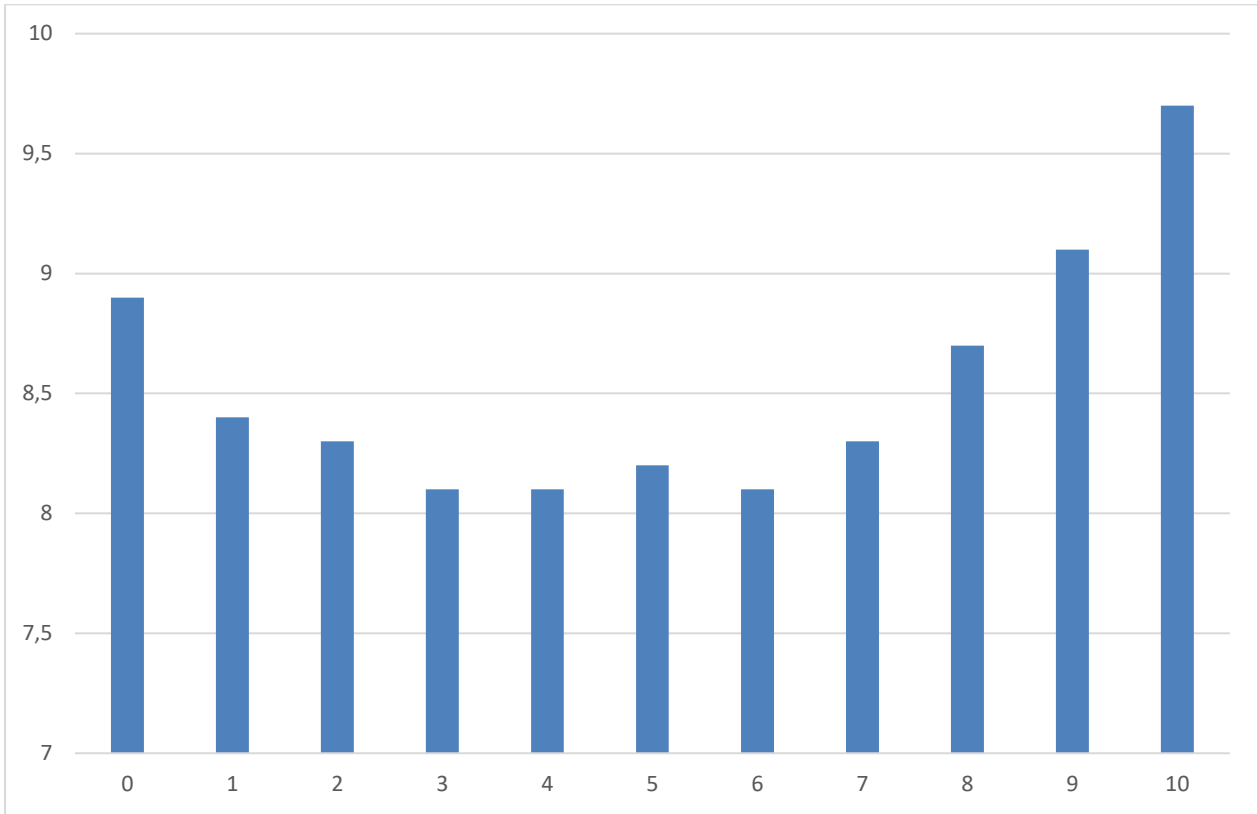
Figure 1: Median values of *Willingness to Contribute* by *Others' Perceived Contribution*

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