

The Energy-Saving Knowledge-Action Gap: Inhibitory Pathways of Social Norm Conflict and the Moderating Role of Goal Self-Efficacy*

Yin Xile, He Linshuo, Zhou Huiyuan, Chen Siyu, Zhang Feng

2026-08-20

ChinaRxiv

View the original and related papers at
<https://chinaxiv.org/items/chinaxiv-202608.00099>

Source: ChinaXiv. Machine translation. Verify with the original.

Abstract

In current residents' energy-saving practices, there is a widespread "knowledge-action gap" characterized by conflict between high injunctive norms and low descriptive norms. Existing studies have examined the negative effects of social norm conflict on energy conservation, but have not deeply analyzed its internal mechanisms, and discussions of effective interventions are even rarer. Integrating norm focus theory and norm activation theory, this study proposes parallel mediating pathways of responsibility and psychological reactance, and further examines the mitigating role of goal self-efficacy. Through two field experiments and three scenario-based simulation experiments, the theoretical hypotheses were tested across different energy-saving contexts (stair use, low-carbon travel, and post-meal food packaging). The findings show that: (1) social norm conflict significantly inhibits individuals' energy-saving behavior; (2) social norm conflict jointly inhibits energy-saving behavior by reducing responsibility and increasing psychological reactance; (3) goal self-efficacy effectively mitigates the inhibitory effect of social norm conflict on energy-saving behavior, and its effect is even stronger than providing high injunctive norm information alone; (4) goal self-efficacy mainly acts on the pathway through which social norm conflict affects responsibility, while it has no significant intervention effect on the psychological reactance triggered by social norm conflict. The results reveal the inhibitory pathways through which social norm conflict affects energy-saving behavior and provide theoretical and empirical support for designing effective interventions.

Full Text

The Energy-Saving Knowledge-Action Gap: Inhibitory Pathways of Social Norm Conflict and the Moderating Role of Goal Self-Efficacy*

Yin Xile^{1,2} He Linshuo² Zhou Huiyuan² Chen Siyu³ Zhang Feng⁴

(¹Center for Modern Business Research, Zhejiang Gongshang University;

²School of Business Administration, Zhejiang Gongshang University, Hangzhou 310018)

(³School of Economics and Management, Zhejiang University of Water Resources and Electric Power, Hangzhou 310018) (⁴School of Economics, Nankai University, Tianjin 300071)

Abstract In current residents' energy-saving practices, there is a widespread "knowledge-action gap" dilemma arising from conflicts between highly injunctive norms and weak descriptive norms. Existing studies have examined the negative effects of social norm conflict on energy conservation, but have not deeply analyzed its internal influence mechanisms, and discussions of effective intervention approaches remain even rarer. Integrating norm focus theory and norm activa-

tion theory, this study proposes parallel mediating pathways through sense of responsibility and psychological reactance, and further examines the mitigating role of goal self-efficacy. Through two field experiments and three scenario-simulation experiments, the theoretical hypotheses are tested across different energy-saving contexts (stair use, low-carbon travel, and taking leftovers home after meals). The findings show that: (1) social norm conflict significantly inhibits individuals' energy-saving behavior; (2) social norm conflict jointly suppresses energy-saving behavior by reducing sense of responsibility and increasing psychological reactance; (3) goal self-efficacy effectively mitigates the inhibitory effect of social norm conflict on energy-saving behavior, and its effect is even superior to providing highly injunctive normative information alone; (4) goal self-efficacy operates primarily on the pathway through which social norm conflict affects sense of responsibility, whereas it has no significant intervention effect on the psychological reactance triggered by social norm conflict. The findings reveal the inhibitory pathways through which social norm conflict affects energy-saving behavior, and provide theoretical support and data support for designing effective intervention measures.

Keywords social norm conflict; goal self-efficacy; psychological reactance; sense of responsibility; energy conservation

Chinese Library Classification Number B849: C91

1 Introduction

As a low-cost and efficient behavioral nudge tool, social norms have received extensive attention in the pro-environmental domain (He Guibing et al., 2018; Chen Sijing et al., 2021). Their efficacy stems not only from the injunctive norms concerning what most people believe one “ought to do” (Injunctive Norm), but is also profoundly influenced by descriptive norms concerning what people “actually do” (Descriptive Norm) (Cialdini et al., 1990; Tang Meihui et al., 2024). Among these, individuals' energy-saving behavior, because of its non-mandatory decision-making nature, the visibility of behavior, and the collective-action dilemma, is readily influenced by social cues and evaluations, and has therefore become an important domain for testing the effects of social norms (Bonan et al., 2020; Mundaca et al., 2022). In particular, in recent years policy advocacy has often fallen into a knowledge-action gap dilemma in promoting energy conservation—for example, emphasizing the value of saving while simultaneously presenting information or images indicating severe waste—to stimulate individual action. However, experiments have found that such information strategies, which deliberately highlight social norm conflict (hereafter referred to as norm conflict), do not have the intended effect and may even produce negative effects (Keizer et al., 2008; Hamann et al., 2015). In response, research has mainly drawn on norm focus theory to argue that individuals are more susceptible to descriptive norms with behavioral salience. However, this perspective has difficulty deeply revealing how norm conflict is perceived and internalized by individuals and thereby affects the micro-mechanisms of their

energy-saving behavior. Therefore, this paper further integrates norm activation theory

Received: 2025-08-22

* National Natural Science Foundation of China (72103183); Zhejiang Provincial Soft Science Project (2026C35079); Special Fund for Basic Scientific Research Operating Expenses of Provincial Universities in Zhejiang Province (2026ZDPY02)

Corresponding author: Chen Siyu, E-mail: chensy@zjweu.edu.cn

(Norm Activation Theory, NAT, Schwartz, 1977), proposes that norm conflict may inhibit energy-saving behavior through parallel pathways: first, by weakening the sense of responsibility (collective inaction triggers diffusion of responsibility and reduces anticipated guilt for violating norms); and second, by eliciting psychological reactance (inconsistent words and actions by others trigger threats to freedom and feelings of moral hypocrisy).

On this basis, grounded in practical needs, this paper aims to examine what intervention conditions can alleviate the negative impact of norm conflict and stimulate individuals' energy-saving actions. This line of reasoning is inspired by Habib et al. (2021), whose research revealed that norm conflict instead produced a positive effect in the context of organ donation. This suggests that goal self-efficacy (hereafter "goal efficacy") may be a key boundary condition for explaining contradictions in existing research: compared with the certainty of the contribution of organ donation, everyday energy-saving effects are difficult to perceive directly, making individuals prone to low goal efficacy characterized by a sense that their efforts are futile. Accordingly, on the basis of examining the mediating pathways of responsibility and psychological reactance, this paper further tests whether goal efficacy produces positive intervention effects on the two types of mediators.¹

1.1 The Impact of Norm Conflict on Energy Conservation

Research has found that the effects of two types of norms on energy conservation are related to the following factors: norm consistency (Cialdini, 2003) and norm focus (Kallgren et al., 2000). First, when the directions of the two types of norms are consistent, their combined effect is most positive (Bonan et al., 2020; Bhanot, 2021). However, in practice, norm conflicts between high injunctive norms and low descriptive norms are also common: members of society generally endorse the idea of energy conservation, yet the proportion who put it into practice is low (Hamann et al., 2015). In this regard, norm focus theory provides a core explanation: when cognitive resources are limited or motivation is insufficient, individuals' decisions tend to rely on cues that are salient and easy to obtain (Cialdini, 2003; Kredentser et al., 2012). In situations of norm conflict, intuitively visible descriptive norms often have greater behavioral salience than injunctive norms (Huber et al., 2020), causing individuals to unconsciously refer

to others' behavior, even when it runs counter to injunctive norms (Keizer et al., 2008; Bergquist & Nilsson, 2016). In sum, when individuals observe norm conflict, they focus on low descriptive-norm information, ignoring or obstructing the effect of high-level injunctive norms, thereby reducing their energy-saving behavior.

H1: Compared with a control group with no norm cues or a group with only high injunctive norms, the norm-conflict group (high injunctive-low descriptive) significantly reduces individuals' energy-saving behavior.

1.2 The Mediating Role of Responsibility

According to NAT, responsibility is the core mechanism of norm internalization: the transformation of external norms into action often proceeds through the chain process of "awareness of consequences and ascription of responsibility—personal norms—behavior" (De Groot & Steg, 2009; Han & Cudjoe, 2020). In norm-conflict situations, the internalization of responsibility is disrupted in two ways. First, collective inaction triggers diffusion and denial of responsibility, leading individuals to believe that the situation is not urgent or important, or that the responsibility for saving energy does not lie with them (Elsamen et al., 2025). Second, anticipated guilt is a key component in activating responsibility (Onwezen et al., 2013; Jacobson et al., 2021). However, others' inaction substantially reduces the perceived psychological cost of violating norms, making it difficult for the anticipated guilt associated with violating high injunctive norms to be fully awakened (Jacobson et al., 2021), thereby further weakening the strength of responsibility. Therefore, by intensifying diffusion of responsibility and reducing anticipated guilt, norm conflict substantially weakens responsibility and prevents the transformation of social norms into energy-saving behavior.

¹ The goal efficacy examined in this paper is closer to response efficacy and perceived consumer effectiveness (PCE), rather than classical self-efficacy as defined by Bandura (1977). Although goal efficacy, response efficacy, and PCE differ from subtle perspectives (the first two emphasize the effect of behavior on the goal, whereas the latter emphasizes the importance and meaningfulness of individual contribution), all focus on the effectiveness of behavioral outcomes, are often treated as interchangeable concepts, and are jointly distinguished from self-efficacy, which concerns individual behavioral capability (Rogers, 1975; Hamann & Reese, 2020). The reason for examining goal efficacy is that, in energy-saving contexts such as stair use and packing leftovers after meals, obstacles to individual behavior often lie not in "I cannot do it," but in "doing it is useless" or "my contribution is meaningless." This doubt about behavioral significance or goal attainment is precisely the core connotation captured by goal efficacy.

H2: Norm conflict inhibits energy-saving behavior by reducing the sense of responsibility.

1.3 The Mediation of Psychological Reactance

Beyond the pathway of responsibility, NAT also emphasizes the role of moral emotions such as guilt and empathy in norm internalization (Han, 2014). However, in the special context of norm conflict, the direction of emotional arousal may be reversed and alienated into defensive emotions such as perceived threat to freedom and moral hypocrisy. On the one hand, the coercive language of highly injunctive norms is itself easily regarded as a restriction on behavioral freedom (Kang et al., 2021), while low descriptive norms further strengthen this perception. On the other hand, the contradiction between the “ought” requirement of norm conflict and the “is” reality triggers individuals’ cognitive dissonance, which in turn produces negative moral evaluations of advocates as inconsistent in word and deed and hypocritical (Reynolds-Tylus et al., 2019). In this situation, the guilt that individuals might originally have been aroused to feel may be dissolved; replacing it is a form of reactant emotion generated by perceived threat to freedom and moral hypocrisy (Kavvouris et al., 2020). Psychological reactance theory further indicates that when individuals perceive their behavior as constrained, and when this constraint is viewed as unreasonable or hypocritical, it strongly activates a motivational state aimed at restoring psychological freedom, thereby resisting the guided behavior (Brehm & Cole, 1966; Dillard & Shen, 2005).

H3: Norm conflict inhibits energy-saving behavior by increasing psychological reactance.

1.4 The Moderation of Goal Efficacy

Goal efficacy, also referred to as response efficacy (Response Efficacy; Rogers, 1975; Hamann & Reese, 2020), reflects individuals’ perceptions of whether their own behavior can produce actual effects and value for a specific goal. This includes individuals’ belief that their own behavior can directly produce positive environmental effects (e.g., “Turning off the lights can directly save electricity”), as well as their belief that their own behavior can indirectly promote environmental goals by demonstrating or influencing others (e.g., “My behavior can encourage others to follow suit”; Hamann & Reese, 2020; Hornsey et al., 2021).

Furthermore, goal efficacy is expected to alleviate the negative effects generated by norm conflict through the aforementioned mediating pathways. In terms of the responsibility pathway, according to the views of McDonald et al. (2014) and Habib et al. (2021), individuals with high goal efficacy firmly believe that “my actions can change outcomes”; thus, their concern for environmental problems and moral attribution are less susceptible to interference from negative social cues such as “if others do not act, I need not act either,” thereby counteracting or even reversing the diffusion of responsibility brought about by collective inaction. At the same time, high goal efficacy also increases individuals’ anticipated emotional costs of inaction (e.g., anticipated guilt; Basil et al., 2008; Onwezen et al., 2013), thereby inhibiting the negative effect of norm conflict on the sense

Figure 1. Theoretical model

Figure 1: Figure 1. Theoretical model

of responsibility. In terms of the psychological reactance pathway, individuals with high goal efficacy experience less perceived threat to freedom when facing external rules, and are more likely to provide constructive responses, such as interpreting injunctive norms as suggestions rather than threats (Basil et al., 2008; DiRusso & Myrick, 2021). Meanwhile, belief in behavioral effectiveness can effectively dissolve the sense of hypocrisy and reactant psychology caused by inconsistency between others' words and deeds, reducing the intensity of negative emotions (Feldman & Hart, 2016). Thus, in the face of norm conflict, high goal efficacy alleviates the decline in responsibility by inhibiting the diffusion of responsibility and strengthening anticipated guilt on the one hand; on the other hand, it inhibits the rise of psychological reactance by reducing the perceived threat to freedom and perceived moral hypocrisy.

H4: High goal efficacy (relative to low goal efficacy) alleviates the negative effect of norm conflict on energy-saving behavior.

H5a: High goal efficacy alleviates the negative effect of norm conflict on the sense of responsibility.

H5b: High goal efficacy weakens the positive effect of norm conflict on psychological reactance.

Based on the above hypotheses, the theoretical model shown in Figure 1 was constructed. On this basis, the study adopted an approach progressing from the total effect (Experiment 1), the mediation mechanism

inhibition (Experiments 2 and 3) to moderation (Experiments 4 and 5), five field or scenario-simulation experiments covering different energy-saving contexts were designed (Table 1).

Figure 1. Theoretical model

Labels in the figure: norm conflict; goal efficacy; sense of responsibility; psychological reactance; individual energy-saving behavior; H1 (Experiment 1); H2 (Experiments 2 and 3); H3 (Experiments 2 and 3); H4 (Experiments 4 and 5); H5a (Experiment 4); H5b (Experiment 4).

Table 1. Overview of the Experimental Design

Study	Experiment 1 N=2906	Experiment 2 N=225	Experiment 3a N=200	Experiment 3b N=200	Experiment 4 N=300	Experiment 5 N=797
Experiment design	Single-factor, three-level design (control group vs. high-injunction group vs. conflict group)	Single-factor, three-level between-subjects design (control group vs. high-injunction group vs. conflict group)	2 (normative information: high in-junction vs. norm conflict) $\times$ 2 (psychological reactivity: baseline vs. enhancement group) between-subjects design	2 (normative information: high in-junction vs. norm conflict) $\times$ 2 (sense of responsibility: baseline vs. enhancement group) between-subjects design	2 (normative information: high in-junction vs. norm conflict) $\times$ 2 (goal efficacy: high vs. low) between-subjects design	Single-factor, two-level between-subjects design (norm-conflict group vs. conflict-high goal-efficacy group)
Experimental scenario	Use of campus stairs	Low-carbon travel	Low-carbon travel	Low-carbon travel	Packing food after meals	Use of campus stairs
Experiment type	Field experiment	Scenario-simulation experiment	Scenario-simulation experiment	Scenario-simulation experiment	Scenario-simulation experiment	Field experiment
Participant recruitment	Teachers and students at a university	Credemo	Credemo	Credemo	Credemo	Teachers and students at a university

Study	Experiment 1 N=2906	Experiment 2 N=225	Experiment 3a N=200	Experiment 3b N=200	Experiment 4 N=300	Experiment 5 N=797
Experimental objective	Test H1: the main effect of norm conflict on individual energy-saving behavior	Test the mediating roles of sense of responsibility (H2) and psychological reactance (H3)	Further verify the causal mediating effects of sense of responsibility (H2) and psychological reactance (H3) between norm conflict and energy-saving behavior	Further verify the causal mediating effects of sense of responsibility (H2) and psychological reactance (H3) between norm conflict and energy-saving behavior	Test the moderating role of goal efficacy in the main effect (H4) and in the mediating effects of sense of responsibility (H5a) and psychological reactance (H5b)	Further test the effect of goal efficacy in moderating the influence of norm conflict on individual energy-saving behavior (H4)
Experimental result	H1 was supported	H2 and H3 were supported	H2 and H3 received further support	H2 and H3 received further support	H4 and H5a were supported; H5b was not supported	H4 received further support

2 Experiment 1: A Field Experiment on the Effect of Norm Conflict on Individual Energy-Saving Behavior

2.1 Experimental Objective

Experiment 1 aimed to test Hypothesis H1, namely whether norm conflict, compared with a single high-injunctive norm or a no-norm control group, significantly reduces individual energy-saving behavior in a real-world setting. Because it is difficult to conduct manipulation checks in field experiments, a pilot experiment was conducted before Experiment 1 began. The results showed that

the injunctive norm and the descriptive norm perceived by participants differed significantly across experimental groups.

differences (Appendix A1). Before the formal experiment, we also completed pre-registration (AsPredicted #190404, <https://aspredicted.org/5whs-k7h9.pdf>).

2.2 Experimental Design and Participants

A single-factor experimental design was adopted (control group vs. high injunctive-norm group vs. norm-conflict group), with stair-use behavior as the dependent variable. Students and faculty/staff at a university in Hangzhou were selected as the observation targets. A total of 3,015 person-times of data were collected. After excluding 109 elevator-use observations with reasonable explanations (including carrying heavy objects or boxes, limited mobility, and using a stroller, among other circumstances), the final valid sample comprised 2,906 person-times: 1,854 male person-times, accounting for 63.80% (specific demographic characteristics are shown in Appendix A1). The numbers of person-times in each experimental group were: control group, 1,068 (36.75%); high injunctive-norm group, 957 (32.93%); and norm-conflict group, 881 (30.32%).

2.3 Experimental Materials

The descriptive norms and injunctive norms were induced by reference to the proportional methods used by Smith et al. (2012) and Bonan et al. (2020): on the basis of the control-group materials, the high-injunctive-norm group added survey information indicating that most people encouraged and approved of taking the stairs, whereas the norm-conflict group further added, on the basis of the high-injunctive-norm group, survey information indicating that very few people actually did so.

2.4 Experimental Procedure

The observation site for the experiment was the first floor of a university teaching building (five stories high), where the elevator was located close to the stair entrance. The entire experiment was divided into three phases, in which energy-saving posters containing no norm information, high injunctive-norm information, and norm-conflict information were posted, respectively. Posters in each phase were posted continuously for one week, and observations were conducted for three hours per day (one hour in the morning and two hours in the afternoon), with a two-week interval between phases. The experiment was scheduled during a relatively stable period of the semester, avoiding the adaptation period at the beginning of the semester, the high-pressure exam-preparation period at the end of the semester, and periods of intensive large-scale campus activities. Observations were conducted on workdays, avoiding peak pedestrian-flow periods before and after classes, weekends, and public holidays, so as to minimize pressure or fluctuations in work and rest caused by special schedules. During the

Bar chart showing the effects of normative information on stair-use behavior.

Y-axis: Proportion choosing the stairs (%), 0–50. Groups: Control group 32.96%; High-instruction group 32.29%; Conflict group 20.20%. Significance brackets: Control vs. High-instruction, ns; Control vs. Conflict, ;

High-instruction vs. Conflict, .

Figure 2: Bar chart showing the effects of normative information on stair-use behavior. Y-axis: Proportion choosing the stairs (%), 0–50. Groups: Control group 32.96%; High-instruction group 32.29%; Conflict group 20.20%. Significance brackets: Control vs. High-instruction, ns; Control vs. Conflict, ; ***High-instruction vs. Conflict, .***

experiment, trained observers recorded and coded participants' gender, whether they were accompanied by others, appearance (student vs. faculty/staff), and whether they had a reasonable reason to take the elevator (e.g., carrying heavy objects or boxes, an obvious leg injury, or pushing a stroller). To reduce observer effects, records were made at a corner near the staircase that was difficult for participants to notice (the experimental materials are shown in Appendix A1).

2.5 Experimental Results and Analysis

2.5.1 Chi-Square Test

The chi-square test showed that there were significant differences among the three groups in behavioral choice ($\chi^2(2) = 46.36$, $p < 0.001$, $\varphi = 0.13$). Bonferroni-corrected (corrected $\alpha = 0.017$) pairwise comparisons between groups showed (Figure 2) that the proportion choosing the stairs in the conflict group (20.20%) was significantly lower than that in the high-injunctive group (32.29%, $\chi^2(1) = 34.39$, $p < 0.001$, $\varphi = -0.14$) and the control group (32.96%, $\chi^2(1) = 39.67$, $p < 0.001$, $\varphi = -0.14$), whereas there was no significant difference between the high-injunctive group and the control group ($\chi^2(1) = 0.10$, $p = 0.748$). The above results indicate that norm conflict significantly reduced individuals' stair-use behavior, supporting H1.

Figure 2. Effect of normative information on stair-use behavior (Experiment 1)

Note: Black lines indicate mean $\pm$ standard error; *ns* indicates no statistical significance; * indicates $p < 0.05$, ** indicates $p < 0.01$, and *** indicates $p < 0.001$.

2.5.2 Regression analysis

To control for the effects of environmental and individual differences, a binary Logistic regression analysis was conducted (dependent variable: choosing the stairs = 1, choosing the elevator = 0). Correlation analyses showed that obser-

vation time (morning, afternoon), weather, gender, whether participants were accompanied, and appearance characteristics (teacher, student) were all significantly correlated with participants' stair-use behavior ($r_{\text{observation time}} = 0.06$, $p = 0.002$; $r_{\text{weather}} = 0.08$, $p < 0.001$; $r_{\text{gender}} = 0.14$, $p < 0.001$; $r_{\text{accompanied}} = -0.12$, $p < 0.001$; $r_{\text{appearance characteristics}} = 0.09$, $p < 0.001$). Therefore, the above covariates were included in the regression model. The results showed that the odds of choosing the stairs among participants in the conflict group were significantly lower than those in the control group ($OR = 0.56$, 95% CI [0.43, 0.72], $p < 0.001$) and the high-instruction group ($OR = 0.53$, 95% CI [0.42, 0.66], $p < 0.001$); H1 was again supported. ²

2.6 Summary

Experiment 1 tested the effect of normative conflict on energy-saving behavior through a field experiment. This large-sample field survey ($N = 2906$), compared with questionnaire measurement, more realistically captured overt behavior and reduced self-report bias. The results showed that, under the normative-conflict condition, the proportion of individuals choosing the stairs (20.20%) was significantly lower than under the no-conflict conditions (high-instruction group: 32.29%; control group: 32.96%), supporting the hypothesis that normative conflict inhibits energy-saving behavior (H1). However, Experiment 1 still had the following limitations. First, Experiment 1 did not measure mediating variables such as sense of responsibility and psychological reactance, making it difficult to reveal the internal pathways through which normative conflict inhibits behavior. Second, although Experiment 1 captured genuine energy-saving behavior with high ecological validity through field observation, its between-period implementation design objectively introduced a potential risk of temporal confounding. Although the experimental periods avoided academic-semester pressure points and peak traffic flows, and environmental variables such as weather and observation time were included as covariates in the regression model for robustness testing (with results remaining unchanged), fluctuations in campus activities or dynamic changes in the participant population across different weeks may still have interfered with the experimental results to some extent. Therefore, the exper-

² One week before the formal experiment, we conducted a two-day pre-observation and recorded participants' behavior data under natural conditions ($N = 386$ person-times). To assess the effect of the experimental situation itself relative to the natural state, these data were used as a baseline reference for comparative analysis. The results showed that the stair-use rate in the control group (32.96%) did not differ significantly from the baseline level (30.57%) ($\chi^2(1) = 0.74$, $p = 0.39$); whereas the normative-conflict group (20.20%) was significantly lower than the baseline level ($\chi^2(1) = 16.11$, $p < 0.001$, $\varphi = -0.11$). It should be noted that these observational data came from routine checks conducted before the implementation of the field experiment

to examine the site conditions, pedestrian flow, recording procedures, and to screen out potential confounding factors; they were not rigorously designed and collected as a formal baseline group. Therefore, they can only serve as preliminary, auxiliary evidence for assessing how the experimental intervention differed from the natural state.

Experiment 2 will adopt stricter randomized control. On the premise of excluding interference from physical-environment and temporal factors, it will manipulate individuals' perceived norm conflict regarding energy saving relative to a generalized reference group (e.g., ordinary citizens), examine its influence on energy saving, and further investigate the mediating mechanisms of responsibility and psychological reactance.

3 Experiment 2: Testing the Mediating Role of Responsibility and Psychological Reactance

3.1 Experimental Purpose

Experiment 2 further tests whether the mediating effects are established; that is, whether norm conflict reduces individuals' sense of responsibility (H2) and enhances psychological reactance (H3), thereby lowering their willingness to engage in low-carbon travel (Experiment 2 preregistration, AsPredicted #190408, <https://aspredicted.org/4vcn-m75x.pdf>).

3.2 Experimental Design and Participants

The experiment adopted a single-factor between-subjects design (control group vs. high injunctive-norm group vs. norm-conflict group), with willingness to engage in low-carbon travel as the dependent variable. The required sample size was estimated using G*Power 3.1. The results showed that, when the effect size was $f = 0.25$, a total of 159 participants would be needed to achieve statistical power of $\alpha = 0.05$ and Power = 0.80. After setting attention-check items and restrictions on respondents' location (minimum distance not less than 1 km), participants were recruited from the Credemo platform to take part in the experiment, yielding 225 valid samples (56.44% female; $M_{\text{age}} = 33.18$, $SD_{\text{age}} = 9.38$). Each participant received 2 yuan as compensation for the experiment.

3.3 Experimental Materials

As in Experiment 1, Experiment 2 used a percentage method to induce social-norm information. The control group was informed of travel-planning information and that they needed to choose low-carbon transportation such as driving or cycling. On the basis of the control-group materials, the high-injunctive-norm group additionally received survey information indicating that most citizens encourage and approve of cycling. The norm-conflict group further added, on the basis of the high-injunctive-norm group, survey information indicating that

most citizens in fact choose to drive (rather than cycle) (see Appendix A2 for the specific materials).

3.4 Experimental Procedure

First, participants were randomly assigned to groups and asked to carefully read the corresponding experimental materials. Next, they reported three items measuring willingness to engage in low-carbon travel (e.g., “The above scenario makes me want to use low-carbon transportation such as a bicycle” ; Beck & Toulouse, 2023; 1 = strongly disagree, 7 = strongly agree; $\alpha = 0.92$). They then answered two manipulation-check items concerning perceived social norms (He & Qian, 2023) and completed the psychological reactance and responsibility scales. Psychological reactance was measured with five items ($\alpha = 0.89$); representative items included “The above citizens’ survey information makes me feel that my freedom to choose my travel mode has been interfered with” and “I feel resistant to the citizens’ views or practices in the above survey information” (Dillard & Shen, 2005; Kang et al., 2021). Responsibility was measured with reference to Wu and Yang (2018) using four items ($\alpha = 0.82$); a representative item was “If choosing to drive leads to increased carbon emissions, I bear a certain responsibility.”

Finally, participants were asked to report control variables (climate-change skepticism, frequency of low-carbon travel, frequency of driving) and basic demographic information (including gender, age, education, major, occupational type, years of work experience, average monthly household income, number of cars owned by the household, whether they had a driver’s license, etc.). These variables were included as covariates in the subsequent analyses.

3.5 Experimental Results and Analysis

3.5.1 Manipulation Check Both the manipulation check and the pre-experimental results showed that the perceived injunctive norms and perceived descriptive norms of the different experimental groups differed significantly.

differences; see Appendix A2 for details.

3.5.2 Main-Effect Analysis of Low-Carbon Travel Intention

A one-way analysis of variance showed that different normative information conditions (1 = control, 2 = high directive, 3 = conflict) had a significant effect on low-carbon travel intention ($F(2, 210) = 28.03$, $p < 0.001$, $\eta_p^2 = 0.21$). Bonferroni post hoc tests indicated that the conflict group ($M = 4.40$, $SD = 1.71$) exhibited lower low-carbon travel intention than both the high-directive group ($M = 6.11$, $SD = 0.56$, 95% CI $[-1.74, -0.88]$, $p < 0.001$) and the control group ($M = 5.76$, $SD = 1.04$, 95% CI $[-1.38, -0.52]$, $p < 0.001$). This result is consistent with Experiment 1 and again supports H1.

3.5.3 Analysis of Between-Group Differences in Sense of Responsibility and Psychological Reactance

One-way analyses of variance were conducted separately with sense of responsibility and psychological reactance as dependent variables. The results showed significant differences across normative information groups in both sense of responsibility ($F(2, 210) = 8.29, p < 0.001, \eta_p^2 = 0.07$) and psychological reactance ($F(2, 210) = 21.89, p < 0.001, \eta_p^2 = 0.17$). Bonferroni post hoc tests revealed that, for sense of responsibility, the conflict group ($M = 4.92, SD = 1.50$) scored significantly lower than the high-directive group ($M = 5.84, SD = 0.57, 95\% CI [-0.98, -0.24], p < 0.001$) and the control group ($M = 5.70, SD = 0.83, 95\% CI [-0.83, -0.09], p = 0.009$). For psychological reactance, the conflict group ($M = 3.16, SD = 1.57$) scored significantly higher than the high-directive group ($M = 2.06, SD = 0.66, 95\% CI [0.68, 1.58], p < 0.001$) and the control group ($M = 2.18, SD = 0.87, 95\% CI [0.57, 1.46], p < 0.001$). These results provide preliminary support for H2 and H3, indicating that normative conflict reduces participants' sense of responsibility and increases their psychological reactance.

3.5.4 Mediation-Effect Test

Using normative information (0 = high-directive group, 1 = normative-conflict group) as the independent variable, low-carbon travel intention as the dependent variable, and sense of responsibility and psychological reactance as mediating variables, a mediation test was conducted (PROCESS v4.2, Model 4; 5000 samples; Hayes, 2022). The results showed (Figure 3) that, compared with the high-directive group, the normative-conflict group significantly reduced participants' sense of responsibility ($b = -0.59, SE = 0.17, p < 0.001, \beta = -0.49$) and increased their psychological reactance ($b = 1.16, SE = 0.21, p < 0.001, \beta = 0.88$). After including the independent variable and the two mediating variables, sense of responsibility positively predicted low-carbon travel intention ($b = 0.66, SE = 0.07, p < 0.001, \beta = 0.52$), whereas psychological reactance negatively predicted it ($b = -0.20, SE = 0.06, p = 0.001, \beta = -0.17$). Analysis of indirect effects showed that the indirect effects through sense of responsibility (*indirect effect* = $-0.39, 95\% CI [-0.62, -0.17]$) and psychological reactance (*indirect effect* = $-0.23, 95\% CI [-0.46, -0.07]$) were both significantly negative, and the standardized *indirect effects* were -0.25 and -0.15 , respectively. Meanwhile, after controlling for the mediating variables, the direct effect of normative information on low-carbon travel intention was also significant ($b = -0.64, SE = 0.16, p < 0.001, \beta = -0.42$). More detailed mediation results are provided in Appendix A2.

In addition, using normative information (0 = control group, 1 = conflict group) as the independent variable, the results remained unchanged: the indirect effects through psychological reactance (*indirect effect* = $-0.13, SE = 0.05, 95\% CI [-0.24, -0.04]$) and sense of responsibility (*indirect effect* = $-0.11, SE = 0.06, 95\% CI [-0.23, -0.01]$) did not include 0, indicating that both mediating effects were significant. These results further support H2 and H3, showing that when

Figure 3. Multiple-mediator test of responsibility and psychological reactance (Experiment 2)

Figure 3: Figure 3. Multiple-mediator test of responsibility and psychological reactance (Experiment 2)

participants face normative conflict, they experience greater psychological reactance and a lower sense of responsibility, thereby reducing their low-carbon travel intention.

Figure 3. Multiple-mediator test of responsibility and psychological reactance (Experiment 2)

Note: β denotes standardized coefficients; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Further, to examine the potential competing mediators of perceived hypocrisy (Stone et al., 1997) and anticipated guilt (Jacobson et al., 2021), we included both in the parallel mediation model in which responsibility and psychological reactance were situated (PROCESS v4.2, Model 4). Perceived hypocrisy was measured with three items ($\alpha = 0.93$); representative items included “I feel that most citizens are hypocritical when it comes to low-carbon travel” and “I doubt whether most citizens are truly sincere about low-carbon travel” (Barden et al., 2005). Anticipated guilt was measured with reference to Jacobson et al. (2021) and Onwezen et al. (2013) using three items (e.g., “If I choose to drive rather than travel in a low-carbon way, I will feel guilty,” $\alpha = 0.91$). The experimental results showed that norm conflict significantly increased participants’ perceived hypocrisy ($b = 1.87$, $SE = 0.25$, $p < 0.001$, $\beta = 1.11$) and significantly reduced anticipated guilt ($b = -0.64$, $SE = 0.23$, $p = 0.006$, $\beta = -0.42$), indicating that norm conflict simultaneously activated these two potential competing mediating variables, and that the directions of the effects were consistent with theoretical expectations. After the four mediating variables were simultaneously entered to predict willingness to travel in a low-carbon way, the path from perceived hypocrisy to willingness was not significant ($b = 0.02$, $SE = 0.06$, $p = 0.757$, $\beta = 0.02$); anticipated guilt was positively significant ($b = 0.16$, $SE = 0.07$, $p = 0.022$, $\beta = 0.16$). Meanwhile, the effects of responsibility ($b = 0.51$, $SE = 0.10$, $p < 0.001$, $\beta = 0.41$) and psychological reactance ($b = -0.24$, $SE = 0.07$, $p = 0.001$, $\beta = -0.20$) on willingness remained significant. Specifically, the indirect effects of perceived hypocrisy (*indirect effect* = 0.03, 95% CI = [-0.34, 0.33]) and anticipated guilt (*indirect effect* = -0.11, 95% CI = [-0.29, 0.01]) were both nonsignificant; whereas the indirect effects of responsibility (*indirect effect* = -0.30, 95% CI = [-0.52, -0.12]) and psychological reactance (*indirect effect* = -0.27, 95% CI = [-0.59, -0.02]) remained significantly negative.

3.6 Summary

Experiment 2 further tested the effect of norm conflict on individuals' energy-saving behavior and its potential mechanisms. The results showed that, compared with the condition without norm conflict (i.e., the high-command group and the control group), the norm-conflict group reduced individuals' sense of responsibility and elicited stronger psychological reactance; the two jointly led to a decrease in individuals' energy-saving behavior.

According to the classic mediation chain of NAT (De Groot & Steg, 2009), individuals' sense of responsibility for behavioral consequences must further activate their internal sense of moral obligation (i.e., personal norms), and the latter is the direct driver of pro-environmental behavior. This article focuses on the immediate, initial cognitive adjustment in responsibility and emotional reactance responses that individuals generate after exposure to norm-conflict information, rather than incorporating personal norms—a more downstream construct—into the research hypotheses. To examine the applicability of NAT in the special context of norm conflict, we further tested the chain of “norm conflict → responsibility/psychological reactance → personal norms → energy-saving behavior.”

mediation model (PROCESS v4.2, Model 80). Following Helferich et al. (2023) and Onwezen et al. (2013), personal norms were measured with three items (e.g., “I feel that I should choose low-carbon transportation such as bicycles” ; $\alpha = 0.89$). The results showed that the chain-mediating effect of responsibility was significant (*indirect effect* = -0.26 , 95% CI = $[-0.49, -0.08]$; standardized *indirect effect* = -0.17), whereas the simple mediating path from responsibility through personal norms was no longer significant (*indirect effect* = -0.13 , 95% CI = $[-0.32, 0.02]$). The simple mediating path from psychological reactance through personal norms remained significant (*indirect effect* = -0.26 , 95% CI = $[-0.48, -0.10]$), but its chain mediation was not significant (*indirect effect* = 0.03 , 95% CI = $[-0.02, 0.09]$).

The above results support NAT's theoretical proposition that knowledge of responsibility itself does not directly drive ultimate behavior. In contrast, psychological reactance bypasses the internalization stage of personal norms and directly affects energy-saving behavior.

In addition, Experiment 2 used a traditional mediation-effect test, which is insufficient to provide causal evidence that the mediating variables affect energy-saving behavior. Therefore, Experiment 3 adopted a manipulation-of-mediation-as-a-moderator (MMM) design, experimentally manipulating the mediating variables to verify whether they play a causal mediating role between norm conflict and energy-saving behavior.

4 Experiment 3: Causal Mediation Effect Analysis

4.1 Experimental Purpose

To overcome the causal-inference limitations of traditional mediation analysis (e.g., confounding variables and reverse causality), Experiment 3 used the mediation-variable moderation method (MMM design; Ge, 2023) to directly manipulate psychological reactance (Experiment 3a) and responsibility (Experiment 3b), testing their causal mediating roles in the process by which norm conflict influences energy-saving behavior.

4.2 Experimental Design and Participants

Experiment 3a used a 2 (norm information: high injunctive norm vs. norm conflict) $\times$ 2 (psychological reactance: baseline condition vs. enhancement condition) between-subjects design. Experiment 3b used a 2 (norm information: high injunctive norm vs. norm conflict) $\times$ 2 (responsibility: baseline condition vs. enhancement condition) between-subjects design. The dependent variable in both experiments was willingness to engage in low-carbon travel.³ According to G*Power estimates, the required sample size for each of the two experiments was at least 128 participants. Participants were recruited through the Credemo platform. Experiment 3a (63.00% female, $M_{\text{age}} = 33.07$, $SD_{\text{age}} = 10.76$) and Experiment 3b (59.50% female, $M_{\text{age}} = 32.57$, $SD_{\text{age}} = 10.94$) each obtained 200 valid questionnaires. Both experiments were preregistered before commencement (AsPredicted #241637, <https://aspredicted.org/hvm5-t9yk.pdf>).

4.3 Experimental Materials

Experiments 3a and 3b added manipulation information for psychological reactance and responsibility, respectively, on the basis of Experiment 2.

Manipulation wording for norm information (high injunctive norm, norm conflict): Same as Experiment 2.

Manipulation wording for psychological reactance: Dillard and Shen (2005) found that when stronger or more direct persuasive language is used in message delivery (e.g., “you must”), it increases individuals’ sense that their freedom is threatened, thereby eliciting stronger psychological reactance. Therefore, participants read the following information: “During the survey, some citizens even believed that they should not be able to choose to drive. They emphasized that, even if some people hold different views, in order to save energy and reduce emissions, everyone needs to choose low-carbon transportation such as bicycles.”

Manipulation wording for responsibility: Following Wu and Yang (2018), responsibility was enhanced by strengthening individuals’ cognition of the association between their own behavior and environmental harm. “As a member of society, we have a responsibility to contribute to environmental protection. Our daily behav—

³ Considering that an injunctive norm is more policy-relevant than a no-norm control group in energy-saving practice operations, subsequent experiments used the high-injunctive-norm condition as the baseline condition.

will have an impact on the environment. For example, driving increases carbon emissions and exacerbates climate change, whereas choosing low-carbon modes of travel not only reduces carbon emissions but also reflects our commitment to environmental protection.”

Baseline-condition statement: “The purpose of this trip is to reach the park and engage in leisure activities. Whether you choose to drive or ride a bicycle, you can arrive at the destination smoothly, and there is no significant difference between the two travel modes in terms of time.”

4.4 Experimental Procedure

Participants were first randomly assigned to one of four experimental conditions and read the corresponding manipulation materials. Next, they completed the low-carbon travel intention items. In Experiments 3a and 3b, the reliability of the intention scale was $\alpha = 0.87$ and $\alpha = 0.70$, respectively. Participants then completed the manipulation-check items and the psychological reactance scale ($\alpha = 0.89$) and responsibility scale ($\alpha = 0.72$). Finally, they completed items on control variables and demographic information. The measures for the above scales and items were the same as in Experiment 2.

4.5 Experimental Results and Analysis

According to the principles of MMM design (Ge, 2023), the establishment of a mediation effect must satisfy three conditions: (1) the mediator manipulation is effective; that is, there are significant differences in the measured psychological reactance and responsibility (measured variable M) between the manipulated-enhancement group and the unmanipulated baseline group; (2) in the baseline group of the unmanipulated mediator variable, norm conflict must significantly influence the measured variable M; and (3) norm conflict (X) and the manipulated mediator variable—psychological reactance/responsibility (manipulated M)—must have an interaction effect on energy-saving behavior (Y).

4.5.1 Mediator-Variable Manipulation Check (Condition 1)

Independent-samples t tests showed that the psychological-reactance enhancement group scored significantly higher than the baseline group ($M = 2.80$, $SD = 1.35$ vs. $M = 2.33$, $SD = 1.02$; $t(198) = 2.79$, $p = 0.006$). The responsibility enhancement group also scored significantly higher than the baseline group ($M = 5.66$, $SD = 0.68$) than the baseline group ($M = 5.34$, $SD = 0.92$; $t(198) = 2.80$, $p = 0.006$), indicating that both manipulations were effective.

4.5.2 Analysis of the Effect of Norm Conflict on Psychological Reactance and Responsibility (Condition 2) Independent-samples t tests showed that, in the baseline condition, norm conflict significantly positively predicted the level of psychological reactance and, at the same time, significantly negatively predicted the level of responsibility, satisfying the second condition for establishing a mediation effect (Table 2).

Table 2. Effects of Norm Conflict on Mediating Variables Under the Baseline Condition

Dependent variable	Group	M	SD	t value	p value
Psychological reactance	High-injunction group	1.97	0.77	-3.69	<0.001
Psychological reactance	Norm-conflict group	2.68	1.13	-3.69	<0.001
Responsibility	High-injunction group	5.52	0.74	2.05	0.044
Responsibility	Norm-conflict group	5.15	1.04	2.05	0.044

4.5.3 Interaction-Effect Test (Condition 3) First, with low-carbon travel intention as the dependent variable, a 2 (norm information) $\times$ 2 (psychological reactance) two-factor analysis of variance was conducted. The results showed that the main effect of norm information was significant ($F(1, 196) = 6.49$, $p = 0.012$, $\eta_p^2 = 0.03$), the main effect of psychological reactance was not significant ($F(1, 196) = 0.62$, $p = 0.431$), and the interaction between the two was significant ($F(1, 196) = 4.59$, $p = 0.033$, $\eta_p^2 = 0.02$). Simple-effects analysis found (Table 3) that, under the psychological-reactance baseline condition, low-carbon travel intention in the norm-conflict group was significantly lower than that in the high-injunction group, whereas under the enhancement condition the difference between the two groups was not significant. This indicates that intervening in the state of the mediating variable through experimental means blocked the path by which the independent variable acted on the dependent variable through the mediating variable, thereby significantly weakening the negative effect of norm conflict on individual energy saving under the enhancement condition.

Next, with low-carbon travel intention as the dependent variable, a 2 (norm information) $\times$ 2 (responsibility) two-factor analysis of variance was conducted, and the results showed...

...descriptive norm information ($F(1, 196) = 8.79, p = 0.003, \eta_p^2 = 0.04$) and sense of responsibility both had significant main effects ($F(1, 196) = 9.68, p = 0.002, \eta_p^2 = 0.05$), and their interaction was also significant ($F(1, 196) = 4.99, p = 0.027, \eta_p^2 = 0.03$). Further simple-effects analyses found (Table 3) that under the baseline-responsibility condition, the low-carbon travel intention of the norm-conflict group was significantly lower than that of the high-injunction group. Under the responsibility-enhancement condition, however, this negative effect disappeared, and the difference between the two groups was not significant. In sum, the interaction effects of norm information with psychological reactance and sense of responsibility were both significant, satisfying the third condition for establishing a mediation effect.

Table 3 Simple-Effects Analysis of the Effects of Norm Information × Sense of Responsibility/Psychological Reactance on Low-Carbon Travel Intention

Mediating- variable condi- tion	Norm group	<i>M</i>	<i>SD</i>	<i>F</i> (1,196)	<i>p</i> value	η_p^2
Psychological reactance base- line	High injunction	6.23	0.53	10.99	0.001	0.05
Psychological reactance base- line	Norm conflict	5.53	1.35	10.99	0.001	0.05
Psychological reactance en- hance- ment	High injunction	5.79	1.00	0.08	0.774	-
Psychological reactance en- hance- ment	Norm conflict	5.73	1.13	0.08	0.774	-
Responsibility base- line	High injunction	5.95	0.64	13.51	<0.001	0.06

Mediating- variable condi- tion	Norm group	<i>M</i>	<i>SD</i>	<i>F</i> (1,196)	<i>p</i> value	η_p^2
Responsibility base- line	Norm con- flict	5.48	0.88	13.51	<0.001	0.06
Responsibility en- hance- ment	High injunc- tion	6.03	0.38	0.27	0.605	-
Responsibility en- hance- ment	Norm con- flict	5.97	0.58	0.27	0.605	-

4.6 Summary

Experiment 3 used an MMM design, remedying the limitation in Experiment 2 that the causal effect of the M→Y path in the mediation analysis was unclear, and further supported the parallel mediating pathways of sense of responsibility and psychological reactance. On this basis, Experiment 4 will introduce goal self-efficacy as a moderating variable to further examine the boundary conditions under which norm conflict affects individuals' energy-saving behavior and its intervention mechanism.

5 Experiment 4: The Moderating Effect of Goal Self-Efficacy

5.1 Experimental Purpose

Experiment 4 aimed to test whether goal self-efficacy plays a moderating role in the mediating process through which norm conflict influences individuals' energy-saving behavior via sense of responsibility and psychological reactance (AsPredicted #190420, <https://aspredicted.org/hnmt-qwc3.pdf>).

5.2 Experimental Design and Participants

The experiment adopted a 2 (norm information: high injunctive norm vs. norm conflict) × 2 (goal self-efficacy: high vs. low) between-subjects design. The dependent variable was participants' energy-saving intention in a post-meal takeout-packing scenario. G*Power 3.1 estimated a minimum sample size of 128 participants. After setting attention-check items and restrictions on respondents' locations, participants were recruited from the Credemo platform to take part in the experiment, yielding 300 valid samples (56.30% female, $M_{\text{age}} = 31.56$, $SD_{\text{age}} = 8.78$). Participants received 2 yuan as compensation.

5.3 Experimental Materials

Norm-information manipulation statements: Following the norm-manipulation paradigm (proportion method) validated in Experiments 1-3, it was applied to the post-meal takeout-packing scenario. In the high-injunctive-norm condition, participants saw the information that “street-survey results show that most people approve of packing unfinished food.” In the norm-conflict condition, participants saw the information that “street-survey results show that most people approve of packing unfinished food, but in practice very few do so.”

Goal self-efficacy manipulation statements: Referring to Hamann and Reese (2020), goal self-efficacy was manipulated by emphasizing the direct improvement of the environment brought about by an individual’s packing behavior, as well as its demonstrative effect on others (specific materials are provided in Appendix A4).

5.4 Experimental Procedure

The experiment used a post-meal takeout-packing situation. After participants were randomly assigned to groups and read the norm and efficacy manipulation materials, they first reported three items concerning their intention to pack leftover food after a meal, such as “The above scenario makes me want to pack unfinished food” (Beck & Toulouse,

2023; $\alpha = 0.81$). Second, participants completed the manipulation-check items; the norm-conflict perception items were the same as in Experiment 2, and goal efficacy included three items (e.g., “My food-packaging behavior will achieve the expected environmental-improvement effect” ; Carroll & Kachersky, 2019; $\alpha = 0.91$). Next, participants completed the psychological reactance ($\alpha = 0.88$) and responsibility scales ($\alpha = 0.84$), with measurement items identical to those in Experiment 2. Finally, they reported the control variables (climate-change skepticism, dining frequency, takeaway frequency) and demographic information.

5.5 Experimental Results and Analysis

5.5.1 Manipulation Check The results of independent-samples t tests showed that the manipulations of norm-conflict information and goal efficacy in Experiment 4 were both effective; see Appendix A4 for details.

5.5.2 Test of the Moderating Effect The results of a 2×2 ANOVA with post-meal takeaway-packaging intention as the dependent variable (including the control variables as covariates) indicated that the main effect of goal efficacy was significant ($F(1, 293) = 15.06, p < 0.001, \eta_p^2 = 0.05$), the main effect of normative information was not significant ($F(1, 293) = 1.59, p = 0.208$), and their interaction was significant ($F(1, 293) = 10.81, p = 0.001, \eta_p^2 = 0.04$). Simple-effects analyses found that under the low-efficacy condition, post-meal takeaway-

packaging intention in the norm-conflict group ($M = 5.44$, $SD = 1.18$) was significantly lower than that in the high-injunction group ($M = 5.83$, $SD = 0.72$; $F(1, 293) = 10.44$, $p = 0.001$, $\eta_p^2 = 0.03$). Under the high-efficacy condition, there was no significant difference in post-meal takeaway-packaging intention between the two groups ($M_{\text{high-injunction group}} = 5.95$, $SD_{\text{high-injunction group}} = 0.81$; $M_{\text{conflict group}} = 6.01$, $SD_{\text{conflict group}} = 0.56$; $F(1, 293) = 2.03$, $p = 0.155$). These results support H4, indicating that high goal efficacy significantly attenuates the negative effect of norm conflict on energy-saving intention.

Further analyses examined how goal efficacy moderated the effects of norm-conflict information on the two types of mediating variables. First, a 2×2 ANOVA with responsibility as the dependent variable showed that the main effect of goal efficacy was significant ($F(1, 293) = 19.56$, $p < 0.001$, $\eta_p^2 = 0.06$), the main effect of normative information was not significant ($F(1, 293) = 0.68$, $p = 0.412$), and their interaction was significant ($F(1, 293) = 14.57$, $p < 0.001$, $\eta_p^2 = 0.05$). Simple-effects analyses found that under the low-efficacy condition, norm conflict negatively affected responsibility ($M_{\text{high-injunction group}} = 5.65$, $SD_{\text{high-injunction group}} = 0.78$; $M_{\text{conflict group}} = 5.22$, $SD_{\text{conflict group}} = 1.28$; $F(1, 293) = 10.85$, $p = 0.001$, $\eta_p^2 = 0.04$), whereas under the high-efficacy condition this effect became significantly positive ($M_{\text{high-injunction group}} = 5.79$, $SD_{\text{high-injunction group}} = 0.78$; $M_{\text{conflict group}} = 5.91$, $SD_{\text{conflict group}} = 0.74$; $F(1, 293) = 4.44$, $p = 0.036$, $\eta_p^2 = 0.02$). Second, a 2×2 ANOVA with psychological reactance as the dependent variable showed that the main effect of normative information was significant ($F(1, 293) = 5.64$, $p = 0.018$, $\eta_p^2 = 0.02$), and the main effect of efficacy was also significant ($F(1, 293) = 9.33$, $p = 0.002$, $\eta_p^2 = 0.03$), but the interaction was not significant ($F(1, 293) = 0.71$, $p = 0.40$). These results provide preliminary support for H5a but not for H5b, indicating that the moderating effect of goal efficacy is mainly manifested in reversing the negative effect of norm conflict on responsibility.

5.5.3 Moderated Mediation Effect Using post-meal takeaway-packaging intention as the dependent variable, normative information as the independent variable, goal efficacy as the moderator, and psychological reactance and responsibility as parallel mediators, a moderated mediation test was conducted (PROCESS v4.2, Model 8, Bootstrap 5000; Hayes, 2022), with the control variables included in the model as covariates. As shown in Figure 4, goal efficacy effectively intervened in the negative effect of norm conflict on energy-saving intention, and this moderating effect showed significant path differences.

Responsibility pathway. The moderated mediation effect of responsibility was significant ($index = 0.32$, 95% CI = [0.13, 0.56]). Specifically,

Norm conflict and goal efficacy interacted to influence perceived responsibility ($b = 0.73$, $SE = 0.19$, $p < 0.001$), and the conditional-effect results showed that goal efficacy significantly buffered the negative impact of norm conflict on perceived responsibility: under the low-efficacy condition, norm conflict significantly reduced perceived responsibility ($b = -0.44$, $SE = 0.13$, $p = 0.001$),

whereas under the high-efficacy condition, this effect became significantly positive ($b = 0.29$, $SE = 0.14$, $p = 0.036$). Combined with the significant positive effect of perceived responsibility on energy-saving intention ($b = 0.44$, $SE = 0.05$, $p < 0.001$), the conditional indirect effect of perceived responsibility was significantly negative under low efficacy (*indirect effect* = -0.20 , $BootSE = 0.09$, 95% CI = $[-0.38, -0.05]$), but became significantly positive under high efficacy (*indirect effect* = 0.13 , $BootSE = 0.05$, 95% CI = $[0.04, 0.24]$). This indicates that goal efficacy significantly changed the direction of the responsibility-mediated pathway: among individuals with low goal efficacy, perceived responsibility was weakened when they faced norm conflict, thereby reducing intention to take away leftovers; among individuals with high goal efficacy, perceived responsibility instead increased when they faced norm conflict, thereby promoting intention to take away leftovers. These results support H5a.

Psychological-resistance pathway. The interaction between norm conflict and goal efficacy did not significantly affect psychological resistance ($b = -0.19$, $SE = 0.22$, $p = 0.40$), and the moderated mediation effect of psychological resistance was also not significant (*index* = 0.03 , 95% CI = $[-0.04, 0.14]$), failing to support H5b. However, the conditional effects showed a differentiation trend consistent with the hypothesis: norm conflict significantly increased psychological resistance under the low-efficacy condition ($b = 0.36$, $SE = 0.16$, $p = 0.023$), whereas under the high-efficacy condition, this effect was not significant ($b = 0.17$, $SE = 0.16$, $p = 0.282$). Combined with the significant negative effect of psychological resistance on energy-saving intention ($b = -0.18$, $SE = 0.04$, $p < 0.001$), the conditional indirect effect of psychological resistance was significantly negative under low efficacy (*indirect effect* = -0.07 , $BootSE = 0.04$, 95% CI = $[-0.17, -0.004]$), but was not significant under high efficacy (*indirect effect* = -0.03 , $BootSE = 0.03$, 95% CI = $[-0.09, 0.01]$). These results indicate that the moderation of the psychological-resistance pathway by goal efficacy was directionally consistent with the prediction of H5b, but its effect did not reach the level of statistical significance.

Finally, after incorporating the pathways of perceived responsibility and psychological resistance, the direct effect of the interaction term between normative information and goal efficacy on intention to take away leftovers was not significant ($b = 0.24$, $SE = 0.15$, $p = 0.117$). Correspondingly, the conditional direct effect of norm conflict on intention to take away leftovers was nonsignificant under both low-efficacy ($b = -0.15$, $SE = 0.11$, $p = 0.159$) and high-efficacy ($b = 0.09$, $SE = 0.11$, $p = 0.409$) conditions. Together with the moderated mediation effect of perceived responsibility described above, as well as the significant overall interaction effect of normative information $\times$ goal efficacy on intention to take away leftovers ($F(1, 293) = 10.81$, $p = 0.001$, $\eta_p^2 = 0.04$), this nonsignificant result for the direct interaction term indicates that the moderating effect of goal efficacy on the relationship between norm conflict and intention to take away leftovers does not operate directly on behavioral intention, but is instead realized through the mediating mechanism of reshaping individuals' perceived responsibility; moreover, as goal efficacy increases, the mediating effect

Figure 4. Moderated mediation (Experiment 4)

Figure 4: Figure 4. Moderated mediation (Experiment 4)

of perceived responsibility reverses from negative to positive.

Figure 4. Moderated mediation (Experiment 4)

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. The path coefficient reported in the figure for normative information $\times$ goal efficacy predicting willingness to take away leftovers after dining is the conditional direct effect after controlling for responsibility and psychological reactance, rather than the overall interaction effect tested in H4.

Further, personal norms were incorporated into the model to test the moderated chain mediation effect (PROCESS v4.2, Model 83). The results showed that the moderated chain mediation effect through responsibility was significant (*indirect effect* = 0.22, 95% CI = [0.09, 0.41]); moreover, under the low-efficacy condition, the chain mediation of normative information $\rightarrow$ responsibility $\rightarrow$ personal norms $\rightarrow$ willingness to take away leftovers after dining was significantly negative (*indirect effect* = -0.13, 95% CI = [-0.28, -0.04]), whereas under the high-efficacy condition it was significantly positive (*indirect effect* = 0.09, 95% CI = [0.02, 0.17]). These results further supported the NAT theoretical view that normative information drives behavior by sequentially activating responsibility and personal norms.

5.6 Summary

Experiment 4 constructed a post-meal takeout scenario and tested the moderating mechanism by which goal efficacy influences the effect of norm conflict on energy-saving intention. The results showed that the overall moderating effect of goal efficacy was significant, and that this effect mainly stemmed from the significant moderation of the mediating path through responsibility: among individuals with low goal efficacy, responsibility decreased significantly in the norm-conflict condition, whereas high goal efficacy reversed this negative effect. By contrast, the moderated mediation effect of goal efficacy on the psychological-reactance pathway was not significant. This result is consistent with NAT's view that responsibility is an important factor in norm activation, and it also corresponds to the finding proposed by Hamann and Reese (2020) that goal efficacy has a key predictive role in environmental behavior.

Integrating the results of Experiments 1 through 4, this paper has systematically tested the causal pathways and boundary conditions through which norm conflict affects energy conservation. Because Experiment 4 used self-report questionnaire measures, its inferences about actual behavior are limited. Therefore, Experiment 5 continued the field-experiment paradigm of Experiment 1 and further introduced a high goal-efficacy manipulation on the basis of norm conflict, examining whether it could buffer the negative impact of norm conflict.

6 Experiment 5: The Buffering Effect of Goal Efficacy on the Negative Impact of Norm Conflict (Field Experiment)

6.1 Experimental Purpose

Experiment 5 aimed to provide field-experimental evidence for H4, namely, whether high goal-efficacy information can attenuate the negative effect of norm conflict on individuals' actual energy-saving behavior.

6.2 Experimental Materials and Procedure

Experiment 5 followed the real campus elevator setting used in Experiment 1, with elevator-use behavior as the dependent variable. Building on the norm-conflict condition in Experiment 1, a “norm conflict + high efficacy” poster was added (Appendix A5): in addition to norm-conflict information, it also emphasized the direct efficacy of individual behavior for environmental improvement (Hamann & Reese, 2020): “Your energy-saving behavior is very important for the environment. Taking the stairs can directly reduce carbon emissions and make an important contribution to energy conservation and emission reduction. Regardless of what others do, your actions are producing real impacts!” To ensure consistency of the experimental conditions (time, location, and environment), the experimental operations (e.g., observation periods, coding rules, and records of control variables) were all the same as in Experiment 1.

6.3 Participants

A total of 812 person-times were collected in the norm conflict + high goal-efficacy condition. After excluding 15 cases in which the elevator was used for legitimate reasons, 797 valid person-times remained. For comparison, data from the norm-conflict condition in Experiment 1 were used as the control.

6.4 Experimental Results and Analysis

The chi-square test showed that the elevator-use rate in the norm conflict + high goal-efficacy condition reached 36.76%, and its effect was significantly higher than that in the norm-conflict condition (20.20%, $\chi^2(1) = 56.83$, $p < 0.001$, $\varphi = 0.18$). Thus, goal efficacy can significantly increase individuals' elevator-use behavior under norm-conflict situations. Furthermore, to control for the effects of environmental and individual differences, weather, gender, presence of companions, appearance characteristics, and other factors significantly related to elevator use were included as covariates in a Logistic regression model. The results showed that, compared with the norm-conflict condition, the odds of participants choosing the elevator in the norm conflict + high efficacy condition increased significantly ($OR = 2.09$, 95%CI [1.63, 2.68], $p < 0.001$). This result is consistent with Experiment 4 and further supports the view that goal efficacy alleviates the negative influence of norm conflict.

6.5 Summary

Experiment 1 found that the elevator-use rate in the norm-conflict condition (20.20%) was significantly lower than that in the high-injunctive condition (32.29%) and the control condition (32.96%), verifying the inhibitory effect of norm conflict on energy-saving behavior. On this basis, Experiment 5 further introduced high goal-efficacy information and found that the elevator-use rate in the norm conflict + high goal-efficacy condition was the highest among all experimental conditions (36.76%); moreover, its effect was not only significantly higher than that in the norm-conflict condition, but also higher than the baseline level in the pre-observation data of Experiment 1 (30.57%, $\chi^2(1) = 4.40$, $p = 0.036$, $\varphi = 0.06$), and even better than the condition in which only high injunctive-norm information was provided ($\chi^2(1) = 3.86$, $p = 0.049$). This result indicates that adding high goal-efficacy information in a norm-conflict situation can effectively alleviate, or even reverse, its negative impact on energy-saving behavior.

It should be noted that Experiment 5 reused the data from Experiment 1 as the control. Although both experiments were conducted during semesters with relatively few campus activities and stable academic pressure levels (September–October and November, respectively), and although Experiment 5 strictly replicated the observation locations, time periods, coding rules, and observer procedures of Experiment 1, the time interval of several months may still have introduced complex factors that could not be fully controlled, such as the unobserved historical effects of the academic calendar and campus atmosphere. Therefore, Experiment 5 is a preliminary, exploratory field proof. It suggests that, in real-world settings, goal-efficacy information that strengthens the value of behavioral contribution has the potential to alleviate the negative influence of norm conflict, but its effectiveness still needs to be further verified in contemporaneous randomized field designs.

7 General Discussion

7.1 Summary of the Research

Based on five experiments, this paper examined the effects of norm conflict on individuals' energy-saving behavior, as well as its internal mechanisms and boundary conditions, and reached the following conclusions. First, norm conflict significantly reduced individuals' energy-saving intentions and actual behavior. This conclusion was cross-validated across multiple energy-saving scenarios, including stair use, low-carbon travel, and taking away leftovers after dining, and is consistent with Keizer et al.'s (2008) finding that norm conflict—compared with high injunctive norms—significantly increased participants' littering behavior. Second, the mediation analyses showed that norm conflict indirectly affected energy-saving behavior by reducing individuals' sense of responsibility and eliciting psychological reactance. On this basis, this paper found that

goal efficacy significantly moderated the mediating pathway through sense of responsibility, whereas its moderation of the psychological-reactance mediation was not significant.

7.2 Theoretical Contributions

First, this paper extends NAT to the context of norm conflict. Existing research, much of it based on norm focus theory, holds that individuals are more likely to follow descriptive norms in situations of norm conflict, and emphasizes that the influence of descriptive norms on behavior is mainly direct and unconscious, whereas injunctive norms operate more through social pressure and emotional rewards (Cialdini et al., 1990; Huber et al., 2020). However, this theoretical perspective focuses more on judging effects at the behavioral level and reveals relatively little about the internal mechanisms through which individuals perceive normative information, trigger cognitive responses, and transform these responses into behavioral intentions in conflict situations; in particular, it neglects how norm conflict reshapes responsibility cognition and emotional experience. In addition, existing research on norm conflict involves energy-saving behavior only rarely, and is often limited to a single scenario—such as turning off lights (Leoniak & Cwalina, 2019)—or to self-reported data (Smith et al., 2012), lacking systematic tests across diverse behavioral types and ecological contexts. To address these gaps, this paper uses NAT to clarify the parallel psychological pathways through which external norms must pass when internalized into individual behavior. One is the mainstream cognitive-attribution pathway centered on sense of responsibility, that is, the chain process of “consequence awareness/responsibility—personal norm—behavior” (De Groot & Steg, 2009; Han & Cudjoe, 2020). The other is the emotion-driven pathway proposed by some studies, in which compliant emotions such as guilt and shame play a key role in norm adherence (Han, 2014; Onwezen et al., 2013). Further, this paper proposes that, in situations of norm conflict, both of these pathways are distorted: the responsibility-attribution pathway is impeded because collective inaction and expected guilt are reduced, manifesting as a weakening of responsibility; the emotional-arousal pathway, by contrast, undergoes a directional reversal because of perceived threats to freedom and a sense of moral hypocrisy, whereby compliant guilt is alienated into resistant reactance. Accordingly, this paper identifies and reveals sense of responsibility and psychological reactance as two core mediating pathways through which norm conflict inhibits energy-saving behavior.

Second, this paper innovatively identifies goal efficacy as a boundary condition for the influence of norm conflict on energy saving. Most previous studies have examined the negative effects of norm conflict (Smith et al., 2012), but have rarely explored its moderating mechanisms. At the same time, research on goal efficacy has focused on its direct effects, such as how enhancing individuals' goal efficacy can strengthen their pro-environmental intentions and actual behavior (Han et al., 2016; Hamann & Reese, 2020). By comparison, this paper finds that

high goal efficacy can buffer the influence of norm conflict on the responsibility pathway—but not the psychological-reactance pathway—allowing individuals to maintain relatively high responsibility awareness and behavioral motivation even under circumstances of an energy-saving knowledge-action gap. This finding provides useful insights for constructing behavioral intervention models oriented toward norm conflict.

7.3 Practical Implications

This study is expected to provide the following insights for the design of energy-saving policies, individual behavioral interventions, and the shaping of public opinion. First, the formulation of energy-saving policies should attach importance to the consistency between injunctive and descriptive norms, so as to avoid triggering norm conflict in publicity. Against the short-term undesirable backdrop of social action, energy-saving publicity should avoid statically presenting the low-descriptive-norm situation that “most people have not yet acted.” Instead, it should highlight high injunctive norms, or shift toward emphasizing trend information about dynamic improvement, making the direction of behavioral change and progress salient.

Second, goal efficacy is the key to breaking the predicament of the energy-saving knowledge-action gap. This study finds that when individuals believe their behavior is meaningful...

when it is possible to change the outcome, they can still maintain a high level of responsibility in the face of norm-conflict information. Therefore, in energy-saving behavior interventions, individuals' goal self-efficacy should be strengthened through concrete examples and quantifiable goals. For instance, policy-makers may present the visible effects of individual behavior by stating that “saving 1 kWh of electricity can reduce emissions by approximately X grams of carbon,” or stimulate goal self-efficacy by emphasizing that one's actions are driving the green role-model effect of others.

Finally, attention should be paid to the potential risks of psychological reactance and to pathways for mitigating it. The study found that individuals are more likely to experience psychological reactance when facing norm conflict, and that this reactance still exists among individuals with high efficacy. This finding echoes and explains behavioral rebound in energy-saving practice. For example, individuals with high goal self-efficacy (such as public figures) are often able to maintain a sense of pro-environmental responsibility in norm-conflict contexts involving inconsistency between words and deeds. However, when confronted with public opinion's “moral abduction” or with others who “say one thing and do another,” they also often display strong dissatisfaction and reactance. Therefore, norm-advocacy language should remain friendly, inspiring, and choice-oriented, and avoid moralistic appeals that put one on a pedestal or pressure-laden expressions such as “you must” and “everyone should.” At the same time, community participation mechanisms—such as energy-saving point

exchanges and volunteer actions—can be integrated to transform energy saving from an obligation into an honor and an autonomous choice, thereby reducing the negative impact brought about by reactance.

7.4 Research Limitations and Prospects

This study constructed a relatively systematic theoretical model and verified its effects and mechanisms through multiple experiments, but it still has the following limitations and areas for extension. First, it did not capture the evolution and fluctuation trends of energy-saving behavior over the time dimension. Prior research, such as Nolan et al. (2008), found that the influence of descriptive normative information on residents' energy-saving behavior remains effective over a relatively long period. Therefore, future research may consider adopting longitudinal designs to gain a deeper understanding of the long-term impact of norm conflict on energy-saving behavior. Second, H5b proposed that goal self-efficacy can moderate the indirect effect of norm conflict on energy-saving behavior through psychological reactance, but the results of Experiment 4 failed to support this hypothesis. Although the results of the conditional indirect effect analysis were consistent with theoretical expectations—namely, the negative indirect effect of psychological reactance was significant under the low-efficacy condition and no longer significant under the high-efficacy condition—the overall moderated mediation index did not reach a significant level. In this regard, one speculative explanation is that the responsibility pathway involves cognitively adjustable processes such as outcome cognition and responsibility attribution, whereas psychological reactance is rooted in perceived threats to freedom and negative moral evaluation, and has stronger defensive and automatic characteristics. Goal self-efficacy, as a cognitive belief about behavioral effectiveness, may be better at intervening in cognitive appraisal processes, but its intervention effect on defensive emotional responses is limited. Therefore, merely improving individuals' perception of behavioral effectiveness is not sufficient to stably weaken the psychological reactance triggered by norm conflict. Based on this, future research may explore combining efficacy information with strategies such as reducing the sense of coercion and enhancing communication sincerity, and test their joint intervention effects on the psychological-reactance pathway.

References

- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215.
- Barden, J., Rucker, D. D., & Petty, R. E. (2005). "Saying one thing and doing another" : Examining the impact of event order on hypocrisy judgments of others. *Personality and Social Psychology Bulletin*, 31(11), 1463-1474.
- Basil, D. Z., Ridgway, N. M., & Basil, M. D. (2008). Guilt and giving: A process model of empathy and efficacy. *Psychology & Marketing*, 25(1), 1-23.
- Beck, M., & Toulouse, N. Ö. (2023). Assessing the impact of energy labels

on attitude and behavioral intention: An empirical investigation. *Journal of Cleaner Production*, 415, 137751.

Bergquist, M., & Nilsson, A. (2016). I saw the sign: Promoting energy conservation via normative prompts. *Journal of Environmental Psychology*, 46, 23–31.

Bhanot, S. P. (2021). Isolating the effect of injunctive norms on conservation behavior: New evidence from a field experiment in California. *Organizational Behavior and Human Decision Processes*, 163, 30–42.

Bonan, J., Cattaneo, C., d'Adda, G., & Tavoni, M. (2020). The interaction of descriptive and injunctive social norms in promoting energy conservation. *Nature Energy*, 5(11), 900–909.

Brehm, J. W., & Cole, A. H. (1966). Effect of a favor which reduces freedom. *Journal of Personality and Social Psychology*, 3(4), 420–426.

Carroll, R., & Kachersky, L. (2019). Service fundraising and the role of perceived donation efficacy in individual charitable giving. *Journal of Business Research*, 99, 254–263.

Chen, S. J., Pu, X. L., Zhu, Y., Wang, H., & Liu, J. W. (2021). The impact of normative misperception on food waste in dining out: Mechanism analyses and countermeasures. *Acta Psychologica Sinica*, 53(8), 904–918.

[Chen Sijing, Pu Xueli, Zhu Yue, Wang Hao, Liu Jianwei. (2021). The impact of normative misperception on food waste in dining out: psychological mechanisms and countermeasures. *Acta Psychologica Sinica*, 53(8), 904–918.]

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science*, 12(4), 105–109.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, 58(6), 1015–1026.

De Groot, J. I. M., & Steg, L. (2009). Morality and prosocial behavior: The role of awareness, responsibility, and norms in the norm activation model. *Journal of Social Psychology*, 149(4), 425–449.

Dillard, J. P., & Shen, L. (2005). On the nature of reactance and its role in persuasive health communication. *Communication Monographs*, 72(2), 144–168.

DiRusso, C., & Myrick, J. G. (2021). Sustainability in CSR messages on social media: How emotional framing and efficacy affect emotional response, memory and persuasion. *Environmental Communication*, 15(8), 1045–1060.

Elsamen, A. A., Fotiadis, A., Alalwan, A. A., & Huan, T. C. (2025). Enhancing pro-environmental behavior in tourism: Integrating attitudinal factors and norm activation theory. *Tourism Management*, 109, 105155.

- Feldman, L., & Hart, P. S. (2016). Using political efficacy messages to increase climate activism: The mediating role of emotions. *Science Communication*, 38(1), 99-127.
- Ge, X. (2023). Experimentally manipulating mediating processes: Why and how to examine mediation using statistical moderation analyses. *Journal of Experimental Social Psychology*, 109, 104507.
- Habib, R., White, K., & Hoegg, J. (2021). Everybody thinks we should but nobody does: How combined injunctive and descriptive norms motivate organ donor registration. *Journal of Consumer Psychology*, 31(3), 621-630.
- Hamann, K. R. S., & Reese, G. (2020). My influence on the world (of others): Goal efficacy beliefs and efficacy affect predict private, public, and activist pro-environmental behavior. *Journal of Social Issues*, 76(1), 35-53.
- Hamann, K. R. S., Reese, G., Seewald, D., & Loeschinger, D. C. (2015). Affixing the theory of normative conduct (to your mailbox): Injunctive and descriptive norms as predictors of anti-ads sticker use. *Journal of Environmental Psychology*, 44, 1-9.
- Han, H. (2014). The norm activation model and theory-broadening: Individuals' decision-making on environmentally-responsible convention attendance. *Journal of Environmental Psychology*, 40, 462-471.
- Han, M. S., & Cudjoe, D. (2020). Determinants of energy-saving behavior of urban residents: Evidence from Myanmar. *Energy Policy*, 140, 111405.
- Han, D., Duhachek, A., & Agrawal, N. (2016). Coping and construal level matching drives health message effectiveness via response efficacy or self-efficacy enhancement. *Journal of Consumer Research*, 43(3), 429-447.
- Hayes, A. F. (2022). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford Press.
- He, G. B., Li, S., & Liang, Z. Y. (2018). Behavioral decision-making is nudging China toward the overall revitalization. *Acta Psychologica Sinica*, 50(8), 803-813.
- [He Guibing, Li Shu, Liang Zhuyuan. (2018). Nudging others with small steps: Behavioral decision-making helps promote social development. *Acta Psychologica Sinica*, 50(8), 803-813.]
- He, S., & Qian, Q. K. (2023). Planning home energy retrofit in a social environment: The role of perceived descriptive and injunctive social norms. *Sustainable Cities and Society*, 99, 104954.
- Helferich, M., Thøgersen, J., & Bergquist, M. (2023). Direct and mediated impacts of social norms on pro-environmental behavior. *Global Environmental Change*, 80, 102680.
- Hornsey, M. J., Chapman, C. M., & Oelrichs, D. M. (2021). Ripple effects: Can information about the collective impact of individual actions boost perceived

efficacy about climate change? *Journal of Experimental Social Psychology*, 97, 104217.

Huber, J., Viscusi, W. K., & Bell, J. (2020). Dynamic relationships between social norms and pro-environmental behavior: Evidence from household recycling. *Behavioural Public Policy*, 4(1), 1-25.

Jacobson, R. P., Jacobson, K. J. L., & Reid, A. E. (2021). Guilt enhances the persuasive effects of injunctive but not descriptive social norms. *Social Psychological and Personality Science*, 12(6), 868-876.

Kallgren, C. A., Reno, R. R., & Cialdini, R. B. (2000). A focus theory of normative conduct: When norms do and do not affect behavior. *Personality and Social Psychology Bulletin*, 26(8), 1002-1012.

Kang, G. W., Piao, Z., & Ko, J. Y. (2021). Descriptive or injunctive: How do restaurant customers react to the guidelines of COVID-19 prevention measures? The role of psychological reactance. *International Journal of Hospitality Management*, 95, 102934.

Kavvouris, C., Chrysochou, P., & Thøgersen, J. (2020). “Be careful what you say” : The role of psychological reactance on the impact of pro-environmental normative appeals. *Journal of Business Research*, 113, 257-265.

Keizer, K., Lindenberg, S., & Steg, L. (2008). The spreading of disorder. *Science*, 322(5908), 1681-1685.

Kredentser, M. S., Fabrigar, L. R., Smith, S. M., & Fulton, K. (2012). Following what people think we should do versus what people actually do: Elaboration as a moderator of the impact of descriptive and injunctive norms. *Social Psychological and Personality Science*, 3(3), 341-347.

Leoniak, K. J., & Cwalina, W. (2019). The role of normative prompts and norm support cues in promoting light-switching behavior: A field study. *Journal of Environmental Psychology*, 64, 1-11.

McDonald, R. I., Fielding, K. S., & Louis, W. R. (2014). Conflicting norms highlight the need for action. *Environment and Behavior*, 46(2), 139-162.

Mundaca, L., Román-Collado, R., & Cansino, J. M. (2022). Assessing the impacts of social norms on low-carbon mobility options. *Energy Policy*, 162, 112814.

Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Personality and Social Psychology Bulletin*, 34(7), 913-923.

Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The norm activation model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology*, 39, 141-153.

Reynolds-Tylus, T., Martinez-Gonzalez, A., & Quick, B. L. (2019). The role of choice clustering and descriptive norms in attenuating psychological reactance to water and energy conservation messages. *Environmental Communication*, 13(7), 847–863.

Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*, 91(1), 93–114.

Schwartz, S.H. (1977). Normative influences on altruism. *Advances in Experimental Social Psychology*, 10, 221–279.

Smith, J. R., Louis, W. R., Terry, D. J., Greenaway, K. H., Clarke, M. R., & Cheng, X. (2012). Congruent or conflicted? The impact of injunctive and descriptive norms on environmental intentions. *Journal of Environmental Psychology*, 32(4), 353–361.

Stone, J., Wiegand, A. W., Cooper, J., & Aronson, E. (1997). When exemplification fails: Hypocrisy and the motive for self-integrity. *Journal of Personality and Social Psychology*, 72(1), 54–65.

Tang, M. H., Tian, S. Y., & Xie, T. (2024). Beyond the myth of slimming: The impact of social norms on positive body image and caloric intake among young adults. *Acta Psychologica Sinica*, 56(10), 1367–1383.

[Tang Meihui, Tian Shuyuan, Xie Tian. (2024). Beyond the slimness myth: The influence of the social norm of “thinness as beauty” on positive body image and caloric intake among young people. *Acta Psychologica Sinica*, 56(10), 1367–1383.]

Wu, B., & Yang, Z. (2018). The impact of moral identity on consumers’ green consumption tendency: The role of perceived responsibility for environmental damage. *Journal of Environmental Psychology*, 59, 74–84.

The Attitude-Behavior Gap in Energy Conservation: Inhibitory Pathways of Social Norm Conflict and the Moderating Role of Goal Self-Efficacy

YIN Xile^{1, 2}; HE Linyan²; ZHOU Huijuan²; CHEN Siyu³; ZHANG Feng⁴

(¹ Modern Business Research Center, Zhejiang Gongshang University, Hangzhou 310018, China) (² School of Business Administration, Zhejiang Gongshang University, Hangzhou 310018, China) (³ School of Economics and Management, Zhejiang University of Water Resources and Electric Power, Hangzhou 310018, China) (⁴ School of Economics, Nankai University, Tianjin 300071, China)

Abstract

Social norms are widely used as low-cost nudges to promote pro-environmental behavior, including energy conservation. Both injunctive norms (what people ought to do) and descriptive norms (what most people actually do) significantly influence energy-saving behavior. However, residential energy conservation is often marked by a pervasive attitude-behavior gap, reflected in a conflict between high (positive) injunctive norms and low (negative) descriptive norms. While some interventions deliberately highlight this norm conflict to motivate action, emerging evidence suggests that doing so may backfire, inhibiting rather than promoting energy-saving behavior. Previous research, primarily grounded in the Focus Theory of Normative Conduct, has documented this negative effect but lacks a deep examination of the underlying psychological mechanisms. Integrating the Focus Theory of Normative Conduct with Norm Activation Theory, this study proposed a dual-mediator model, arguing that norm conflict suppresses energy-saving

behavior by simultaneously reducing personal responsibility and eliciting psychological reactance. Furthermore, we hypothesized that goal self-efficacy would buffer this inhibitory effect.

A multi-method approach involving five experimental studies (two field studies and three scenario-based experiments) was employed to test the hypotheses across different energy-saving contexts: stair use, intentions to use low-carbon transportation, and intentions to take leftovers home. Study 1 (field experiment, $N = 2906$) used a one-factor design (norm: control vs. high injunctive norm vs. norm conflict) to examine the effect of norm conflict on actual stair-use behavior. Study 2 (scenario experiment, $N = 225$) utilized a one-factor between-subjects design (control vs. high injunctive norm vs. norm conflict) to investigate the mediating roles of personal responsibility and psychological reactance in intentions to use low-carbon transportation. Study 3 employed a manipulation-of-mediator design: Studies 3a ($N = 200$) and 3b ($N = 200$) each used a 2 (norm: high injunctive vs. conflict) $\times$ 2 (mediator: baseline vs. enhanced reactance/responsibility) factorial design to causally test the respective mediating pathways. Study 4 ($N = 300$) used a 2 (norm: high injunctive vs. conflict) $\times$ 2 (goal self-efficacy: high vs. low) between-subjects design to explore the moderating role of goal self-efficacy in intentions to take leftovers home. Finally, Study 5 returned to the field stair-use paradigm and added a “norm conflict + high goal self-efficacy” condition ($N = 797$) to assess changes in actual behavior following an efficacy-enhancing message. Data were analyzed using analyses of variance (ANOVAs), chi-square tests, bootstrap mediation analyses, and moderated mediation analyses.

The findings consistently demonstrated a significant inhibitory effect of social norm conflict on energy-saving behavior and intentions across contexts. Specifically, in Study 1, the stair-use rate in the norm conflict condition (20.20%) was significantly lower than those in both the high injunctive norm (32.29%) and

control (32.96%) conditions. Study 2 supported the proposed dual mediation pathways: norm conflict decreased personal responsibility and increased psychological reactance, which, in turn, reduced energy-saving intentions. The causal roles of these mediators were supported by the manipulation-of-mediator design in Study 3. Study 4 revealed that goal self-efficacy significantly moderated the effect of norm conflict: high efficacy buffered the negative effect of norm conflict on responsibility and consequently on behavioral intention, but did not significantly alleviate the heightened psychological reactance elicited by norm conflict. Crucially, the field experiment in Study 5 showed that introducing a high efficacy message alongside norm conflict information not only mitigated the negative effect (increasing the stair-use rate from 20.20% in the norm conflict condition to 36.76%), but also produced a higher rate than the high injunctive norm message alone.

The present research advances theory by integrating the Focus Theory of Normative Conduct with Norm Activation Theory to identify a dual-pathway (reduced personal responsibility and increased psychological reactance) through which injunctive-descriptive norm conflict undermines energy-saving behavior. It further identifies goal self-efficacy as a key boundary condition that primarily preserves personal responsibility, thereby mitigating the adverse effects of norm conflict.

Practically, these findings suggest that interventions should avoid messages emphasizing widespread inaction, and should instead incorporate concrete efficacy cues (e.g., quantifiable personal contributions or demonstrable peer influence) to address the dilemma created by conflicting norms.

Keywords social norm conflict, goal self-efficacy, psychological reactance, personal responsibility, energy conservation

Appendix A: Experimental Materials and Items

Appendix A1: Field Experiment on Norm Conflict and Energy-Saving Behavior (Experiment 1)

I. Pre-experiment

The pre-experiment recruited 60 participants through the Credemo platform. After excluding one participant who failed the attention check, the final valid sample was 59 participants (43 females; age 31.40 ± 7.80). Participants were randomly assigned to the control group ($n = 19$), the high-injunctive-norm group ($n = 20$), or the conflict group ($n = 20$), and then read the following materials (the specific material information was the same as in the formal experiment). Participants in the control group saw only “energy-saving advocacy information”; those in the high-injunctive-norm group saw “energy-saving advocacy + street-survey information indicating that most residents encourage taking the stairs”; and those in the norm-conflict group saw “energy-saving advocacy +

Appendix Figure 1. Energy-saving posters posted in Experiment 1 (from left to right: control group, high-injunctive-norm group, and norm-conflict group)

Figure 5: Appendix Figure 1. Energy-saving posters posted in Experiment 1 (from left to right: control group, high-injunctive-norm group, and norm-conflict group)

street-survey information indicating that most residents encourage taking the stairs but only a minority commit to doing so.”

Participants then reported their perceived degree of norm conflict. Following He and Qian (2023), the measurement items included: “Most people around me (friends, family members, or neighbors) believe that taking the stairs is worthy of encouragement and approval,” and “Most people around me (friends, family members, or neighbors) can take the stairs regularly.” (1 = strongly disagree, 7 = strongly agree). The one-way ANOVA results showed that the between-group difference in perceived injunctive norms was significant ($F(2, 56) = 8.37, p = 0.001, \eta_p^2 = 0.23$). Specifically, the norm-conflict group ($M = 6.45, SD = 0.51, 95\%CI[0.47, 1.91], p < 0.001$) and the high-injunctive-norm group ($M = 6.00, SD = 0.80, 95\%CI[0.02, 1.46], p = 0.044$) were both significantly higher than the control group ($M = 5.26, SD = 1.28$). Similarly, the between-group difference in perceived descriptive norms was also significant ($F(2, 56) = 28.76, p < 0.001, \eta_p^2 = 0.51$). Specifically, the norm-conflict group ($M = 2.45, SD = 1.28$) was significantly lower than the high-injunctive-norm group ($M = 5.20, SD = 1.01, 95\%CI[1.79, 3.71], p < 0.001$) and the control group ($M = 4.79, SD = 1.40, 95\%CI[1.36, 3.32], p < 0.001$).

II. Posters Used in the Field Experiment

Appendix Figure 1. Energy-saving posters posted in Experiment 1 (from left to right: control group, high-injunctive-norm group, and norm-conflict group)

III. Observation Location

Photographs of the experimental site are shown in Appendix Figure 2. First, all posters adopted a uniform visual specification (50 cm $\times$ 70 cm) and were fixed 20 cm to the right of the elevator button panel, ensuring that all teachers and students waiting in front of the elevator or pressing the button could see them clearly. The present experiment aimed to examine how normative information promotes individuals’ shift from high-energy-consumption behavior (taking the elevator) to low-energy-consumption behavior (taking the stairs), and the elevator entrance was the key behavioral decision point at which the choice between taking the elevator and taking the stairs was made. Second, the observer was positioned at the corner platform between the first and second floors of the stairwell. This position allowed the observer to see both the elevator entrance and the stair passage, ensuring a complete record of all participants’ travel choices

Appendix Figure 2. Photograph of the experimental site

Figure 6: Appendix Figure 2. Photograph of the experimental site

(taking the elevator or taking the stairs). At the same time, this position was relatively concealed, outside the line of sight of participants at the behavioral choice node (the elevator entrance/stair entrance), and students often stopped there (to make phone calls, chat, or study on their own, etc.). Thus, the observer was not easily identified by participants, thereby minimizing interference from the observer effect on participants' natural behavior.

In addition, before the experiment began, we carefully inspected the experimental site and confirmed that there were no posted slogans related to energy saving, environmental protection, or social norms in the elevator and stairwell areas of the teaching building. We also asked students who regularly attended classes in that teaching building and confirmed that they had no impression of any related slogans over the past year. Therefore, the posters posted during the experiment constituted the only source of normative-information intervention. The entire experimental procedure strictly followed ethical standards, obtained ethics approval and permission from the administrative department, and did not interfere in any way with the normal teaching and office order on campus.

Appendix Figure 2. Photograph of the experimental site

IV. Influence of On-Site Behavior

In the experiment, in addition to the descriptive information on the poster, participants may also have been influenced by the behavior of others observed on site. In this regard, the experimental results indicate that, in this campus environment, others' actual behavior itself exhibited the characteristics of a low-descriptive norm in which "only a minority take the stairs" (the stair-use rate among participants in the baseline and control groups was around 30%). Therefore, real-world observation reinforced the low-descriptive-norm information conveyed by the norm-conflict poster, rather than weakening or distorting the manipulation. To further rule out the potential interference of real-world observation, participants who were alone (i.e., without companions) were selected as a subsample ($N = 2091$, accounting for 71.95% of the total sample). The results showed that the stair-use rate in the norm-conflict group (23.00%) remained significantly lower than that in the high-injunctive-norm group (34.53%, $\chi^2(1) = 21.96$, $p < 0.001$, $\varphi = -0.13$) and the control group (38.11%, $\chi^2(1) = 37.16$, $p < 0.001$, $\varphi = -0.16$), with the direction of the effects entirely consistent with the full sample. This result indicates that, after removing the direct social influence brought about by real-world companion behavior, the negative effect of norm conflict still robustly exists.

V. Behavioral Record Form

Appendix Table 1. Behavioral Record Form for the Field Experiment

Time		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Recorder																					
Weather		Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy	Sunny	Cloudy
No.	Gender	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Whether		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Appearance		ac-	ac-	char-	char-	there	there	there	there	there	there	choice	choice								
com-		com-	ac-	was	was	was	was	was													
pa-		pa-	ter-	a	a	a	a	a													
nied		nied	is-	is-	rea-	rea-	rea-	rea-	rea-												
			tics	tics	son-	son-	son-	son-	son-												
					able	able	able	able	able												
					rea-	rea-	rea-	rea-	rea-												
					son	son	son	son	son												
					for	for	for	for	for												
					us-	us-	us-	us-	us-												
					ing	ing	ing	ing	ing												
					the	the	the	the	the												
					ele-	ele-	ele-	ele-	ele-												
					va-	va-	va-	va-	va-												
					tor	tor	tor	tor	tor												
No.	Male	Female	Individual	Group	Student	Faculty/Staff	2	3	4	5	Take	Take									
					Com-	Car-	Car-	Car-	Ob-	stairs	ele-										
					pletely	ry-	ry-	ry-	vi-												
					empty	ing	ing	ing	ous												
					handed	a	a	a	leg												
					wa-	back-	heavy	in-													
					ter	pack	ob-	jury													
					cup,	or	ject	or													
					doc-	com-	or	push-													
					u-	puter	box	ing													
					ments	bag	a														
					or		cart														
					books																
1																					
2																					
3																					

VI. Demographic Characteristics of Participants

Appendix Table 2. Sample Demographic Characteristics (Experiment 1)

Name	Category	Sample Size	Percentage
Gender	Male	1854	63.80%
Gender	Female	1052	36.20%
Appearance characteristics	Student	2460	84.65%
Appearance characteristics	Faculty/Staff	446	15.35%
Whether accompanied	Individual	2091	71.95%
Whether accompanied	Group	815	28.05%

Appendix A2: Test of the Mediating Roles of Psychological Resistance and Sense of Responsibility (Experiment 2)

I. Experimental Materials

(I) Survey Background

Dear Sir/Madam, hello!

Welcome to this survey on willingness to engage in low-carbon travel!

This questionnaire is intended to understand your attitudes and views regarding low-carbon travel. It is expected to take you about 3 minutes to complete. Please read each question carefully and answer honestly based on your actual situation and feelings. We will provide a reward of 2 yuan after you complete the questionnaire. The questionnaire collects data anonymously. All information you provide will be kept strictly confidential and used only for aggregate statistical analysis; no personally identifying information will be disclosed. Participation is entirely voluntary, and you have the right to withdraw from the survey at any time. I have read and understood

This is an attention-check question, used to test whether you are answering carefully. Please select "Very dissatisfied."

Very dissatisfied Dissatisfied Satisfied Very satisfied

(II) Scenario Materials

Below is a scenario material. Please read it carefully. Imagine this scenario as realistically as possible, and describe in your mind in detail the thoughts and feelings you experience.

Control group:

Today is Sunday, and you plan to visit a nearby park. When deciding how to get to your destination, you face a choice: drive or ride a bicycle. Compared with riding a bicycle, driving will increase carbon emissions and is harmful to the environment, but it can save physical energy and is more comfortable. Your destination is several kilometers away, and either driving or cycling is feasible.

Poll image: “Do you encourage and approve of choosing low-carbon transportation such as bicycles for short trips?” Results: 88% Yes; 12% No; 859 participants.

Figure 7: Poll image: “Do you encourage and approve of choosing low-carbon transportation such as bicycles for short trips?” Results: 88% Yes; 12% No; 859 participants.

At the same time, we conducted a survey of travel modes among residents of this city; they expressed their attitudes toward whether they choose low-carbon transportation such as bicycles for short trips, as well as what they actually do.

High injunctive-norm group:

Today is Sunday, and you plan to visit a nearby park. When deciding how to get to your destination, you face a choice: drive or ride a bicycle. Compared with riding a bicycle, driving will increase carbon emissions and is harmful to the environment, but it can save physical energy and is more comfortable. Your destination is several kilometers away, and either driving or cycling is feasible.

At the same time, we conducted a survey of travel modes among residents of this city. The results showed that as many as 88% of residents encourage and approve of choosing low-carbon transportation such as bicycles for short trips.

Norm-conflict group:

Today is Sunday, and you plan to visit a nearby park. When deciding how to get to your destination, you face a choice: drive or ride a bicycle. Compared with riding a bicycle, driving will increase carbon emissions and is harmful to the environment, but it can save physical energy and is more comfortable. Your destination is several kilometers away, and either driving or cycling is feasible.

At the same time, we conducted a survey of travel modes among residents of this city. The results showed that as many as 88% of residents encourage and approve of choosing low-carbon transportation such as bicycles for short trips, but only 16% of residents actually choose to do so for short trips (the vast majority chose to drive).

Are you encouraged and praised for choosing low-carbon transportation, such as riding a bicycle, for short-distance trips?

88% Yes 12% No

859 participants

When making short-distance trips, do you often choose low-carbon transportation, such as riding a bicycle?

16% Yes 84% No

859 participants

Please recall a similar experience you have encountered in real life, and answer the following questions. Please indicate the extent to which you agree with the following statements (1 = strongly disagree, 7 = strongly agree):

(三) Low-Carbon Travel Intention

1. The above scenario makes me want to use low-carbon transportation such as a bicycle.
2. In this scenario, the likelihood that I would use low-carbon transportation such as a bicycle is very high.
3. In this scenario, compared with driving, I would readily choose low-carbon transportation such as a bicycle.

(四) Perceived Norms

1. In the above survey, I feel that most citizens encourage and approve of choosing bicycling as a low-carbon mode of travel for short-distance trips.
2. In the above survey, I feel that most citizens would choose bicycling as a low-carbon mode of travel for short-distance trips.

(五) Psychological Reactance

1. The survey information from the above citizens makes me feel that my freedom to choose my mode of travel has been interfered with.
2. The survey information from the above citizens makes me feel constrained when choosing my mode of travel.
3. The survey information from the above citizens makes me feel an impulse not to comply (or even to do the opposite).
4. I feel resistant toward the views or practices of the citizens in the above survey information.
5. When reading the citizens' survey information, I had rebellious thoughts.

(六) Sense of Responsibility

1. In this scenario, if choosing to drive leads to an increase in carbon emissions, I bear a certain responsibility.
2. In this scenario, I think my mode of travel may pollute the environment.
3. In this scenario, I think I have a responsibility to choose low-carbon transportation.

4. In this scenario, I am willing to do what I can to contribute to reducing carbon emissions.

(七) Perceived Hypocrisy

1. I think most citizens act hypocritically when it comes to low-carbon travel.
2. I doubt whether most citizens are truly sincere about low-carbon travel.
3. I feel that, when it comes to low-carbon environmental protection, the public often merely “puts on a show.”

(八) Anticipated Guilt

1. In this scenario, if I choose to drive rather than travel in a low-carbon way, I would feel guilty.
2. In this scenario, not choosing a low-carbon mode of travel such as bicycling would make me feel ashamed.
3. In this scenario, when thinking about choosing to drive, I would feel uneasy about my decision.

(九) Personal Norms

1. In this scenario, I feel that I should choose low-carbon transportation such as a bicycle.
2. In this scenario, I feel that taking low-carbon action is important.
3. Based on my own values and principles, I feel obligated to take low-carbon action.

(10) Control Variables

1. Considering the causes of climate change, which of the following best describes your view?

Caused entirely by natural processes

Caused mainly by natural processes

Caused entirely by human activities

Caused mainly by human activities

There is no climate change or major environmental problem

I don't know

2. In the past two weeks, how often have you used low-carbon transportation (e.g., bicycles; 1 = never, 7 = always)?
3. In the past two weeks, how often have you used a car (driving or taking a taxi)?

(11) Demographic Characteristics

1. Your gender Male Female

2. Your age (fill in the blank)

3. Your educational attainment High school Associate degree Bachelor's degree Graduate student Doctoral degree or above

4. Your major

Economics Management Science Engineering Medicine Agriculture
Literature History Philosophy Law Education

5. Your occupational type

Student State-owned enterprise Public institution Civil servant Private enterprise Foreign-funded enterprise Other

6. How many years have you been working? (fill-in-the-blank question)

7. Per-capita monthly household income

Below 1,000 yuan 1,000–3,000 yuan 3,000–5,000 yuan 5,000–10,000 yuan
Above 10,000 yuan

8. Number of cars owned by your household 0 1 2 3 or more

9. Do you have a driver's license? Yes No

II. Experimental Manipulation Check

The analysis of variance showed that there were significant differences among the different experimental groups in perceived injunctive norms ($F(2, 222) = 12.43$, $p < 0.001$, $\eta_p^2 = 0.10$) and perceived descriptive norms ($F(2, 222) = 63.43$, $p < 0.001$, $\eta_p^2 = 0.36$). Bonferroni post hoc tests found that the high-injunction group ($M = 6.33$, $SD = 0.72$, 95% CI [0.26, 0.89], $p < 0.001$) and the norm-conflict group ($M = 6.31$, $SD = 0.62$, 95% CI [0.23, 0.86], $p < 0.001$) had higher perceived injunctive norms than the control group ($M = 5.76$, $SD = 1.00$). The norm-conflict group ($M = 3.41$, $SD = 2.24$) had lower perceived descriptive norms than the control group ($M = 5.53$, $SD = 1.04$, 95% CI [−2.72, −1.52], $p < 0.001$) and the high-injunction group ($M = 6.04$, $SD = 0.88$, 95% CI [−3.22, −2.03], $p < 0.001$). The above results indicate that Experiment 2 effectively manipulated the perceived norm conflict among participants.

III. Supplementary Results of the Mediation-Effect Test

Appendix Table 3 summarizes all path coefficients, effect sizes, and confidence intervals in the mediation model, covering the unstandardized coefficient (b), standard error, t value, p value, 95% confidence interval, and standardized coefficient (β).

Appendix Table 3. Complete results of the multiple mediation test for responsibility and psychological reactance

Path	Unstandardized coefficient (<i>b</i>)	SE	<i>t</i> value	<i>p</i> value	Standardized coefficient (β)
X → Psycho- logical reac- tance	1.16	0.21	5.54	<0.001	0.88***
X → Respon- sibility	−0.59	0.17	−3.51	<0.001	−0.49***
Psychological reac- tance → Y	−0.20	0.06	−3.38	0.001	−0.17**
Responsibility → Y	0.66	0.07	8.98	<0.001	0.52***
X → Y (direct effect)	−0.64	0.16	−3.93	<0.001	−0.42***
Indirect effect of psycho- logical reac- tance	−0.23	0.10	(95% CI: [−0.46, −0.07])		−0.15
Indirect effect of responsi- bility	−0.39	0.12	(95% CI: [−0.62, −0.17])		−0.25
Total indirect effect	−0.62	0.13	(95% CI: [−0.9, −0.37])		−0.40

Appendix A3: Experimental Stimulus Materials (Experiment 3)

I. Manipulation Stimulus Materials for the Mediating Variables

Responsibility manipulation material: As members of society, we have a responsibility to contribute to environmental protection. Our everyday behaviors affect the environment. For example, driving increases carbon emissions

and exacerbates climate change, whereas choosing low-carbon modes of travel can not only reduce carbon emissions but also demonstrate our commitment to environmental protection.

Psychological reactance manipulation material: During the survey, some citizens even stated that driving should not be chosen. They emphasized that, even if some people hold different views, in order to save energy and reduce emissions, everyone needs to choose low-carbon means of transportation such as bicycles.

Neutral information material unrelated to responsibility (psychological reactance): The purpose of this trip is to arrive at the park and have fun there. Whether you choose to drive or ride a bicycle, you can reach the destination smoothly; there is no significant difference in travel time between the two modes of transportation.

The manipulation checks for the dependent variable, independent variable, and mediating variable; the control variables (climate-change skepticism and frequency of low-carbon travel); and basic demographic information (including gender, age, education, major, occupational type, years of work experience, average monthly household income, number of cars owned by the household, and whether the participant has a driver's license, etc.) used the same measurement items as in Experiment 2.

Appendix A4: Moderated Mediation Test of Goal Efficacy (Experiment 4)

I. Experimental Materials

(I) Survey Background Refer to the materials in Experiment 2.

(II) Scenario Materials Please read the following scenario materials carefully, imagine the scenario as realistically as possible, and describe in detail in your mind the thoughts and feelings you would experience. Participants will be randomly shown one of four sets of experimental materials: high injunctive norm & low goal efficacy, high injunctive norm & high goal efficacy, norm conflict & low goal efficacy, and norm conflict & high goal efficacy.

Norm information manipulation material	Norm information manipulation material	Goal-efficacy manipulation material	Goal-efficacy manipulation material
Norm information manipulation material	Norm information manipulation material	Goal-efficacy manipulation material	Goal-efficacy manipulation material
High injunctive information	According to statistics, people often waste food when dining in restaurants, and one-third of food is thrown into trash bins. We conducted a street survey among citizens in this city, and the results showed that as many as 88% of people encourage and approve of packing up unfinished food. Are you willing to encourage and approve of packing up unfinished food? 88% Yes 12% No 859 participants	High goal-efficacy information	Meanwhile, an authoritative environmental assessment report on urban food-and-beverage waste indicates that packing up every 1 kilogram of food can directly avoid approximately 2.5 kilograms of carbon emissions; the direct effect of an individual' s packing-up behavior is genuinely visible. Moreover, dining in public restaurants has a relatively strong social contagion effect: an individual' s packing-up behavior can easily be noticed and actively followed by nearby customers, thereby producing a significant demonstration effect and effectively motivating people around them to act together.

Norm information manipulation material	Norm information manipulation material	Goal-efficacy manipulation material	Goal-efficacy manipulation material
Norm-conflict information	According to statistics, people often waste food when dining in restaurants, and one-third of food is thrown into trash bins. We conducted a street survey among citizens in this city, and the results showed that as many as 88% of people encourage and approve of packing up unfinished food, but in reality only 16% of people regularly do so. Are you willing to encourage and approve of packing up unfinished food? 88% Yes 12% No 859 participants Do you regularly pack up unfinished food? 16% Yes 84% No 859 participants	Low goal-efficacy information	Meanwhile, an authoritative environmental assessment report on urban food-and-beverage waste indicates that, although packing up every 1 kilogram of food can avoid approximately 2.5 kilograms of carbon emissions, this accounts for only a very small share of the city' s total annual carbon emissions of tens of millions of tons, and the direct effect of an individual' s packing-up behavior is limited. Moreover, dining in public restaurants has a relatively strong social boundary effect: an individual' s packing-up behavior is usually regarded as an independent private choice, making it difficult to generate a substantive demonstration effect on nearby customers and impossible to motivate people around them to act together.

Now please imagine the following scenario. You are dining at a restaurant in this city. After the meal, there is some food left on the table.

food. At this point you face a choice: whether you need to pack it up. Packing it up can reduce food waste, but it may also feel troublesome or inconvenient to carry.

Please indicate the extent to which you agree with the following statements (1 = strongly disagree to 7 = strongly agree):

(III) Willingness to Pack Up Leftovers After the Meal

1. The above scenario makes me want to pack up the unfinished food.
2. In this scenario, it is highly likely that I would pack up the unfinished food.
3. In this scenario, compared with wasting food, I would readily choose to pack up the unfinished food.

(IV) Norm Perception

1. In the above scenario, most citizens believe that packing up unfinished food is worthy of encouragement and approval.
2. In the above scenario, most citizens would in fact choose to pack up and take away unfinished food after the meal.

(V) Goal Efficacy

1. In the above scenario, my behavior of packing up food would achieve the expected effect of improving the environment.
2. In the above scenario, my personal packing-up behavior has substantive significance for reducing urban food waste.
3. In the above scenario, if I participate in reducing food waste, I personally will have a direct impact on local environmental-protection actions.

(VI) Psychological Reactance

1. The survey information from the above citizens made me feel that my freedom to choose how to deal with leftover food was interfered with.
2. The survey information from the above citizens made me feel subject to some kind of restriction when deciding whether to pack up the food.
3. The survey information from the above citizens produced in me an impulse not to comply (or even to do the opposite).
4. I felt resistance toward the citizens' views or practices in the above survey information.
5. When reading the citizens' survey information, I had rebellious thoughts.

(VII) Sense of Responsibility

1. In this scenario, if wasting food leads to environmental damage, I bear a certain responsibility.
2. In this scenario, I feel that my own wasteful behavior may aggravate environmental problems.

3. In this scenario, I feel that I have a responsibility to pack up the unfinished food.
4. In this scenario, I am willing to do my best to contribute to protecting the environment.

(VIII) Personal Norm

1. In this scenario, I feel that I should choose to pack up the unfinished food.
2. In this scenario, I feel that taking the action of packing up is important.
3. Because of my own values and principles, I feel obligated to save food.

(IX) Control Variables

1. Considering the causes of climate change, which of the following best describes your view?
2. Your frequency of dining out.

More than once a day Once a day 2-3 times per week Once per week 2-3 times per month Once per month or less

3. In the past two weeks, how many times did you pack up unfinished food (1 = never to 7 = always)?

II. Manipulation Check

The independent-samples *t*-test results showed that perceived injunctive norms did not differ significantly between the high-injunction condition ($M = 6.22, SD = 1.10$) and the norm-conflict condition ($M = 6.18, SD = 0.99$; $t(298) = 0.33, p = 0.741$); perceived descriptive norms in the high-injunction condition ($M = 5.47, SD = 1.42$) were significantly higher than in the norm-conflict condition ($M = 2.81, SD = 1.76$; $t(298) = 14.38, p < 0.001$). The above results were consistent with expectations, indicating that, compared with the high-injunction condition, the high-injunction-low-description norm-conflict condition had lower perceived descriptive norms and no significant difference in perceived injunctive norms. Furthermore, perceived goal efficacy in the low-efficacy condition ($M = 4.35, SD = 1.68$) was significantly lower than in the high-efficacy condition ($M = 5.82, SD = 0.82$; $t(298) = 9.63, p < 0.001$), indicating that the goal-efficacy manipulation was effective.

Appendix A5: Field Experiment on Goal Efficacy (Experiment 5)

I. Poster Design

Please conserve energy!

Your energy-saving behavior is extremely important for the environment! Taking the stairs can directly reduce carbon emissions and make an important contribution to energy conservation and emissions reduction. Regardless of what others do, your actions are producing a real impact!

We conducted a campus survey. The results showed that as many as **86%** of students support and encourage taking the stairs, but only **16%** of students actually do so.

“Under non-emergency circumstances, do you support taking the stairs?”

- **86%** Yes
- **14%** No

“Under non-emergency circumstances, do you often take the stairs?”

- **16%** Yes
- **84%** No

413 participants.

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv. Machine translation. Verify with the original.