

Be a Rascal Among Rascal? The Vicarious Moral Self-Regulation Effect in College Students' Pro-Environmental Behaviors

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Purpose: According to social interaction theory, the psychology and behavior of individuals are influenced by others, especially these significant or intimate others. This classical social phenomenon, “Be a rascal among rascal”, which explains the influence of others’ behavior on an individual’s behavior, has also been observed in pro-environmental behavior. In recent years, environmental psychologists have termed this interesting phenomenon as the “vicarious moral self-regulation effect”, in which the prior environmental behavior of significant or intimate others influences an individual’s subsequent environmental behavior. However, the stability and psychological mechanisms of the vicarious moral self-regulation effect are still not well understood. Therefore, this study aims to verify the vicarious moral self-regulation effect in pro-environmental behavior through four studies.

Methods and Results: In Study 1, 90 participants were randomly assigned to one of three groups (a stronger green credentials manipulation, a weaker green credentials manipulation, or a control group about a close friend), and results showed that participants in both stronger and less green credential groups made fewer carbon-neutral choices than those in the control group in the carbon emissions task. In Study 2 (120 participants), compared to the control group, participants in the group imagining both environmentally friendly and unfriendly behavior of close friends made fewer carbon-neutral choices. This finding also was observed in Study 3 (93 participants), where participants under the group of free recalling both environmentally friendly and unfriendly behavior of close friends made fewer green purchasing choices. In Study 4 (75 participants), compared to the control group, participants in the group of both imagining and free recalling the environmentally friendly behavior of a close friend made fewer carbon-neutral choices, and participants in the group of both imagining and free recalling the environmentally unfriendly behavior of close friend made fewer green purchasing choices.

Conclusion: Results suggest that the environmentally friendly behavior of a close friend induces the vicarious moral licensing effect (those who handle vermilion are not reddened), and the environmentally unfriendly behavior of a close friend induces the vicarious moral identity effect (those who touch ink are blackened). Environmental behaviors of intimate others induce the obvious fluctuating changes in college students’ subsequent pro-environmental behaviors. This vicarious moral self-regulation effect can be explained by the mechanism of self-other overlap and provide scientific references for promoting pro-environmental behaviors among college students.

Keywords: pro-environmental behavior, moral self-regulation, vicariance, moral licensing effect, moral cleansing effect

Introduction

Moral Fluctuation and Consistency in PEB

Numerous studies in recent years have revealed that people seek a balance between their moral (eg, environmentally friendly) and immoral (eg, environmentally unfriendly) behaviors. Thus, people are more tolerant of their immoral behavior after engaging in a certain moral behavior (licensing effect)¹⁻⁷ or tend to cleanse their prior immoral behavior by engaging in some subsequent moral behavior (cleansing effect).⁸⁻¹¹ However, past behaviors may motivate

individuals to continue consistent behaviors in the future (eg, moral identity effect).^{12–20} Importantly, recent studies about pro-environmental behaviors (PEB) have reported that this dynamic moral self-regulation phenomenon can also be induced by the behavior of intimate others, showing a “vicarious moral licensing and cleansing effect”.²¹ Vicarious moral licensing refers to a phenomenon that imagining or recalling past environmentally friendly behaviors of significant or intimate others could lead to a decrease in subsequent environmentally friendly behaviors or an increase in environmentally unfriendly behaviors in individuals themselves.²¹ For example, when a family member or an intimate friend donates to an environmental charity, people believe that they have performed the pro-environmental act in the place of the family or an intimate other and are more likely to purchase less environmentally friendly products in their subsequent daily lives. In contrast, when a family member buys a car that consumes high amounts of gas and is less environmentally friendly, the rest of the family may subsequently focus more on “saving energy and reducing emissions” in their daily lives to compensate for the negative effects of the prior environmentally unfriendly behavior. Therefore, vicarious moral cleanliness refers to a phenomenon that imagining or recalling past environmentally unfriendly behaviors of intimate others could lead to an increase in subsequent environmentally friendly behaviors or a decrease in environmentally unfriendly behaviors in individuals themselves.²¹ However, sometimes individuals also maintain environmental behaviors of the same nature with intimate others, showing a vicarious moral identity. To provide sufficient empirical evidence for this “vicarious moral self-regulation effect” induced by intimate others’ behaviors, this study systematically examined the mechanisms by which intimate others’ environmental behaviors dynamically regulated Chinese college students’ PEB through four behavioral experiments. In addition, the possible mechanisms underlying vicarious moral self-regulation effect in the Chinese cultural context are discussed and elaborated.

Moral Licensing and Cleansing Effect in PEB

Many studies have examined the effect of moral self-regulation and its internal mechanism in PEB.^{1–11} On the one hand, studies found that people need consistency in behaviors and beliefs to maintain the stability and integrity of their personalities. According to self-perception theory, if people integrate their past behavior into their self-image, they will continue to maintain these prior behaviors. Previous studies have suggested that this phenomenon of “consistency of moral behaviors” works through a positive feedback mechanism of moral self-regulation, namely the “moral identity effect”.^{12–15} Aquino and Reed II defined moral identity as a self-concept that revolves around a set of moral traits (ie, the central traits of the moral self). Furthermore, individuals with high moral identity engage in more moral behaviors and maintain consistency in moral behavior over time compared to individuals with low moral identity.¹³ For example, in the domain of PEB, when people perceive their past behaviors as eco-friendly, they are subsequently more likely to engage in environmentally friendly behaviors, such as daily green consumption,¹⁶ support for environmental policies,^{17,18} and recycling.^{19,20} Thus, past behaviors may increase the likelihood of people engaging in consistent behaviors in the future, regardless of whether they are positive or negative behaviors.^{22,23}

On the other hand, people can also use past moral behavior as points that allow them to achieve identity-related goals and relax their efforts in pursuing these goals, leading to seemingly inconsistent behavior. For instance, Sachdeva et al argued that this “volatility of moral behaviors” was mediated through two typical negative feedback mechanisms of moral self-regulation: moral licensing and cleansing effects.¹ The moral licensing effect can induce a decrease in moral behavior or an increase in immoral behavior when moral self-perceptions are higher than moral self-images. For instance, participants who received positive feedback on PEB were less likely to recycle DIY materials in the follow-up task than those receiving negative feedback and control conditions.²³ Similar findings were reported in other PEB such as recycling water waste,^{24,25} using more paper in laboratory tasks,²⁶ seeking personal carbon footprint information,²⁷ petition signing,²⁸ and various other general and specific pro-environmental intentions.^{4,5,24,28,29} As for the moral cleansing effect, a threat to moral self-image triggers individuals to behave more morally. For example, when the past less PEB was highlighted, participants subsequently focused on more carbon footprint events in web searches.²⁷ Consumers tend to purchase more affordable goods after splurging to reestablish a self-image of self-control and conservation.³⁰ Moreover, people are more inclined to spend money earned through immoral means on moral expenditures (eg, funding others’ schooling and charitable environmental donations) to restore a damaged self-image.^{31,32}

However, several studies observed no significant moral cleansing effect in the domain of pro-environmental behavior.^{33,34}

Vicarious Moral Self-Regulation Effect

This moral self-regulation of an individual's behavior can also be induced by the behavior of intimate others, showing a "vicarious moral self-regulation effect". Imagining the behavior of others can cause the same neurological and bodily responses as if individuals themselves had engaged in those behaviors, showing a "vicarious effect".^{35,36} According to Kouchaki et al, after observing the non-racist behaviors of other in-group members, participants showed stronger stereotypes and biases toward African Americans in subsequent job offers, exhibiting a "vicarious moral licensing effect".³⁷ In the area of prosocial behavior, individuals perceive selfishness as less shameful and immoral after intimate others exhibit selfish rather than generous behavior, showing a "vicarious moral identity effect".³⁸ Researchers have also found a significant "vicarious moral identity effect" in the field of moral behavior, showing that the helpfulness of intimate others induces individuals to exhibit more helpfulness.^{39,40} In contrast, the immoral behavior of intimate others induces individuals to engage in more immoral behavior and less moral behavior without inducing a significant "vicarious moral cleansing effect".^{9,41} These studies tentatively suggest the existence of the vicarious moral self-regulation effect, whereby the behavioral attributes of others influence an individual's behavior.

Self-perception theory posits that people sometimes infer their attributes by observing their freely chosen actions. Goldstein and Cialdini hypothesized that in addition, people sometimes infer their attributes by observing the freely chosen actions of others with whom they feel a sense of merged identity—almost as if they had observed themselves performing the acts.³⁹ Thus, they proposed the "vicarious self-perception theory" to reveal the underlying mechanisms by which the behavior of intimate others influences an individual's behavior. According to this theory, both observing the behavior of others and sharing a certain identity between others and self can induce the influence of the behaviors of others on own behavior. In real interpersonal interactions, people not only experience interpersonal connections with non-intimate others (eg, colleagues or acquaintances) but also experience a sense of "oneness" with intimate others (eg, close friends or relatives).⁴² A great deal of self-other overlap may occur when people feel intimate with other persons, and the traits, behaviors, and characteristics of intimate others may be perceived as their own to some extent.^{39,43} Moreover, such highly overlapping psychological constructs may lead to vicarious cognitions^{44,45} and emotional experiences,^{46,47} and then further influence individual behavior. Thus, when people feel intimate with another person, they may act as if some aspects and behaviors of this intimate other are somehow also their own, which impacts their moral balance.

The Cost or Effort of PEB

According to previous studies about the moral self-regulation effect in PEB, the cost of PEB was a key variable to be considered.^{48–51} When people are aware of their past environmental behavior, they may feel a stronger environmental self-identity.^{52,53} Recent studies have shown that environmental self-identity is stronger when the initial PEB more strongly signals that one is a pro-environmental person. This indicates that the influence of previous PEB on environmental self-identity depends on the signaling strength of the behavior.⁴⁹ The harder one tries to take some pro-environmental actions, the more this behavior can signal environmental self-identity.

Purpose and Hypotheses of This Study

Despite the initial exploration of the "vicarious moral self-regulation effect", it still lacks enough empirical evidence for this effect in the environmental domain. A recent behavioral study by Meijers et al in the field of pro-environmental behavior provided preliminary support for this effect.²¹ Imagining or recalling the environmentally friendly behavior of intimate others induced a significant "vicarious moral licensing effect".²¹ However, imagining or recalling their environmentally unfriendly behaviors did not induce a significant "vicarious moral cleansing or identity effect". Additionally, prescriptive morality is sensitive to positive outcomes, activation-based, and focused on what we should do (ie, we should protect nature); however, proscriptive morality is sensitive to negative outcomes, inhibition-based, and focused on what we should not do (ie, we should not cut down forests at will).⁵⁴ Some empirical evidence shows that the two types of morality have different mechanisms of formation and function.⁵⁵ Thus, to further verify the stability and

prevalence of this vicarious effect in PEB, this study systematically explores its characteristics using different priming methods and pro-environmental behavior measurement tasks. Firstly, various priming methods, such as issuing green certificates task (Study 1),²⁷ behavioral imagery priming task (Study 2), and free recall and description task (Study 3 and 4), were respectively used to verify the vicarious moral self-regulation effect in Chinese college students' PEB, which helped to expand the ecological validity of this effect. Secondly, we tested the vicarious moral self-regulation effect in both carbon emission–benefit behavior (Study 1, 2, and 4) in the proscriptive moral domain and green purchasing behaviors in the prescriptive moral domain (Study 3 and 4). Thirdly, the current study not only re-validated the vicarious moral licensing effect in the PEB, but also observed the presence of vicarious moral cleansing or identity effects. Therefore, this study systematically verified whether the environmental behaviors of intimate others would induce Chinese college students to show stable vicarious moral self-regulation effects in both carbon emission and green purchasing behaviors.

Therefore, the following hypotheses are proposed based on relevant findings from previous studies. Compared to the control group, the participants who perceived friends' environmentally friendly behaviors (ie, by issuing strong green certificates, imagining, or recalling intimate behaviors), would subsequently engage in more environmentally unfriendly behaviors or less friendly behaviors, indicating a significant “vicarious moral licensing effect”; meanwhile, the participants who perceived friends' environmentally unfriendly behaviors (ie, by issuing weak green certificates, imagining, or recalling intimate behaviors), would subsequently engage in more environmentally unfriendly behaviors or less friendly behaviors, indicating a significant “vicarious moral identity effect”; In addition, we speculate that the costliness of PEB would modulate the influence of prior intimate others' PEB on the degree of implementing subsequent PEB.

Study I

Methods

Participants and Experimental Design

According to calculations using G*Power 3.1, at least 81 participants needed to be recruited with the guaranteed medium effect size (effect size = 0.3, according to the previous study²¹) and statistical test power ($\beta = 0.85$). Ninety college students aged 18–22 years (42 males, Mage = 19.33 ± 0.78) participated in this study. The study adopted a 3 (Groups: strong green certificate group, weak green certificate group, and control group) × 4 (Benefit–emissions matrix: low benefit–low emissions, low benefit–high emissions, high benefit–low emissions, and high benefit–high emissions) mixed design, where the Group was a between-participants variable, the Benefit–emissions was a within-participants variable, and the dependent variables were participant pro-environmental intentions and the proportions of choosing the carbon neutral option. All right-handed, non-psychiatric history participants with normal or corrected vision were randomly and equally divided into three groups. A monetary reward (¥ 30, about 4.19 \$) was given as remuneration after the experiment based on the participants' task performance.

Measurements and Materials

Green Certificate Priming Task

According to a previous study about the green certificate priming paradigm²⁷, we have respectively compiled 5 items about the rare PEB, common PEB, and daily life behaviors according to the actual situation in China. Participants were randomly assigned to one of three conditions: stronger green certificate group, weaker green certificate group, and control group. In detail, the participants in the stronger green certificate group were given five certificates and asked if their intimate friend had ever performed the five common environmental behaviors (eg, putting waste paper into the recycling bin instead of throwing it away); the participants in the weaker green certificate group answered the question whether their intimate friend had ever engaged in the five scarce environmental behaviors (eg, writing a letter to a government agency urging them to legislate for the environment); the participants in the control group were asked if their intimate friend had ever engaged in the five environmentally irrelevant behaviors (eg, flying a kite). Participants chose one of the two response options for each behavior: “Yes, he/she did” and “No, he/she did not do”. Finally, the frequency of responses for both options was recorded for all participants. In addition, two questions were asked to assess the effect of these behaviors: (a) Is the behavior environmentally friendly? (1 = yes, 2 = no); (b) Please assess the extent of

environmental friendliness about the behavior (1 = very unfriendly, 2 = somewhat unfriendly; 3 = not sure; 4 = very environmentally friendly; 5 = environmentally friendly). In addition, to ensure the representativeness of the three types of environmental behaviors, we recruited other participants to evaluate the familiarity and ease of five commons, five rare pro-environmental behaviors, and five daily life behaviors.

Inclusion of Other in the Self (IOS) Scale

This scale, developed by Aron et al, which consists of seven pairs of circles, with one circle representing the self and the other circle representing a target person, uses the degree of overlap of seven pairs of circles to characterize the degree of closeness between self and others, with more overlapping parts representing greater social proximity and intimacy between self and others.⁴³ Before the experiment, participants were requested to independently nominate an intimate same-sex friend and complete the IOS measure. Only nominees who scored 5 and above met the operational definition of intimate others. Otherwise, participants would renominate a same-sex friend until the requirement was met.

Willingness to Engage in Pro-Environmental Behavior

The pro-environmental behavior willingness scale proposed in a previous study⁵³ was used in the present study, with Cronbach's alpha value of 0.91 ($M = 4.88$, $SD = 1.34$). It consists of six items and uses a 7-point Likert scale to measure the willingness of participants to engage in PEB (1 for complete disagreement and 7 for complete agreement). In detail, all 6 items are "I would be willing to sign a petition to support an environmental cause; I would consider joining a group or club which is concerned with the environment; I would be willing to pay more taxes to support greater government control of pollution; I would be willing to pay more each month for electricity if it meant cleaner air; I would be willing to stop buying products from companies guilty of polluting the environment even though it might be inconvenient for me; I would be willing to make personal sacrifices for the sake of slowing down pollution even though the immediate results may not seem significant".

Carbon Emission Task

A "carbon emissions–monetary reward" dilemma task was developed, involving a personal trade-off between short-term monetary gains and long-term environmental goals.⁴⁸ In this task, participants are faced with a series of dilemmas: Option F, which is financially rewarding but generates carbon emissions, and Option J, which is not financially rewarding but does not generate any carbon emissions. The monetary gain from a randomly selected trial at the end of the experiment was paid to the participant along with the base remuneration (¥15). The corresponding carbon emissions are generated in the laboratory by turning on 10 light bulbs for different durations (1h, 2h, 3h, 4h, and 5h) to achieve purposeless wastage of electricity. The wastage of electrical energy here was like the emissions of polluting gases such as CO₂ produced by a car driving a certain number of miles. Referring to the parameter settings of a previous study,⁴⁸ this study combines four "benefit–emissions matrices" based on the level of monetary benefits (¥2, ¥4, ¥6, ¥8, and ¥10) and carbon emissions (3kg, 6kg, 9kg, 12kg, and 15kg): low emissions–low benefit (¥2–3kg, ¥2–6kg, ¥4–3kg, and ¥4–6kg), high emissions–low benefit (¥2–12kg, ¥2–15kg, ¥4–12kg, and ¥4–15kg), low emissions–high benefit (¥8–3kg, ¥8–6kg, ¥10–3kg, and ¥10–6kg), and high emissions–high benefit (¥8–12kg, ¥8–15kg, ¥10–12kg, and ¥10–15kg), with ¥6 and 9kg serving as intermediate reference points. Thus, larger monetary rewards indicate more purposeless wasted electricity, more indirectly generated CO₂, and more serious negative environmental impacts. Thus, the participants were asked to decide whether to create carbon emissions for monetary gains or to give up monetary gain for carbon neutrality. At the end of the experiment, participants were told that the design of 10 light bulbs for different durations was a sham to induce a conflict between personal and environmental gains. The sequence of the single trial during the Carbon emission task was presented in [Figure 1](#).

Experimental Procedures

The experiment was conducted on a computer in a quiet small room and took about 30 mins, between 9 to 12, or between 14 to 17 during the day. Meanwhile, the stimulus presentation was presented and the participant's keystroke responses were recorded by the E-prime software. First, participants were required to read some scientific knowledge about the

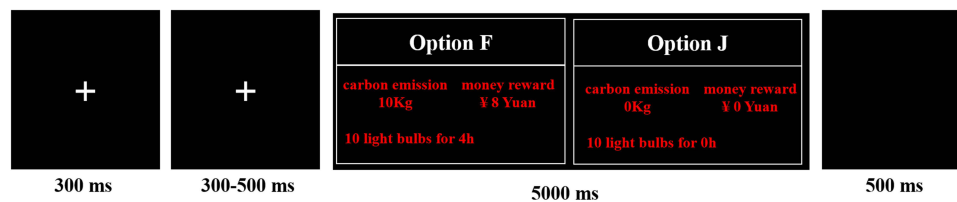


Figure 1 The sequence of events in the carbon emissions for monetary rewards task.

harm to the environment caused by excessive carbon dioxide before the experiment. Secondly, they nominated an intimate same-sex friend and completed the IOS scale. Thirdly, they were then randomly assigned to one of the three groups (strong green certificate group, weak green certificate group, and control group) and completed the green certificate priming task. Finally, they were guided to complete the operational check, pro-environmental behavior willingness scale, and the carbon emission task. After the experiment, they received the experimental payoff and task reward. In addition, to ensure the ecological validity of the experiment, the experimental reward of the participants is closely related to the task performance in the carbon emission task. It takes about 30 minutes to complete the whole experiment, and the specific experimental process is shown in [Figure 2](#).

Data Recording and Statistical Analysis

Results of priming checks, pro-environmental willingness, and behaviors ($M \pm SD$) were presented in [Table 1](#) and [Table 2](#). In the environmental behavior priming task, the frequencies of answers (ie, Yes or No) about whether their friends have ever done the five PEB, were recorded and compared to test the reliability of the green certificate priming. Moreover, a one-way analysis of variance (ANOVA) was conducted on the pro-environmental behavior willingness scores under the three environmental behaviors priming. A repeated measures ANOVA was performed for the proportions of carbon neutral options regarding the two factors of the Group and Benefit–emission matrix. In addition, the post hoc multiple comparisons were corrected with Bonferroni statistics.

Results

Operational Check Results

The operational check results of intimate others' environmental behavior priming are shown in [Table 1](#). Specifically, in the strong green certificate group (30 participants), 26 participants answered that their intimate friends had engaged in all five common environmental behaviors (100% YES response rate). The remaining four participants shared that their intimate friends had engaged in four of the five common environmental behaviors (80% YES response rate). In the weak green certificate group (30 participants), 27 participants answered that none of their intimate friends had engaged in the five rare environmental behaviors (100% NO response rate). The remaining three participants shared that none of their intimate friends had engaged in four of the five rare environmental behaviors (80% NO response rate). In the control group (30 participants), all responded that intimate friends had engaged in the five common daily life events with irrelevant to the environment (100% YES response rate).

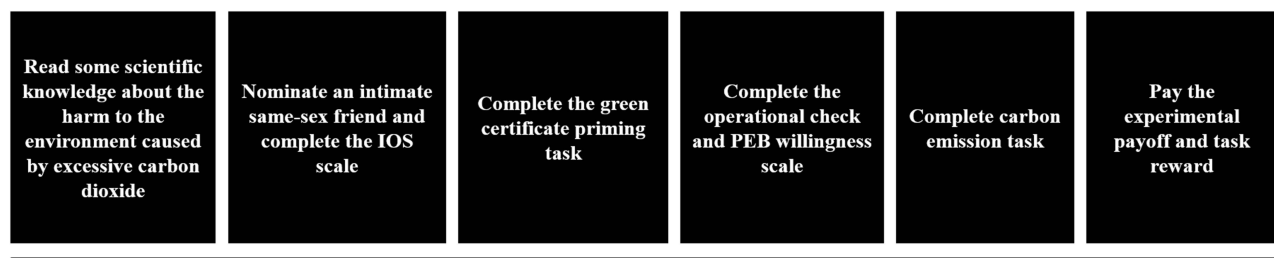


Figure 2 Experimental procedures of Study 1.

Table 1 Results of Priming Checks, Willingness, and PEB in Study 1 (M ± SD)

| | | Strong Green Certificate Group (n=30) | Control Group (n=30) | Weak Green Certificate Group (n=30) |
|-------------------------------|---------------------------|---------------------------------------|----------------------|-------------------------------------|
| Priming checks | Environmental property | 93.33% ± 5.25% | 0% ± 0% | 90.00% ± 6.16% |
| | Environmental ratings | 3.05 ± 0.81 | / | 5.04 ± 0.76 |
| Pro-environmental willingness | | 5.14 ± 1.61 | 4.95 ± 1.81 | 4.81 ± 0.68 |
| Carbon neutral behavior | Low gains-low emissions | 0.66 ± 0.30 | 0.71 ± 0.34 | 0.55 ± 0.35 |
| | Low gains-high emissions | 0.93 ± 0.16 | 0.90 ± 0.19 | 0.91 ± 0.26 |
| | High gains-low emissions | 0.20 ± 0.31 | 0.33 ± 0.41 | 0.19 ± 0.32 |
| | High gains-high emissions | 0.49 ± 0.38 | 0.80 ± 0.29 | 0.43 ± 0.39 |

Pro-Environmental Willingness and Carbon Neutral Behavior

A one-way ANOVA on the total mean scores in the pro-environmental behavioral willingness scale suggested a non-significant main effect of the group ($F(2, 87) = 1.02, p = 0.56, \eta_p^2 = 0.05$). The ANOVA performed on the proportion of participants choosing carbon-neutral behavior in the carbon emission task suggested a significant main effect of the group ($F(2, 87) = 4.26, p = 0.02, \eta_p^2 = 0.09$). Both environmentally friendly ($t(58) = -2.13, p = 0.05$) and unfriendly ($t(58) = -2.67, p = 0.01$) group participants opted for fewer carbon-neutral choices than those in the control group. In addition, the matrix had a significant main effect ($F(3, 261) = 102.70, p < 0.001, \eta_p^2 = 0.54$). Participants had the highest proportion of carbon neutral choices in the low benefit–high emissions condition, followed by the low benefit–low emissions, high benefit–high emissions, the lowest proportion in the high benefit–low emissions conditions ($ts = 7.83 \sim 16.88, ps < 0.001$). In addition, the interaction between the group and matrix was significant ($F(6, 261) = 3.52, p < 0.01, \eta_p^2 = 0.08$, see Figure 3). According to the simple effect analysis, in the high emissions–high benefit condition, participants in both the strong and weak green certificate groups significantly chose less carbon neutral options than those in the control group ($F(2, 87) = 9.13, p < 0.001$). However, such difference was not significant for the other three types of benefit–emissions matrices ($Fs < 1.80, ps > 0.22$).

Discussion of Study 1

Study 1 verified the stability of vicarious moral self-regulation effects in a carbon emission–benefit task by awarding environmental certificates to past environmental behaviors of intimate others.²⁷ As expected, compared to the control group, when a strong green certificate was given to the intimate others (indicating that the intimate others had engaged in several common environmentally friendly behaviors), the participants subsequently chose more carbon emission options for monetary benefit in the laboratory task, demonstrating a “vicarious moral licensing”. Such vicarious moral licensing effect in this study was in accord with previous studies, which reported that past environmentally friendly or moral behavior of intimate others induced subsequently individuals to behave less PEB²¹ and more racial bias for Blacks in career recruitment tasks,^{37,56} and more immoral behaviors.¹² Moreover, after giving a weak green certificate to the intimate others (indicating that intimate others had engaged in few of the scarce environmentally friendly behaviors in the past), the participants subsequently chose more carbon emission options for monetary benefit in the laboratory task, demonstrating a “vicarious moral identity effect”. This finding was also supported by the previous studies, which showed that individuals were more tolerant of selfish behavior³⁸ and engaged in more immoral behavior^{9,41} after they observed intimate others behave the selfish or immoral behavior. Therefore, the consistency of this result with the hypotheses initially validated the vicarious moral licensing and identity effects in the proscriptive moral domain of carbon emissions. However, post-experiment interviews for some participants revealed that they reported these both common and scarce environmentally friendly behaviors may not be enough representative. Thus, such environmental behaviors cited from previous studies may negatively affect the environmental attitude or value of close friends and further could confound the experimental findings. Therefore, Study 2 further validated the findings of Study 1 using a classical behavioral imagery priming task to operate different environmental behaviors of a close friend.

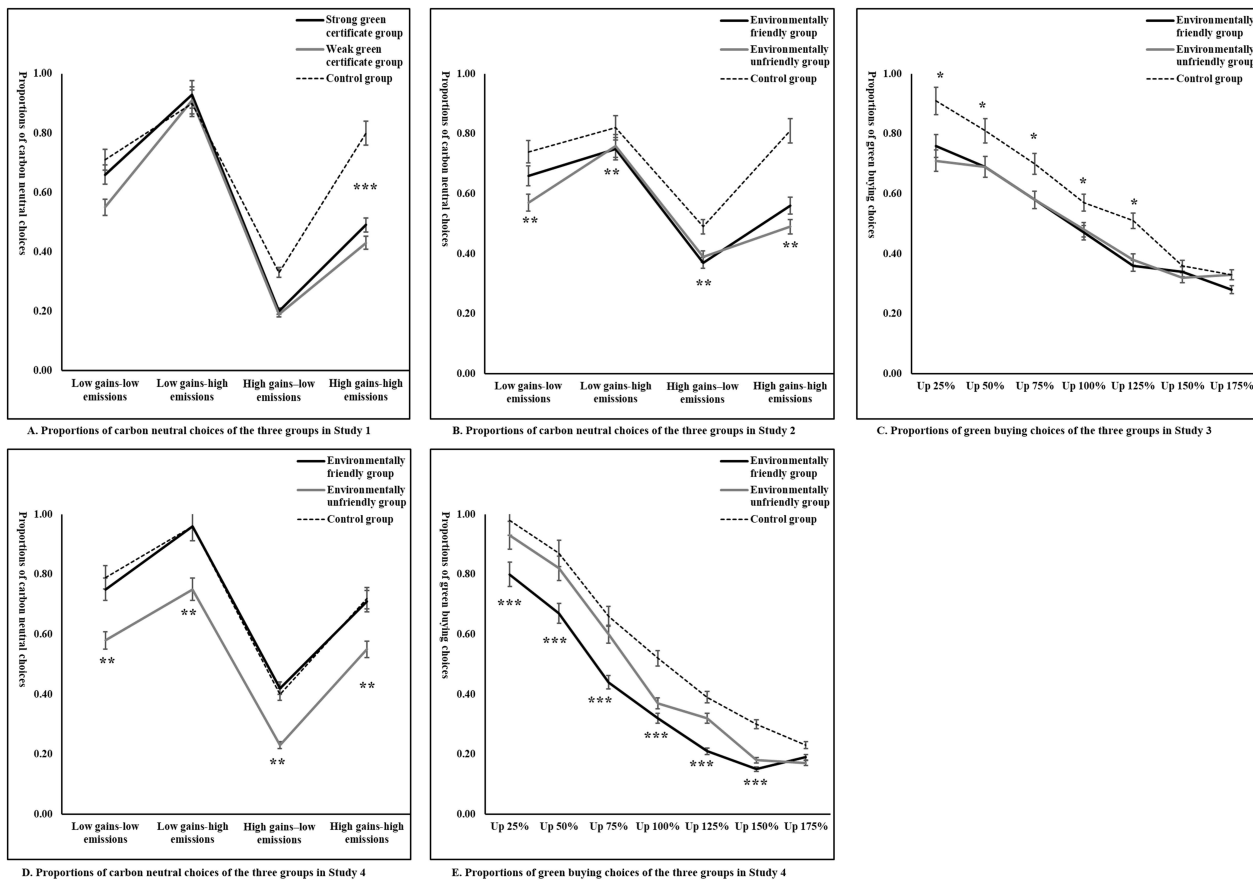


Figure 3 Proportions of carbon emission and green purchasing choices in Study 1–4. **(A)** Is the carbon emission in Study 1; **(B)** Is the carbon emission in Study 2; **(C)** Is the green purchasing in Study 3; **(C and D)** Are the carbon emission and green purchasing in Study 4. **Notes:** * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Study 2

Methods

Participants and Experimental Design

The calculation of G*Power 3.1 showed that at least 81 participants needed to be recruited to guarantee the medium effect size (effect size = 0.3) and statistical test power ($\beta = 0.85$). 120 college students (54 males, Mage = 19.86 ± 0.92) aged 18–22 years participated in this study. The study’s experimental design was the same as that of Study 1.

Experimental Materials and Procedure

Behavioral Imagery Priming Task

Referring to the behavioral imagery task of intimate others used by Meijers et al,¹² participants were asked to provide the name of an intimate other and were presented with a paragraph describing the environmentally friendly behavior (eg, garbage sorting), environmentally unfriendly behavior (eg, wasting water), or environmentally irrelevant behavior (eg, walking and talking with family). The participants were then asked to imagine that the intimate others were the protagonists of these environmental behaviors and to think carefully about how exactly the intimate others engaged in these behaviors and at what cost. Moreover, participants also answered an open-ended question (“Why does the intimate other engage in this behavior?”) to test whether participants had carefully read the contextual information and imagined the scenario. In addition, to avoid the three types of environmental behaviors that the participants could not be understood and imagined, three of the most typical environmental behaviors that require strong effort, the most irritating environmental unfriendly behaviors, and the most common daily behaviors of college students were collected through

interviews in advance by scoring. Finally, the experimental procedure was the same as in Study 1, except that the method of priming environmental behavior was changed to the behavioral imagery priming task.

Results

The priming of environmental behaviors was successful, and the results of the operational test are presented in Table 2. A one-way ANOVA on the pro-environmental behavioral willingness indicated that the main effect of the group was not significant ($F(2, 117) = 0.71, p = 0.50, \eta_p^2 = 0.01$). The main effect of the group on carbon-neutral behavior was significant ($F(2, 117) = 5.86, p = 0.004, \eta_p^2 = 0.09$). Both the participants both environmentally friendly ($t(78) = -2.89, p = 0.03$) and unfriendly ($t(78) = -2.97, p = 0.004$) groups opted for fewer carbon-neutral choices than those in the control group. A significant main effect of the matrix was observed ($F(3, 351) = 22.41, p < 0.001, \eta_p^2 = 0.16$). Participants opted for the highest proportion of carbon-neutral behavior in the low benefit-high emissions condition, followed by low benefit-low emissions, high benefit-high emissions, and the lowest proportion in the high benefit-low emissions conditions ($t_s = 3.23 \sim 5.91, p_s < 0.002$). In addition, the group-matrix interaction was not significant ($F(6, 351) = 1.31, p = 0.25, \eta_p^2 = 0.02$, see Figure 3).

Table 2 Results of Priming Checks, Willingness, and PEB in Study 2 (M \pm SD)

| | | Environmentally Friendly Group (n=40) | Control Group (n=40) | Environmental Unfriendly Group (n=40) |
|-------------------------------|---------------------------|---------------------------------------|----------------------|---------------------------------------|
| Priming checks | Environmental property | 100% \pm 0% | 0% \pm 0% | 100% \pm 0% |
| | Environmental ratings | 4.52 \pm 0.78 | / | 1.55 \pm 0.62 |
| Pro-environmental willingness | | 4.94 \pm 0.98 | 5.07 \pm 0.95 | 4.80 \pm 1.07 |
| Carbon neutral behavior | Low gains-low emissions | 0.66 \pm 0.30 | 0.74 \pm 0.32 | 0.57 \pm 0.34 |
| | Low gains-high emissions | 0.75 \pm 0.37 | 0.82 \pm 0.29 | 0.76 \pm 0.40 |
| | High gains-low emissions | 0.37 \pm 0.41 | 0.49 \pm 0.45 | 0.39 \pm 0.45 |
| | High gains-high emissions | 0.56 \pm 0.39 | 0.81 \pm 0.29 | 0.49 \pm 0.40 |

Discussion of Study 2

Study 2 further revealed the significant vicarious moral licensing and identity effects based on the classical behavioral imagery priming task in the carbon emission task in the proscriptive moral domain. Pro-environmental willingness was not significantly affected, and the vicarious moral cleansing effects were still not observed. The behavioral imagery priming task addressed the lack of representation of both common and scarce environmental behaviors in Study 1. These results are in line with the previous study,²¹ people showed lower environmentally friendly intentions after reading a close other behaves in an environmentally friendly way. However, these environmental behaviors for the imagery priming task which were provided by most subjects through interviews before the experiment, could not represent the personal experience and individual differences of each college student. Thus, Study 3 would adopt the event recall and description task to instruct college students themselves to individually recall and describe a typical environmental behavior of their close friends. Additionally, previous studies have suggested that significantly different behavioral tendencies in prosocial behaviors were observed in pro-social behaviors between the proscriptive and prescriptive moral domains.⁵⁴ Therefore, Study 3 used the green purchasing task in the prescriptive moral domain as an observer of pro-environmental behavior, to further validate vicarious moral self-regulation effects.

Study 3

Methods

Participants and Experimental Design

According to the calculations using G*Power 3.1, at least 75 participants needed to be recruited to guarantee the medium effect size (effect size = 0.3, according to the previous study²¹) and statistical test power ($\beta = 0.85$). Ninety-three college

students (41 males, Mage = 18.92 ± 1.01) aged 18–22 years participated in this study. The study adopted a 3 (group: environmentally friendly group, environmentally unfriendly group, and control group) × 7 (price level: 25%, 50%, 75%, 100%, 125%, 150%, and 175%) two-factor mixed design. The group was a between-participants variable, the price level was operated as 7 levels indicating that the price of green products was higher than that of common products. The dependent variables were pro-environmental willingness and the proportions of participants choosing the green product option.

Experimental Materials and Procedures

Free Recall and Description Task

Referring to Sachdeva et al's free recall and description task in the moral self-regulation study,¹ the participants were asked to recall environmental behaviors which intimate others engaged in the last six months (considering that they were able to recall events within a certain time range), but which was not related to the participants. The participants in the environmentally friendly behavior group were asked to recall and describe the details of an impressive pro-environmentally friendly behavior of intimate others engaging in the last six months. The participants in the environmentally unfriendly behavior group were asked to recall and describe the details of an impressive and harmful behavior to the environment of intimate others. The participants in the control group were instructed to recall and describe the details of a common episode in their daily life that intimate others engaged in the last six months. The participants were asked to recall the events and describe them in as much detail as possible, in no less than 100 words.

Green Purchasing Task

In this task, eight daily life or school products (keychains, notebooks, paper extraction, laundry detergent, garbage bags, mugs, fresheners, and umbrellas) were selected as target products and were divided into both ordinary and green products based on the task guideline. According to Alibaba's survey, the price of green products generally has a premium of about 33%. Therefore, to ensure the ecological validity of the price of green products in the experiment and to avoid the extreme situation in which participants always choose to purchase green products when their price is low, we followed the paradigm of the previous study⁵¹ to manipulate the price level. According to the previous study,^{49,51} the prices of these products were set as 25%, 50%, 75%, 100%, 125%, 150%, and 175% higher than that of ordinary products, respectively. In detail, the prices of the ordinary were as follows: keychain, ¥3.14; notebook, ¥5.15; paper extractor, ¥8; laundry detergent, ¥10; garbage bag, ¥12; mug, ¥15.12; freshener, ¥17.1; umbrella, ¥20. The sequence of single trials during the green purchasing task was presented in Figure 4.

Experimental Procedure

Participants read scientific information about the positive value of green consumption for nature and human survival in the laboratory. The process was the same as in Study 2 except for both the Free recall and description task and the green purchasing task. After the experiment participants would randomly choose the result of a trial as the amount spent on green consumption (10:1 ratio) which was deducted from the base remuneration (¥30). In addition, the whole experiment consisted of 56 trials and lasted about 20 minutes.

Results

The priming of environmental behavior was successful, and the results of the operational test are presented in Table 3. The results of one-way ANOVA on the pro-environmental behavior willingness indicated that the main effect of the



Figure 4 The sequence of events in the green purchasing task of Study 3.

Table 3 Results of Priming Checks, Willingness, and PEB in Study 3 (M ± SD)

| | | Environmentally Friendly Group (n=31) | Control Group (n=31) | Environmental Unfriendly Group (n=31) |
|-------------------------------|------------------------|---------------------------------------|----------------------|---------------------------------------|
| Priming checks | Environmental property | 100% ± 0% | 0% ± 0% | 100% ± 0% |
| | Environmental ratings | 4.65±2.11 | / | 1.54±1.42 |
| Pro-environmental willingness | | 5.16 ±1.00 | 5.23±0.91 | 4.80±0.94 |
| Green purchasing behavior | Up 25% | 0.76± 0.29 | 0.91± 0.11 | 0.71 ± 0.25 |
| | Up 50% | 0.69 ± 0.23 | 0.81 ± 0.20 | 0.69 ± 0.26 |
| | Up 75% | 0.58 ± 0.24 | 0.70 ± 0.24 | 0.58 ± 0.28 |
| | Up 100% | 0.47 ± 0.25 | 0.57 ± 0.27 | 0.48 ± 0.26 |
| | Up 125% | 0.36 ± 0.19 | 0.51 ± 0.25 | 0.38 ± 0.28 |
| | Up 150% | 0.34 ± 0.21 | 0.36 ± 0.19 | 0.32 ± 0.27 |
| | Up 175% | 0.28 ± 0.20 | 0.33 ± 0.19 | 0.33 ± 0.25 |

group was not significant ($F(2, 90) = 1.93, p = 0.15, \eta_p^2 = 0.04$). However, a significant group main effect on green purchasing behavior was observed ($F(62, 90) = 3.53, p = 0.03, \eta_p^2 = 0.07$). Green purchasing behavior was significantly lower in both the environmentally friendly ($t(60) = -2.52, p = 0.01$) and unfriendly groups ($t(70) = -2.20, p = 0.03$) compared to the control group. The main effect of the price level was significant ($F(6, 540) = 106.69, p < 0.001, \eta_p^2 = 0.54$), with higher green product prices indicating a lower proportion of participants choosing green products ($ts = 3.20 \sim 13.99, ps < 0.05$). The interaction between the group and price level was not significant ($F(12, 540) = 1.41, p = 0.16, \eta_p^2 = 0.03$, see Figure 3).

Discussion of Study 3

Study 3 further revealed that environmental behaviors of intimate others through the free recall and description task still induced significant “vicarious moral licensing and identity effects” in green purchasing behaviors in the prescriptive moral domain. These findings were in accord with the previous studies, which suggested that participants would behave less PEB when recalling and describing environmentally friendly behaviors, people made less PEB²¹ and less prosocial behaviors.⁴¹ This finding supported the hypotheses of vicarious moral self-regulation effect in PEB again. Although Studies 1–3 repeatedly found stable vicarious moral self-regulation effects in two typically PEB in proscriptive and prescriptive moral domains, individual differences may arise due to individual differences in the different groups and studies, leading to limitations in comparing the similarities and differences between the two types of PEB. Therefore, Study 4 would use the within-group design between two types of pro-environment behaviors (ie, carbon emission behavior and green purchasing behavior) to further verify the vicarious moral self-regulation effects.

Study 4

Methods

Participants and Experimental Design

Based on the calculations using G*Power 3.1, to guarantee the medium effect size (effect size = 0.3) and statistical test power ($\beta = 0.85$), it needs to recruit at least 81 participants in the carbon emission task and 75 participants in the green purchasing task, respectively. Thus, ninety university students (43 males, Mage = 19.41 ± 0.85) aged 18–22 years participated in this study.

Experimental Materials and Procedures

Vicarious self-regulation was primed by free recalling and describing the intimate friends’ past environmental behaviors (friendly, unfriendly, or unrelated). Subsequently, participants were asked to complete the operational test of priming and the pro-environmental behavior willingness scale, along with the carbon emission and green purchasing tasks. The order of the two tasks was balanced among participants. Study 4 conducted ANOVAs on the dependent variable indicators of

pro-environmental willingness, carbon neutral proportions, and green purchasing proportions. In addition, to avoid interference caused by the presentation order of carbon emission behavior and green purchasing behavior, the presentation order of the two tasks was randomized within the subjects and balanced among the subjects.

Results

The priming of environmental behavior was successful, and the results of the operational tests are presented in Table 4. The results of ANOVA for pro-environmental willingness showed that the main effect of the group was not significant ($F(2, 87) = 0.95, p = 0.83, \eta_p^2 = 0.01$). The main effect of the group on carbon-neutral behavior was significant ($F(2, 87) = 5.91, p = 0.004, \eta_p^2 = 0.12$). Participants in the environmentally unfriendly group opted for fewer carbon-neutral choices than those in the control group ($t(58) = -2.60, p = 0.01$); whereas, there was no significant difference between the environmentally friendly and control groups ($t(58) = 0.28, p = 0.78$). A significant main effect of the benefit–emissions matrix was observed ($F(3, 261) = 69.99, p < 0.001, \eta_p^2 = 0.45$). Participants opted for the highest proportion of carbon neutral behavior in the low benefit–high emissions condition, followed by low benefit–low emissions, high benefit–high emissions, and the lowest proportion in the high benefit–low emissions conditions ($t(89) = 6.05\sim 11.88, ps < 0.001$). The interaction between Group and Matrix was not significant ($F(6, 261) = 0.38, p = 0.89, \eta_p^2 = 0.01$). Moreover, the main effect of the group on green purchasing behavior was significant ($F(2, 87) = 8.52, p < 0.001, \eta_p^2 = 0.16$). Green purchasing behavior was significantly lower in the environmentally friendly group than in the control group ($t(58) = -4.34, p < 0.001$), whereas no significant difference was observed between the environmentally unfriendly and control groups ($t(58) = -1.76, p = 0.08$). The main effect of the price level was significant ($F(6, 522) = 182.58, p < 0.001, \eta_p^2 = 0.68$), with higher green product prices indicating a lower proportion of participants choosing green products ($ts = 3.70 \sim 24.28, ps < 0.01$). In addition, the interaction between Group and Price level was not significant ($F(12, 522) = 1.29, p = 0.25, \eta_p^2 = 0.03$, see Figure 3).

Discussion of Study 4

Study 4 further verified the stability and generalizability of vicarious moral self-regulation effect by a within-group design of two types of PEB. The findings remained stable in terms of vicarious moral licensing and identity effect. Specifically, free recalling and describing environmentally friendly behaviors of intimate others only prompted participants to make fewer subsequent green purchases, demonstrating a clear “vicarious moral licensing effect”, whereas it did

Table 4 Results of Priming Checks, Willingness, and Behaviors of PEB in Study 4 (M ± SD)

| | | Environmentally Friendly Group (n=30) | Control Group (n=30) | Environmental Unfriendly Group (n=30) |
|-------------------------------|---------------------------|---------------------------------------|----------------------|---------------------------------------|
| Priming checks | Environmental property | 100% ± 0% | 0% ± 0% | 100% ± 0% |
| | Environmental ratings | 4.72 ± 0.82 | / | 1.27 ± 0.42 |
| Pro-environmental willingness | | 5.20 ± 0.93 | 5.02 ± 0.98 | 4.92 ± 0.88 |
| Carbon neutral behavior | Low gains-low emissions | 0.75 ± 0.27 | 0.79 ± 0.29 | 0.58 ± 0.38 |
| | Low gains-high emissions | 0.96 ± 0.15 | 0.96 ± 0.12 | 0.75 ± 0.38 |
| | High gains-low emissions | 0.42 ± 0.38 | 0.40 ± 0.46 | 0.23 ± 0.38 |
| | High gains-high emissions | 0.71 ± 0.30 | 0.72 ± 0.36 | 0.55 ± 0.45 |
| Green purchasing behavior | Up 25% | 0.80 ± 0.19 | 0.98 ± 0.05 | 0.93 ± 0.11 |
| | Up 50% | 0.67 ± 0.25 | 0.87 ± 0.18 | 0.82 ± 0.20 |
| | Up 75% | 0.44 ± 0.23 | 0.66 ± 0.27 | 0.60 ± 0.25 |
| | Up 100% | 0.32 ± 0.27 | 0.52 ± 0.29 | 0.37 ± 0.36 |
| | Up 125% | 0.21 ± 0.21 | 0.39 ± 0.30 | 0.32 ± 0.32 |
| | Up 150% | 0.15 ± 0.21 | 0.30 ± 0.27 | 0.18 ± 0.23 |
| | Up 175% | 0.19 ± 0.19 | 0.23 ± 0.16 | 0.17 ± 0.12 |

not affect their carbon-neutral behaviors. Free recalling and describing the environmentally unfriendly behaviors of intimate others also prompted participants to make fewer carbon-neutral purchases, demonstrating a significant “vicarious moral identity effect”, but it did not affect their green purchasing behaviors. However, these findings partly supported the hypotheses of vicarious moral self-regulation effect in both prescriptive and proscriptive PEB. These previous studies have demonstrated that people could behave in different cognitive processes and behavioral responses during prosocial decision-making.⁵⁵ Therefore, such vicarious effects are not persistent in the same individual and can easily accomplish the repair of moral inconsistency dissonance by making a single pro-environmental behavior.

General Discussion

Overall, participants in the four studies had high levels of willingness to engage in PEB ($M = 5.06$, $SD = 0.91$, $Max = 7.00$). After operating either environmentally friendly or unfriendly behaviors of intimate others by the awarding of green certificates task, behavioral imagery priming task, and free recalling and describing tasks, there was no significant change of pro-environment willingness observed in Chinese college students. This finding was supported by previous studies. As explicit pro-environmental behavioral attitude was susceptible to social norms such as social desirability effects, college students may mainly exhibit high levels of pro-environmental behavioral willingness.⁵⁷ However, this may also result from the insensitive measurement instrument for pro-environmental attitudes. Therefore, future studies need to use different measurement instruments to verify the stability and generalizability of vicarious moral self-regulation effects in pro-environmental willingness. In addition, this study obtained relatively consistent results through four studies. Whether by issuing green certificates to intimate friends (Study 1) or by imagining (Study 2) and recalling (Study 3 and 4) intimate friends’ environmental behaviors, vicarious moral licensing and identity effects were stably induced in both proscriptive and prescriptive pro-environmental domains. In general, individuals tend to produce less carbon-neutral behavior or green purchasing behavior when their intimate friends engage in environment-related behaviors, whether friendly or unfriendly. As the saying goes, “He who handles vermilion will be reddened, and he who touches ink will be blackened”. If “red” was compared to environmentally friendly behavior and “black” was compared to environmentally unfriendly behavior, you would become “black” whether your intimate friend was “red” or “black”. This may not seem to be in line with reality, but it does exist stably in our daily life.

On the one hand, this study showed that environmentally friendly behavior of intimate others induced a significant “vicarious moral licensing effect”. Participants perceived the environmentally friendly behavior of intimate others as if they had engaged in the behavior themselves, leading them to make less pro-environmental behavior in subsequent either carbon-neutral behavior or green purchasing behavior. This finding is supported by previous studies. A similar “vicarious moral licensing effect” induced by in-group membership was observed in the area of racial bias, where in-group members’ non-racial bias attitude induced participants to express significant racial bias toward Blacks in subsequent career recruitment tasks.^{37,56} This vicarious moral licensing effect was also validated in pro-environmental behavior. For example, past environmentally friendly or moral behavior of intimate others induced individuals to subsequently behave less PEB.¹² Previous studies have used the moral credits model or the moral credentials model to explain the mechanisms underlying the moral licensing effect.^{5,58} The moral credits model assumed that past moral behaviors can earn moral credits for themselves and then these credits can eliminate the negative effects of future immoral behaviors.^{1,59,60} When the target behavior was morally ambiguous, individuals would award themselves moral credentials for prior moral behavior and provide plausible explanations and preferences for subsequent immoral behavior.^{60,61}

On the other hand, the environmentally unfriendly behavior of intimate others induced a “vicarious moral identity effect” in Chinese college students. Specifically, participants perceived the environmentally unfriendly behavior of intimate others as if they had engaged in it themselves. This passive self-identification induced participants to make less pro-environmental behavior in subsequent either carbon emission tasks or green purchasing tasks. This finding is also supported by other studies. For instance, the selfish or immoral behavior of intimate others can prompt individuals to be more tolerant of selfish behavior³⁸ and to engage in more immoral behavior.^{9,41} When individuals felt psychologically close to these selfish someone, they think that their behavior was not as bad as they thought. This loose moral standard triggered more immoral behaviors. According to the findings of this study, when intimate others made environmentally unfriendly behaviors, individuals also suffered from their contagion and subsequently made less green purchasing

behavior or carbon neutral behavior. Doing good things takes effort while doing bad things is effortless. Previous studies have also attempted to use the “broken windows theory” to explain the “moral identity effect” induced by past immoral behavior. For example, people are more likely to be influenced by immoral or environmentally unfriendly behavior. In addition, these findings in the current study are consistent with the findings of Meijers et al.¹² The environmentally unfriendly behavior of intimate others did not induce a significant “vicarious moral cleansing effect”. Therefore, people do not seem motivated to cleanse the cognitive dissonance caused by the environmentally unfriendly behavior of intimate others. This may be an interpersonal moral balancing effect because cleaning up the environmentally unfriendly behavior of intimate others in a more environmentally friendly way is costly in terms of money, time, and subjective effort, and even brings about psychological burdens and embarrassing experiences. Thus, the evidence for moral cleansing effects in the environmental domain is complex and ambiguous, which may be attributed to the uniqueness of environmental issues, such as the unidentifiability of victims, the complexity of the problem, their global nature, the lack of intentionality, and the ease of free-riding. These factors could hinder individuals to make more psychological efforts to engage in environmental behaviors.^{20,33,62}

Interestingly, the vicarious moral licensing effect disappeared for the carbon emission task in Study 4. It may be attributed to the participants’ moral balancing between the two environmental tasks. Although we balanced the order of the two types of tasks, the “vicarious moral licensing effect” disappeared only in the carbon emission task. It is conjectured that the participants had already accomplished the moral balance in the green purchasing task. Moreover, the carbon emission task in the proscriptive domain was too costly to promote the obvious spillover of the moral licensing effect. Another possible reason is the moral threshold of each participant. Individuals can tolerate the small “bad” things they do; however, it can lead to internal conflicts to inhibit environmentally unfriendly behavior as long as the moral threshold is exceeded. Doing evil (benefiting from carbon emissions) is perhaps more of a challenge to our moral boundaries than doing nothing (not engaging in green consumption). Therefore, the feedback and emphasis on the destructive nature of environmental behavioral consequences may enhance college students’ PEB.

The present study used four behavioral experiments to verify for the first time the existence of vicarious moral self-regulation effects in the pro-environmental behavior of Chinese college students, expanding the research in this field. However, there are some limitations to this study. Firstly, the free recall and description task primarily relied on participants’ retrospective memory, which could lead to factual bias. Secondly, the measures of pro-environmental behavior still lacked sufficient ecological validity. Although both the behavioral experiment and questionnaire method was classical methods for measuring pro-environmental willingness and behaviors, how pro-environmental behavior was dynamically measured in the future still needs to be explored in depth, such as the diary method and the field experiments. Finally, little was still known about the boundary conditions of vicarious moral-self regulation effects during the pro-environmental behavior. Although the environmental behavior of close friends has a significant influence on the subsequent environmental behavior of college students, is this influence moderated by social distance? Where is the boundary, such as relatives, lovers, acquaintances, and strangers? All these need to be explored in the future. In addition, the vicarious moral self-regulation effect observed in college students can also be explained by peer influence.^{63,64} Therefore, future studies can further explore the influence of peer characteristics (such as age, gender, personality, presence or absence, etc) on this vicarious effect in college students.

Conclusion

In summary, whether by issuing green certificates to intimate friends or imagining and recalling intimate friends’ environmental behaviors can reduce Chinese college students’ PEB in the proscriptive and prescriptive moral domain, showing obvious “vicarious licensing and identity effect”. The vicarious moral self-regulation effect (ie, Be a rascal among rascal.) in pro-environmental behavior observed in this study can provide scientific reference to improve the level of pro-environmental behavior among college students.

Ethics Approval and Informed Consent

We confirmed that all participants have signed an informed consent before the experiment and were informed why the research was being conducted. The participants were investigated whether they were willing to attend this research and

whether they are willing to let data be published as well. In addition, they can quit the research anytime if they wished. We also promised that the data would be anonymous and the identifiable information was eliminated as well. Because our research was non-interventional, our studies were approved by the Biomedical Research Ethics Committee of Hunan Normal University. The research reported in the manuscript strictly respects the Declaration of Helsinki Ethical Principles.

Author Contributions

All authors contributed significantly to the work, whether in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; approved the final version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

All authors report that there are no competing interests to declare in this work.

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