Review

Green Product Innovation via Green Transformational Leadership and Employees' OCBE: The Moderating Role of Green Organizational Climate– Empirical Evidence from China' Manufacturing Enterprises

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Abstract

Employees are the key for enterprises to practice green product innovation, and their green innovation behavior is influenced by both direct leadership and organizational atmosphere. However, previous studies mostly studied the influence of leadership on employees' green behavior from the theory of planned behavior. The study based on social learning theory, reveals the mechanism of employees' organizational citizenship behavior toward the environment and green organization atmosphere in stimulating employees' green product innovation. By using SPSS23.0, AMOS24.0 and other data processing software, 312 valid questionnaires of manufacturing enterprises were analyzed. This conclusion is conducive to enrich the relevant research on the impact mechanism of green transformational leadership on green product innovation. Enterprises should take several measures to improve the green atmosphere of the organization and encourage employees' green behavior.

Introduction

In recent years, with the in-depth development of China's economic construction, the issue of green environmental protection has received more and more attention by society. As the main body of innovation, manufacturing enterprises play an important role in the development of innovation and green development under the trend of environmentalism, and continuously promote the green and high-quality development of the economy [1]. How to achieve a balance between improving performance and ensuring environmental sustainability has become an important direction for the sustainable development of manufacturing enterprises [2]. According to data released by the Ministry of

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Industry and Information Technology of China, China's industrial green design products will grow at an annual rate of 78.03% between 2017 and 2021, most of which are manufacturing enterprises. Green product innovation refers to the avoidance or reduction of environmental damage by improving products, processes, technologies and systems [3]. Studies have found that green product innovation can improve the environmental performance of enterprises, to meet the requirements of environmental management [3, 4]. It has become an important determinant of the sustainable development of enterprises. At the same time, increasing manufacturing enterprises are developing green products to increase differentiated advantages [4-6], thereby enhancing their competitiveness [7]. Green product innovation has been widely concerned by the practice of science and manufacturing enterprises and researchers.

From the perspectives of social factors, organizational environment and individual characteristics, existing studies have found that market demand, external participation in environmental regulation [8, 9], knowledge [10], collaboration [11, 12], innovation-oriented learning [13], creative thinking [14], etc. have a significant impact on green product innovation. Some studies have researched the relationship between green innovation and top management commitment [8], academic experience [15], faultlines of top management team [16]. However, few empirical studies examine leaders' incentives for green product innovation [14]. Some study believes that the green drive within the enterprise can explain the environmental behavior of the enterprise more effectively than the external pressure [17]. As the core force of an enterprise, leaders influence a series of traditional organizational outcomes and play a critical role in driving green innovation [18]. Among them, green transformational leadership is defined as the behavior of a leader to encourage subordinates and organizations to achieve environmental goals and exceed the expected environmental performance level [19]. Some studies have shown that specific leadership styles, that is, specific environment-oriented transformational leadership, are important in the context of influencing pro-environmental behaviors in the workplace [20-22], and green transformational leadership is an important decision for green innovation performance factor [23]. Although studies have provided preliminary insights into the role of leadership in predicting employees' pro-environmental behavior and green innovation performance, there is a lack of a comprehensive understanding of the processes and mechanisms by which green transformational leadership affects employees' green innovation. In addition, the research has not considered how leaders can help organizations innovate in green products, and the understanding of the boundary conditions of green product innovation by green transformative leaders has been neglected and needs further exploration.

Organizational citizenship behavior toward the environment is the spontaneous out-of-role behavior of employees [24, 25]. According to the theory of social learning, employees' organizational citizenship behavior toward the environment is the result of the organization members being demonstrated and influenced by environmental leaders [26]. By supporting the organization's green strategies and initiatives, environmentally specific transformational leadership communicate clear environmental values and environmental sustainability priorities to employees [22], thereby formulating norms for acceptable behaviors and demonstrating their commitment to protect the environment. From observation and learning, employees can perceive the leadership's emphasis on environmental practice [27]. At the same time, when employees are supported by their superior management, they will give feedback to participate, and form a form of mutual support among employee groups, so as to stimulate employees' environmental awareness and promote their organizational citizenship behavior toward the environment [28]. The feedback effect of employees' organizational citizenship behavior toward the environment in the group can encourage colleagues to participate in environmental protection and the degree of collaboration [29] and promote active and innovative green behavior. Therefore, this study selects the employees' organizational citizenship behavior toward the environment as mediating variable to explain the impact of environmentally specific transformational leadership on green product innovation.

In addition, social learning theory holds that environment plays an important role in human behavior [30]. People are born with the need to adapt to the environment, and this need will stimulate appropriate behavior [31]. Therefore, this study takes the perceived green organizational climate as a moderating variable, which refers to the employees' common perception of the organization's pro-environmental policies, procedures, and practices [32]. This kind of pro-environmental cognition can diffusion and spread among the group, form a working environment that supports and stimulate innovation. It can also expand the influence of green transformational leadership, and thus affect the environmentally friendly social activities of surrounding colleagues. However, whether the organizational atmosphere is strong or not will affect the strength of norms and the scope of adaptability [33, 34], and further, affect the consistency and uniformity of group behavior [35]. Therefore, the green organizational climate can regulate the relationship between the green transformational leadership and the employee's organizational citizenship behavior toward the environment.

Based on the above discussion, this study takes the organizational citizenship behavior toward the environment as the mediating variable, introduces the green organization atmosphere as the moderator variable, analysis and examines the influence of green
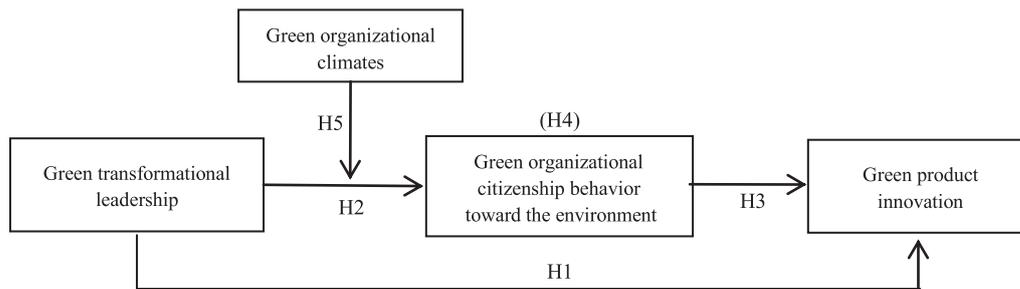
Fig. 1. The hypothetical framework.

transformative leadership on green product innovation, with a view to better guiding the organization practice. This is a positive attempt to expand the application field of social learning theory and further enrich the antecedent research of green product innovation. The hypothetical framework is shown in Fig. 1.

The rest of this article is organized as follows. In section 2, based on social learning theory and research model, we analyze relevant literature and propose corresponding hypotheses. In addition, the main data sources and research methods are introduced. In Section 3, we test the reliability and validity of the measurement model and the structural model, and test whether the hypothesis is valid, summarize and discuss according to the hypothesis. Section 4 summarizes the findings and puts forward research limitations.

Materials and Methods

Theoretical Background and Hypotheses

Green product innovation is a new type of technological innovation, which refers to product innovation to avoid or reduce environmental damage throughout the life cycle. It can avoid or reduce environmental damage in the whole life cycle [3]. It covers innovative projects aimed at energy conservation, consumption reduction and pollution prevention, as well as creative activities in technology, products, services, etc. These products usually use less energy, have lower emissions and use more environmentally friendly materials [7]. At the same time, green product innovation bears higher costs and risks than other green behaviors, with double spillover characteristics [36].

Green transformational leadership is the extension and application of transformational leadership theory in the field of environmental responsibility. Its content mainly focuses on encouraging and supporting active environmental protection measures, which can stimulate individual employees and organizations to produce pro-environmental behaviors beyond expectations, so as to achieve higher environmental goals [20, 37]. According to the characteristics and connotation of green

transformational leadership, Robertson [20] divided it into four aspects: environmental idealized influence, environmental inspirational motivation, environmental intellectual stimulation and environmental individualized consideration. Correspondingly, the impact of environmental idealized influence can shift the attention of goal-setting to tasks related to environmental friendly products by conveying clear environmental values, and build trust and recognition, which helps organizations and individuals to focus more actively on environmental tasks [37], thus catalyzing the innovative concept of green products of organization members. Environmental inspirational motivation encourages employees to increase their environmental passion and optimism [24, 38], so that they will not fear and shrink when they encounter challenges in the innovation process. Environmental intellectual stimulation can encourage and allow employees to think in novel ways, and propose diversified environmental protection strategies and solutions, thereby enhancing the ability of green product innovation [39]. Environmental intellectual stimulation emphasizes paying attention to individual needs with a developmental perspective, guiding individuals to break through self-setting and pursuing high-target innovation [19].

In addition, the research results also demonstrate that enterprise managers with higher environmental awareness can still choose appropriate opportunities for green innovation after considering the risk of green innovation and high cost [36]. At the same time, green product innovation may be affected by organizational conventions and tacit knowledge related to environmental issues [2]. While, green transformational leadership can break through the inherent thinking, stimulate the organization to learn and innovate [20], and provide the organization with the resource support needed for green innovation, including organizational structure adjustment, personnel and fund allocation, ways to participate in decision-making and related project technical support [4]. It can be said that green transformational leadership provides support for the organization's green product innovation from the aspects of stimulating innovation motivation, creating innovation opportunities and cultivating creative ability. Based on this, the following assumptions are put forward:

– H1 Green transformational leadership can positively impact green product innovation.

Organizational citizenship behavior toward the environment is a kind of spontaneous out-of-role behavior of employees, which is usually not rewarded and required by the formal system within the organization. Therefore, it is a voluntary behavior outside the work tasks and responsibilities, which can effectively supplement the defects and deficiencies of the formal environmental management system [40, 41].

The paths for organizational citizenship behavior toward the environment to promote green product innovation include: firstly, because green innovation depends on the voluntary sharing of tacit knowledge of personal experience to a certain extent, these experiences are difficult to formalize through structured and clear practices [42], while organizational citizenship behavior can have a positive impact on the sharing of tacit knowledge [43]; Secondly, the high environmental initiative of organizational citizenship behavior toward the environment often reflects the high self-learning and self-actualization willingness of employees, which is conducive to the accumulation of green innovation knowledge and ability [44]; Finally, the altruism of organizational citizenship behavior toward the environment and the characteristics beneficial to organizational interests can strengthen the coordination between departments and employees, it can help to shape innovation teams and form innovation atmosphere, and further provide conditions for green product innovation.

At the same time, many studies have pointed out that social learning theory explains that organizational citizenship behavior toward the environment is the result of organization members being demonstrated and influenced by environmental leaders [26, 41]. Green transformational leadership provides learning insights related to environmental practices, shifting attention from the one-way influence of formal leadership to the process of encouraging organizational common influence. This influence process can create a culture that encourages organizational citizenship behavior and is expressed in the group in the form of mutual support among employees and organizational support [28]. In addition, green transformational leadership, as the practice of environmental protection values, conveys clear environmental protection orientation and priority of task information to employees [21]. This can change employees' inertial cognition, thus promoting the internalization effect of employees' subjective norms and values, and generating more active pro-environmental behaviors.

Further, organization members will perceive more green support from green transformational leadership. On the one hand, in order to compensate, more organizational citizenship behavior toward the environment will be exported in response, which may stimulate the active participation and discussion of others at the same time [29]. Because employees with more organizational citizenship behavior are more likely to improve their self-control beyond expectations and make additional efforts for environmental goals [40]. This will help to create a better environmental foundation and support conditions for green product innovation of manufacturing enterprises. On the other hand, green transformational leadership focusing on encouraging environmental protection measures can effectively enhance the organizational citizenship behavior toward the environment, and at the same time promote the cooperative spirit and coordinated behavior among employees. It can enhance the conformity of employees to carry out green product innovation. Research have shown that this relationship will be stronger when employees are highly involved in the organization and show a high level of control or obtain extensive innovation support from supervisors [45]. In combination with Hypothesis 1 above, the following hypotheses are proposed:

– H2 Green transformational leadership can positively impact employees' organizational citizenship behavior toward the environment.

– H3 Employees' organizational citizenship behavior toward the environment can positively impact green product innovation.

– H4 Employees' organizational citizenship behavior toward the environment mediates the positive relationship between green transformational leadership and green product innovation.

Green organization atmosphere refers to the atmosphere formed by a series of sustainable development policies implemented by the organization, that is, employees' common views on the environmental management policies, practices and processes of the organization [46]. Atmosphere is formed by individuals in interactive learning, and individuals interpret surrounding information through social interaction to perceive their working environment [47], thus forming a consensus on organizational practices and policies. At the same time, the formation of atmosphere mainly depends on the behavior of employees' superior managers and how they explain the formulation framework of policies to employees [48].

Alt et al. [49] pointed out that a positive green culture can be created at different levels by building a shared vision. In organizational environmental management practices and processes, environmental managers transmit environmental values to employees and establish a common environmental vision, thus promoting employees' pro-green behavior [25]. This kind of more environmentally sensitive values and environmental protection practices are easily perceivable and perceivable by employees, and social interactions related to environmental protection can be initiated (between employees and colleagues, between employees and leaders). This is conducive to surrounding colleagues and organizations to shape a pro-environmental atmosphere and promotes the generation of environmental norms [46, 50]. All this

in turn generates corresponding behavioral decision-making pressure. Therefore, in the context of specific environmental goals, the green organizational climate shows which behaviors are effective and appropriate, because the embedded expectations clarify the scope of employees' behavior.

Based on this, in a strong green organizational climate, employees of manufacturing companies will more clearly perceive the organization's environmental value orientation, more clearly define the organization's strategic development goals, and internalize values as a transfer of psychological resources. It can make the green behavior of employees more unified, thereby promoting the employees' organizational citizenship behavior toward the environment of employees [51, 52]. At the same time, employees will judge if they do not choose the behaviors advocated by the green organization atmosphere, they may face the situation of not being accepted or excluded, which intensifies the consistency of their behavior choice tendency. On the contrary, a lower green organizational climate means that employees have more choices when facing multiple tasks in the workplace, and they are vulnerable to other factors and individual differences in the organizational context [53]. Especially, when encountering how to balance economic interests and environmental interests, it is not easy for employees to complete high-target environmental tasks based on altruism, which is not conducive to the production of pro-environmental behaviors. Accordingly, the following hypotheses are proposed:

– H5 Green organizational climate moderates the relationship between green transformational leadership and employees' organizational citizenship behavior toward the environment, that is, compared with low green organizational climate, green transformational leadership has a stronger impact on employees' organizational citizenship behavior toward the environment under high green organizational climate.

Data Collection Procedures

The data in this paper mainly come from the manufacturing enterprises in the east coast and southwest China. The eastern coastal area has developed economy, high degree of marketization, and active innovation activities. This part of the data comes from Dongguan, Shenzhen, Zhuhai, Zhongshan, Huizhou, Guangzhou and Foshan, etc. The southwest region has taken over the transfer of manufacturing industries from the east, and the data mainly come from Chengdu, Chongqing and Kunming. This study is carried out through two ways: field filling and network filling. On-site filling was conducted through EMBA and MBA training courses. The network questionnaire comes from the manufacturing enterprises and mainly cover electronics and information, biotechnology, environmental protection and other high-tech fields,

with middle and senior managers and line managers related to environmental management as subjects. Considering the availability and validity of the data, the nearest sampling method and target sampling method in non-probability sampling are mainly used to issue questionnaires. Firstly, through the small sample test, the formal questionnaires were issued after eliminating the items with factor load lower than 0.5, and finally 377 questionnaires were obtained. After deleting the samples of missing information, abnormal samples, and the samples of industries and positions that do not conform to the scope of research objects, 312 valid samples are obtained.

Measurement Design

In this study, a foreign maturity scale with good validity was selected as the measurement scale. It was translated and back-translated by two management doctoral students who are familiar with Chinese and English. Then the questionnaires were interpreted and pre-tested among manufacturing employees, so that they could be better understood and in line with the characteristics of the industry, and the final scale was formed based on the discussion of three business managers. Likert 5 subscale was used for all scales, where 5 represents "strongly agree" and 1 represents "strongly disagree". Green transformational leadership was measured by eight items from Robertson et al. [22]. Since this paper studies the collective organizational citizenship behavior toward the environment of employees at the organizational level, it was measured by eight items from Pinzone et al. [26]. Green organizational climate was measured by four items form Norton et al. [51]. Green product innovation was measured by three items form Ryszko [54].

In addition, existing studies have found that the different size and ownership of enterprises, the gender and educational background of managers have different effects on the environmental practices of enterprises [4, 27, 36]. Therefore, we take these four variables as the control variable.

Data Analysis

The main statistical software used in this study includes SPSS23.0 and AMOS24.0. AMOS is mainly used for confirmatory factor analysis and model testing. In the first stage, according to the study of Fornell and Larcker [55], the polymerization validity of the study was explained by factor load, complex reliability (CR) and average variation extraction (AVE). The factor load was required to be greater than 0.7, and AVE value was greater than 0.5, indicating that the polymerization validity was relatively ideal. The correlation coefficient of variables is less than the square root of AVE, indicating that the discriminant validity is ideal. We chose chi-squared fit statistic ($\chi2/df$), absolute fitting indexes, including the root mean square error of

approximation (RMSEA), the standardized root mean square residual (SRMR), and relative fitting indexes, including the comparative fit index (CFI), Tucker-Lewis Index (TLI), as the basis for model fitting test. In the second stage, the relationship between variables was analyzed by hierarchical regression method, and the role of interaction effect and moderating effect was further verified. In order to enhance the robustness of the effect test, the PROCESS macro plug-in by Hayes [56] was used in this study to test the mediation effect. If the 95% confidence interval does not include zero, the mediating effect is significant.

Results and Discussion

Descriptive Statistical Analysis

Among the Respondent, men accounted for 73.72%, and top managers accounted for 26.28%, middle managers accounted for 39.42%. Bachelor's degree or above accounted for 76.92%. About the ownership of the business, state-owned enterprises account for 22.76%. Among the established years of enterprises, 74.68% are 7 years or more, 13.46% are 3~7 years, and 11.86% are less than 3 years. About the scale of enterprises, 28.53% have less than 100 employees, 28.85% have 101~500 employees, 11.22% have 501-1000 employees, and 31.41% have more than 1000 employees.

Measurement Model

Table 1 shows the mean, standard deviation and correlation coefficient of variables. It can be seen that the data structure is good, and there is no violation of the assumption of normal distribution. The correlation between the research variables is moderate or weak, which supports the subsequent hypothesis testing.

Table 2 exhibit the discriminant validity. Cronbach's α value and CR value of each variable are higher than 0.7, and the factor load of each item is higher than 0.7, all the average variance extracted (AVE) value is higher than 0.5, indicating that the reliability and convergence validity of each scale are good. At the same time, the correlation coefficient between each variable and other variable in the Table 1 is less than Square root of AVE for each construct, indicating that the whole measurement tool has good discrimination validity.

Structural Model

We use AMOS24.0 software to conduct confirmatory factor analysis. The fitting index of each model is shown in Table 3. The analysis results show that the four-factor model is significantly better than other models. Its goodness of fit is: $\chi^2/df = 2.946$, RMSEA = 0.079, TLI = 0.924, CFI = 0. 934, SRMR = 0.048, indicating that the whole measurement tool has good discrimination validity.

Research Hypothesis Analysis

The hypothesis test of this study uses hierarchical regression method to introduce control variables, green transformational leadership, organizational citizenship behavior toward the environment and green product innovation into the equation. The test results are shown in Table 4. In the collinearity diagnosis results, the highest VIF value of each regression model is 1.709, which indicates that the multicollinearity problem among variables is not serious.

From model 1, it can be seen that after adding control variables and prediction variables, green transformational leadership can significantly and positively affect green product innovation ($\beta = 0.598$, p<0.001), assuming that H1 is verified.

Table 1. Descriptive statistical results and correlation coefficients.

Constructs	1	2	3	4	5	6	7	8
1. Enterprise Scale	-							
2. Enterprise ownership	-0.128*	-						
3. Gender	0.158**	0.128*	-					
4. Educational background	0.120*	-0.063	-0.110	-				
5. GTL	-0.080	0.101	0.091	-0.080	-			
6. OCBE	0.104	0.069	0.077	0.010	0.604**	-		
7. GOC	0.073	0.097	0.067	-0.033	0.547**	0.656**	-	
8. GPI	0.088	0.048	0.068	-0.095	0.508**	0.641**	0.617**	-
Mean	2.423	1.885	1.244	2.096	3.282	3.187	3.604	3.002
Standard deviation	1.227	0.631	0.430	0.772	0.898	0.991	0.936	1.114

Notes: Tests of hypotheses are two-tailed tests; * p<0.05; ** p<0.01; *** p<0.001; *GTL* green transformational leadership, *OCBE* organizational citizenship behavior toward the environment, *GOC* green organizational climate, *GPI* green product innovation.

Table 2. Descriptive statistical results and correlation coefficients.

Constructs	No. of Items	Cronbach's Alpha	CR	AVE	Square root of AVE
GTL	8	0.928	0.928	0.618	0.786
OCBE	8	0.953	0.949	0.701	0.837
GOC	4	0.895	0.890	0.674	0.821
GPI	3	0.935	0.936	0.829	0.910

Table 3. Confirmatory factor analysis results.

Model	χ^2/df	RMSEA	TLI	CFI	SRMR
1. GTL, GOC, OCBE, GPI	2.946	0.079	0.924	0.934	0.048
2. GOC+GPI, GTL, OCBE	3.713	0.093	0.894	0.906	0.069
3. GTL+GPI, OCBE, GOC	3.799	0.095	0.891	0.903	0.106
4. GTL+GOC+GPI, OCBE	3.806	0.095	0.891	0.903	0.119
5. GTL+GOC+OCBE+GPI	3.773	0.094	0.892	0.902	0.124

Table 4. Results of Hierarchical Regression Analysis.

Construct	OCBE			GPI	
	M2	M4	M5	M1	M3
Enterprise scale	0.123***	0.093**	0.070*	0.108**	0.047
Enterprise ownership	0.047	0.084	0.011	0.016	-0.007
Gender	-0.006	-0.028	-0.002	-0.022	-0.019
Educational background	0.055	-0.004	0.062	-0.087	-0.114*
GTL	0.680***	0.606***	0.466***	0.598***	0.226***
OCBE					0.491***
GOC			0.524***		
GTL×GOC			0.126**		
R^2	0.316	0.518	0.529	0.280	0.434
ΔR^2	0.297	0.507	0.011	0.257	0.164
ΔF	132.673***	163.858**	7.507**	109.243***	90.221***

Notes: Tests of hypotheses are two-tailed tests; * $p<0.05$; ** $p<0.01$; *** $p<0.001$.

This study adopts the three-step method proposed by Baron et al. [57] to verify the mediating effect. First, the significant positive impact of green transformational leadership on green product innovation has been verified; In the second step, from Model 2 in Table 4, it can be seen that green transformational leadership can significantly and positively affect the organizational citizenship behavior toward the environment (β = 0.680, $p<0.001$), assuming H2 is verified. In the third step, as can be seen from model 3, After joining the organizational citizenship behavior toward the environment, organizational citizenship behavior toward the environment significantly affects green

product innovation (β = 0.491, $p<0.001$), and green transformational leadership still significantly positively affects green product innovation, but the significant decline (β = 0.226, $p<0.001$), and the adjusted R^2 increases by 0.164. Therefore, it can be seen that employees' organizational citizenship behavior toward the environment plays a partial mediating role between green transformational leadership and green product innovation, assuming that H3 and H4 are verified.

Due to the limitations of the three-step mediating effect test method, this study further uses the bootstrapping analysis proposed to verify the mediating effect. In the specific operation, PROCESS plug-in is

Table 5. Bootstrapping test results of mediating effect.

Predictor	Effect	SE	Boot 95%CI	
			LLCI	ULCI
Total effect (GTL→GPI)	0.598	0.057	0.486	0.711
Direct effects (GTL→GPI)	0.226	0.064	0.100	0.346
Indirect effects (GTL→GOC→GPI)	0.372	0.047	0.283	0.466

used, the number of repeated sampling samples is 5000, and the 95% confidence interval of deviation correction bootstrap is obtained. The total impact, direct impact and indirect impact results under the intermediary effect are shown in Table 5. Among them, the total impact of green transformational leadership on green product innovation is 0.598 (LLCI is 0.486 and ULCI is 0.711), The direct impact of green transformational leadership on green product innovation is 0.226 (LLCI is 0.100 and ULCI is 0.346), and the indirect impact of green transformational leadership on green product innovation through organizational citizenship behavior toward the environment is 0.372 (LLCI is 0.283 and ULCI is 0.466). The confidence interval does not include 0, which further verifies the mediating role of employees' organizational citizenship behavior toward the environment.

In this study, Hypothesis 4 of hierarchical regression test is used, and the product term of independent variables and regulatory variables is used to eliminate collinearity. These are standardized respectively. The test results are shown in Table 4. Model 4 shows that the product term of green transformational leadership and green organizational climate significantly positively affects employees' organizational citizenship behavior toward the environment (= 0.126, P<0.01), and R² rises from 0.518 to 0.529 in model 5, indicating that green organizational climate positively regulates the impact of green transformational leadership on employees' organizational citizenship behavior toward the environment.

In order to understand the moderating effect of green organizational climate more intuitively, this study uses simple slope analysis method, takes the average
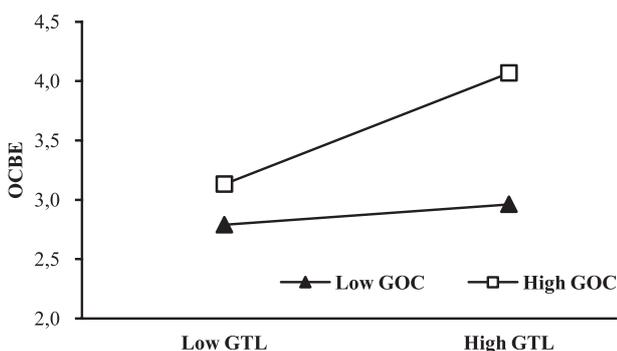
value of green organizational climate one standard deviation on the left and right, divides the sample data into high green organizational climate group and low green organizational climate group, and regresses in the two groups respectively. As shown in Fig. 2, under the condition of high green organizational climate, green transformational leadership has a stronger influence on the citizenship behavior of environmental protection organizations. Under the condition of low green organizational climate, green transformational leadership has a weak impact on organizational citizenship behavior toward the environment, which further verifies that green organizational climate positively regulates the impact of green transformational leadership on organizational citizenship behavior toward the environment.

Discussion

This study draws the following conclusions: (1) Green transformational leadership has a significant positive impact on green product innovation. (2) Organizational citizenship behavior toward the environment plays an intermediary role between green transformational leadership and green product innovation. (3) Green organizational climate has a positive moderating effect between green transformational leadership and organizational citizenship behavior toward the environment, that is, compared with low green organizational climate, green transformational leadership has a stronger impact on organizational citizenship behavior toward the environment under high green organizational climate.

First, we find that green transformational leadership has a significant positive impact on green product innovation in Chinese manufacturing firms. The existing research mainly explores how to improve the green product innovation of enterprises from the aspects of society, organization and individual [4, 10, 11, 14]. Although the importance of managers is reflected in the environmental management literature, it has not received enough attention, this view is consistent with Bhatia and Jakhar [8]. The lack of transformational style among senior management is considered to be one of the important determinants of the success of sustainable development programs [23]. Meanwhile, there are few researches on the relationship between leaders and green product

Fig. 2. Interaction of GTL and GOC on OCBE.

innovation performance [4]. Based on the China's manufacturing enterprises, this study finds that green transformational leaders can improve green products or services, and provide a new perspective for enterprises to carry out green practice. So, in management practice, manufacturing enterprises should attach importance to training and selecting green transformational leaders. Transform leadership style by recruiting and promoting green transformational leaders and training existing leaders. Managers at all levels are encouraged to enhance green leadership, set an exemplary role, and actively communicate and interact with employees, so as to effectively have a positive impact on subordinates and ultimately contribute to the overall green innovation of the enterprise.

Second, organizational citizenship behavior toward the environment plays a mediating role between green transformational leadership and green product innovation. This study helps enterprises to clarify the importance of green environmental behavior of employees in the organization, similar results were also found by Daily et al [40], Akterujjaman et al [58]. In the work environment, learning among employees enables organizations to overcome the boundaries of existing knowledge resources [42]. This suggests that a transformational leadership style alone is not enough, but that an autonomous and altruistic environmental behaviour needs to be fostered among employees in order to successfully achieve the goals of green product innovation. Organan [59] believes that the design of the organizational system will not be perfect, and it is difficult to achieve organizational goals if only relying on employees to complete their own behaviors within the scope of their responsibilities. Therefore, it is necessary to rely on employees' extra-role behaviors in order to promote the effective achievement of organizational goals. At the same time, the enterprises should consider implementing green human resource management to attract, train, motivate and retain pro-environment employees, so as to improve green product innovation [60]. Enterprises should focus on employees' cognition of green product innovation objectives, clearly understand that environmental protection is one of the important objectives of the enterprise, and clarify the environmental protection rewards and environmental protection responsibilities that employees should receive. We also recommend manufacturing enterprises pay attention to the cultivation of green innovation in organizational policies, practices and procedures, to create favorable conditions for stimulating employees' environmental protection behavior.

Finally, our study explores the important moderating role of green organizational climate in green transformational leaders and organizational citizenship behavior toward the environment. Existing studies mostly discuss employees' organizational citizenship behavior toward the environment from the individual level or the organizational level, with little consideration of its simultaneous impact [32, 61]. This paper makes some contributions to the literature on voluntary green behavior by discussing the moderating effect of green organizational climate between green transformational leadership and green product innovation. This paper finds that when employees' perception fits with leaders' expression, they will be encouraged to show voluntary green behavior, thus increasing the green innovation performance of enterprises. This paper clarifies a boundary condition and control mechanism of green transformational leadership on organizational citizenship behavior toward the environment and helps to improve relevant research. Previous studies have shown that the organization's green policies and practices not only contribute to environmental performance, but also enhance organizational competitiveness [62] and promote brand image and recognition [63]. Therefore, we suggest manufacturing enterprises create a good organizational atmosphere for green innovation. It can encourage organizations to adopt and improve their green policies and practices in order to further enhance environmental performance. Organizations can guide and improve employees' knowledge, conscience and awareness of the importance of environmental protection by training employees, organizing seminars and decorating the actual workplace environment. Through the establishment of knowledge and information platforms, technical exchanges and ideological collisions are promoted, and a sharing atmosphere that is precious, rare, difficult to imitate or replace is formed. These internal intangible assets are the key to promoting innovation activities [64, 65]. Meanwhile, from the perspective of enterprise supervision and management, strengthen the protection of intellectual property rights and strengthen the disclosure of environmental information [66], including the information on enterprise environmental management, energy conservation and emission reduction, circular economy, environmental investment, etc, to improve employees' environmental concern [67]. Optimizing the system environment and strengthening the degree of reward and punishment can enhance the deterrence effect of enterprise supervision and improve the innovation ability and atmosphere of enterprises [8]. As our research results show, cultivating green organizational climate can become a positive situational trigger, which can further stimulate employees' voluntary green behavior in the workplace.

Conclusions

This paper supplements the relevant literature on green development and innovation, and investigates the important influencing factors of green product innovation from the inside of the organization. The theoretical contribution of this work is to propose a framework through which enterprises can implement green product innovation in response to environmental regulations and achieve organizational sustainability.

We propose that green transformational leadership and organizational citizenship behavior towards environmental are the two preconditions for successful implementation of green product innovation, and the role of green organization climate is considered in boundary conditions. Based on social learning theory, this theoretical model provides a new explanation mechanism for green product innovation research from the relationship between leadership and employee active green behavior. The model is empirically tested using the data of Chinese manufacturing enterprises. The results show that green transformational leadership and environmental organization citizenship behavior are important antecedents to promote green product innovation practice.

Although the research has achieved some positive results, there are also some limitations. First, the article uses a cross-sectional method to measure variables at the same time point. In the future, it should adopt a multi-time research method to explore the long-term impact of green transformational leadership and the development trend of organizational citizenship behavior toward the environment and organizational green transformational leadership. Second, the future research design should consider the influence of external factors, such as environmental supervision, on green product innovation, and whether there is a synergy between external and internal factors.

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Conflict of Interest

The authors declare no conflict of interest.

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