

Article

How Green Transformational Leadership Affects Green Creativity: Creative Process Engagement as Intermediary Bond and Green Innovation Strategy as Boundary Spanner

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Abstract: Focusing on China's steel industry, the effect of green transformational leadership on employee green creativity, its underlying mechanisms, and the conditions that govern the situation are examined. The sample analysis of 298 employees working with 46 supervisors from 23 companies indicates that green transformational leadership positively affects employee green creativity, and creative process engagement plays a mediating role in the relationship of green transformational leadership to employee green creativity. Moreover, the mediated role is moderated by green innovation strategy, which is used as a boundary spanner to affect the whole path linked by creative process engagement, so that this effect is strengthened when the level of green innovation strategy is high, rather than low. The results verify the hierarchical linear hypothesized model, which is helpful to sketch a more complete view of the relationship between green transformational leadership, creative process engagement, green innovation strategy, and green creativity, and to provide beneficial insights for innovative practice and the green management of steel enterprises.

Keywords: green transformational leadership; creative process engagement; green innovation strategy; green creativity

1. Introduction

With the prosperity and development of China's manufacturing industry, the Chinese government are increasingly concerned by environmental issues [1]. For example, as the largest steel consumer and producer in the world, the traditional steel industry is driving China's national economy forward. However, the steel production process not only brings direct energy consumption and pollutant emissions, but also destroys the ecological environment, through the impact on the upstream and downstream industrial chain [2]. Based on these environmental problems, government and enterprises are exploring the path of green development [3].

Enterprises which pursued green development have paid more attention to layout optimization, product life cycle and post design application, and the impact on the environment and the whole supply chain, thereby promoting sustainable development [2,4]. Previous studies have shown that enterprises can create a win-win situation for themselves and society if they can integrate green creativity into their development process, while pursuing other benefits [5]. Different from general creativity, green creativity emphasizes more environmental friendliness and sustainability of products, services, and practices [6]. Enterprises and society can achieve environmental sustainability through

efficacious green creativity [7]. In addition, green creativity plays an important role in coping with global ecological sustainable changes to gain competitive edges [8,9].

Leadership, as an antecedent of creativity, is considered one of the main features in stimulating creativity [10]. The advantage of transformational leadership is that it motivates subordinates to perform their responsibilities beyond expectations through four aspects, such as intellectual stimulation [11,12], which brings confidence to subordinates and thus improves their internal motivation and external behavior [13]. For instance, transformational leadership positively affects employees' creativity in stimulating green production [6]. Obviously, environmental challenges bring green opportunities, and companies can enhance their competitive advantage by increasing their green image [14]. Once environmental management becomes a consensus among members of the organization, actions to resolve environmental problems will be legalized for economic benefits of the organization or social responsibility of the enterprise [15,16]. Green transformational leadership not only encourages subordinates to achieve environmental goals and business performance [6,17], but also creates a supportive and stimulating environment, and provides necessary contextual resources to express creative expectations [18].

In addition, according to Amabile, creativity requires a high degree of original thinking and integration ability [19]. When referring to Samuelson's research work, Dr. Klein also mentioned, "I tried to maximize my contact with him, picking up insights that he scattered on every encounter" [20], illustrating the significance of engagement with the creative process in promoting creativity. Previous research showed that green transformational leadership and creative process engagement are separate supplements to creativity [6,21]. However, little literature has focused on how employees' creative process engagement drives creative generation. Accordingly, we propose creative process engagement as a sustaining bond for this underlying mechanism.

The existing literature mainly studies the driving factors of green creativity at the organizational level [22]. To better understand the formation of green creativity, we may not only need to study on organizational level, but also need to expand to the individual level, because an individual's green creativity is the basis of organization. Previous studies paid close attention to the internal mechanism of green creativity [6,23]. In fact, external environmental pressures on enterprises can prompt leaders and employees to pursue green creativity [24,25]. In the process of pursuing green development, it is very important for enterprises to adopt the strategy of internal resource integration and external extensive cooperation with stakeholders, which is normally called "open innovation" [26]. On the one hand, open innovation could help enterprises to acquire external knowledge and resources, make up for internal deficiencies, reduce the uncertainty of research and development, and improve learning ability [27–29]. On the other hand, it would assist enterprises to build or embed external innovative network, expand living space, and integrate internal and external technologies to improve innovation ability [30–32]. Therefore, enterprises could formulate a corresponding green innovation strategy [3], which represents the influence of external factors on the company and the internal action criteria of company's green innovation. Studies have found the direct impact of a green innovation strategy on green creativity [1]. However, the way of working in a group is more and more universal, and a green innovation strategy is often formulated by senior leaders, and team leaders often cannot directly affect this process in modern enterprises. In view of a green innovation strategy that reflects the company's determination to take responsibility in the face of environmental problems, and creates the environment to provide support for a team's green innovation [1], we consider the green innovation strategy as a boundary spanner to affect green creativity.

In summary, this study aims to reveal the intermediate paths and boundary conditions between green transformational leadership and green creativity. Therefore, this research contributes three considerations: firstly, we clarified the direct influence of green transformational leadership on green creativity; and secondly, we indicated the mediation of creative process engagement as the mediate path to link green transformational leadership and green creativity; lastly, we introduced a green innovation strategy as a hierarchical moderating mechanism to promote green individual creativity. To

better clarify the hypothesized model, the definition of the main variables are presented in Table 1. This study uses a comprehensive perspective to explore antecedents of creativity, the model proposed, and the intervening variables adopted, which are expected to further complement the literature on green creativity. A hypothetical model is shown in Figure 1.

Table 1. Conceptual Framework.

Term	Definition
Green transformational leadership	Behaviors of leaders who motivate followers to achieve environmental goals and inspire followers to perform beyond expected levels of environmental performance [16].
Creative process engagement	Employees' involvement in the related creative process, such as problem construction and development, information searching and encoding, and alternative idea generation [19,33].
Green innovation strategy	The enterprise adopts green technology or green management to improve or change its production and operation activities to achieve the goals of reducing environmental pollution, conserving resources, reducing waste, and improving the environment in alignment with the external environment, and the condition of the organization [34].
Green creativity	The production novel and useful ideas with environmentally friendly influences on products, services, processes, and practices within organizations [1,35].

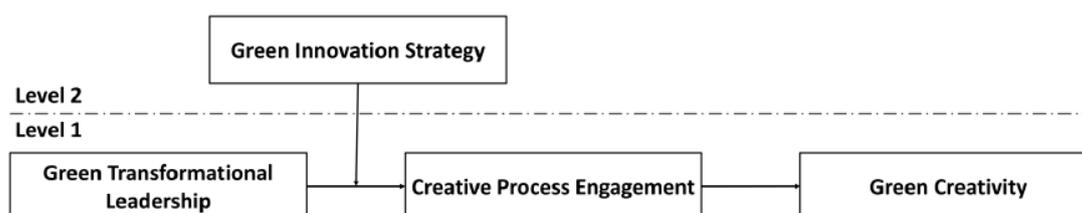


Figure 1. Hypothesized model.

2. Theories and Hypotheses

2.1. Green Transformational Leadership as an Important Antecedent of Green Creativity

Leadership is crucial in affecting organizational and individual innovation [1], especially in China, a country that focuses on collectivism and high-power distance [36]. Previous research indicated that the elements of transformational leadership have global universality [37], especially playing an important role in promoting employee creativity [38–41].

The spirit of transformational leadership lies in intellectual motivation, individual consideration, charisma, and motivation [17]. Intellectual stimulation can enhance the cognitive ability of followers, and improve the efficiency of problem construction, information search, and solution generation in the cognitive process, thereby enhancing their creativity [42,43]. Through individual considerations, transformational leaders pay attention to the development of subordinates, identify their unique needs, provide guidance and support for subordinates, and generate a sense of belonging [6,42]. The charisma of transformational leaders helps to form inspiring ideas among their followers so as to gain their respect and loyalty [44]. Transformative leaders encourage creative thinking by motivating subordinates to express their opinions and gain a passion for ideas [42].

Transformational leadership positively affected employee creativity according to previous studies [42,44]. Organizational creativity is highly dependent on leaders and their characteristics [45], as they have massive effect on improving environmental performance [46]. One of the main concerns of managers is to cultivate employees' green creativity to produce innovation [6]. In the structure characterized by environmental goals, "green transformational leadership" refers to "the development of new ideas about green products, green services, green processes, or green practices that are judged

to be original, novel, and useful” [6,17]. Previous studies indicated a positive correlation between green transformational leadership and green creativity in the electronics commerce [6]. Thus:

Hypothesis 1 (H1). *Green transformational leadership is positively related to green creativity.*

2.2. Intermediary Bond: Creative Process Engagement Links Green Transformational Leadership to a Green Creativity Relationship

Previous research has illustrated that transformational leadership can actively affect creativity at the organizational level [38–41]. However, from an environmental perspective, the mechanism of how green transformational leadership affects green creativity needs further study.

Creative process engagement contains three elements, such as ideas generation [47]. According to the conservation of resources theory, employees should contribute and acquire a great quantity of resources, so that problems can be solved creatively [48]. In the process of resource integration, transformational leaders provide more relaxed working conditions for the creative generation of employees, and stimulate the internal motivation of subordinates to form a sense of collective responsibility [49]. Mumford indicated that transformational leadership could provide followers with excellent conditions, such as the intelligence to promote the integration of neodoxy [50]. Therefore, subordinates can confidently engage in innovative work without worrying that changes brought about by innovative behaviors will challenge established work objectives, work methods, task relationships, and informal norms [51].

Moreover, according to the theory of information processing [52], employees need to reorganize and optimize the knowledge obtained after integrating resources to promote creativity [53,54]. Research suggested that employees’ creative process include: (a) determining the investment strategy, according to the quality of creative work in the first stage; (b) grasping and developing the existing concepts in the second stage [51,55]; and (c) integrating the information in the third stage to form creativity, thereby generating alternative options and solutions [33]. Just like Reiter-Palmon and Illies mentioned, “creatively solving problems requires extensive and laborious cognitive processing” [51]. Once employees’ innovative activities are not effectively organized, the quality of the solutions may be influenced [33]. On these grounds, the hypothesis is as follows:

Hypothesis 2 (H2). *Creative process engagement mediates the relationship that green transformational leadership positively affects with green creativity.*

2.3. Boundary Spanner: Green Innovation Strategy Moderates the Linked Relationship by Creative Process Engagement

The prosperity of manufacturing and the rapid urbanization process have led to increasingly serious environmental problems in China [56]. The government has intervened in various ways, such as by introducing environmental protection policies and regulations, adjusting taxes related to environmental protection, which has highlighted two considerations relating to environmental problems: traditional manufacturing, such as the steel industry, needs to consider how to carry out energy conservation and emission reduction, and reduce “high pollution, high energy consumption, and high emissions” to respond to government policy changes and maintain a competitive advantage in future strategic planning [56,57]; on the other hand, with the prevalence of environmentalism, the market share of green products has been increased, and companies that have achieved better results in green product development performance will generally occupy the first mover advantage [6]. Accordingly, how to make a green innovation strategy has attracted a lot of research attention.

Companies that have a green innovation strategy encourage the reduction of resource waste, and formulate corresponding regulations to monitor whether raw materials are being effectively used, thereby reducing costs [3]. This strategy indicates that enterprises can obtain more green development

caps by adjusting production practices and business operations, such as by adopting environmental management systems to improve work performance [3]. However, few studies explore how green innovation strategies affect green creativity.

Previous research has shown that a green innovation strategy can enhance the relationship between green transformational leadership and creative process engagement [58–60]. The lack of resources (such as financial and human resources) may be the main obstacle to the generation of creativity in employees' innovation process [60]. Therefore, appropriate resources are conducive to the development of green creativity [61]. The resources of green innovation require multi-lateral cooperation, which contains market demand, technological promotion and policy planning, and companies thus must consider adopting corresponding green innovation strategies to meet specific needs [62]. In turn, this green innovation strategy enables insiders to understand external needs, approve neodoxy, inspire ideas generation, and improve resource utilization, thereby promoting green creativity [1]. However, this strategy is usually formulated by the company's board of directors, and the team leader usually cannot directly influence the company's green innovation strategy [63]. Previous research on green innovation strategies emphasized the perspective of the organization, and rarely discussed the role of green innovation strategy at the individual level [64]. To fill this gap, this study assumes that a green innovation strategy moderates the mediation of Hypothesis 2 from a cross-level perspective.

Hypothesis 3 (H3). *Green innovation strategy moderates the mediated path that green transformational leadership affects employees' green creativity by creative process engagement, so that this linkage is strengthened when the standard of organizational green innovation strategy is higher.*

3. Method

3.1. Sampling and Procedure

The steel industry is one of mainstays of China's economic pillar, which is also the main body with high energy consumption and high pollution. The "Made in China 2025" program makes these enterprises face increasingly severe environmental regulations, but also brings them opportunities. Therefore, taking steel enterprises as an example to examine the correlation among green transformational leadership, green innovation strategy, creative process engagement and green creativity is not only representative, but also able to respond to the urgent needs of reality. Hence, this study selected steel-related enterprises in China as research object.

The respondents come from a team-based enterprise and most of the participants (72.7%) were from the R&D department. Official and unofficial communication is brisk among team members. Hence, supervisors are likely to obtain information about the behavior of their followers, and all of which are invited to finish the questionnaire. As a result, this study can minimize sample selection bias to the greatest extent. The coordinator detailed the procedures for accomplishing the investigation to them. In addition, an investigation description that contained the confidentiality commitment was attached for each questionnaire, and the corresponding ID number of the supervisor and subordinate was provided, so that each respondent's response could be matched.

Before our survey, we process all questionnaires in view of the complicacy of matched sampling and the susceptibility of mutual scoring. We used the method of upper and lower matching to conduct a questionnaire on each underling and their direct superiors, respectively, to get the corresponding data, and invited a supervisor to fill in the questionnaire for every subordinate to avoid common method biases. Concretely, team leaders accomplish leadership items that furnish their personal information, and evaluate their followers' green creativity. The leaders' direct subordinates completed employee items, evaluated the level of green transformational leadership, supplemented with green innovation strategy, as well as carrying out creative process engagement and providing relevant personal information. In aggregate, 600 questionnaires were sent out, and 298 of them distributed in 46 teams were recalled, affording the efficacious response rate of 49.7%.

Among the samples of employees, the medial age is 32.53 (SD = 5.42), 71% are male, and the mean tenure of subordinates worked with corresponding supervisors is 4.31 years (SD = 2.46). Moreover, 86% of managers are men that have medial age of 37.79 (SD = 5.26) and mean tenure of 7.53 years (SD = 5.89). Based on Frazier et al. [65], we tested the non-response bias by dividing the sample into two sections according to collection interval, thereby comparing in the light of industry category, sector vacation, enterprise scale, and wages. The matched t-test indicated that we are not concerned about non-response bias, as the diversity of two sections is insignificant ($p > 0.1$).

3.2. Operationalization of Constructs and Measurement Scales

The scale adopted in this research has high validity and reliability, and has been widely verified and recognized, anchored by “1 to 7” grading, from strong disagreement to strong agreement. Additionally, two translators completed translation–back translation, to guarantee the consistency of the scale [66]. The specific measurement scales are as listed below:

Green transformational leadership using the 6-item scale was derived from Chen and Chang [6]. Followers indicated the extent to which they agree with the statements regarding green transformational leadership, e.g., “The leader inspires the organization members with the environmental plans”, Cronbach’s α for this scale was **0.941**.

Creative process engagement was assessed using the 11-item scale adopted from Zhang and Bartol [33]. Employees expressed to what extent they agreed with the rate of each behavior characterization when they confront creative tasks about environmental issues. A sample is “I spend considerable time try to understand the nature of the problem”, Cronbach’s alpha was **0.861**.

The scale for green innovation strategy using 7-items was derived from Song and Yu [1]. Followers expressed to what extent they agreed with about green innovation strategy of the company (ICC1: 0.19; ICC2: 0.61). For example, “To what extent has your firm modified its business practices or operations to reduce energy consumption”, Cronbach’s alpha was **0.911**.

The scale that measures green creativity was derived from 6-item scales developed by Chen and Chang [6], where supervisors score their followers’ green creativity. Cronbach’s alpha was **0.951**. The whole conception of green creativity is reflected in this scale. A sample is “This member of the organization suggests new ways to achieve environmental goals”.

3.3. Control Variables

Followers also filled out personal details about their age (in years), gender (0, “male”, 1, “female”), post, and working lives they have followed with supervisors on the demographic page of the questionnaire. Job positions are measured by dummy variables, from “introductory employees” (1) to “senior management or higher positions” (5). In addition, we also controlled the team’s scale, as the sample was collected by team. These variables are controlled, because they are embodied in a series of recent studies [42,67].

In addition, previous studies indicated that company age, team scale, and ownership all influence a company’s green innovation [1,61,68]. We thus controlled the variables mentioned above. A continuous quantity measurement is used to check the year since the establishment of the company, where 1 = less than 2 years, 2 = 2–5 years, 3 = 6–10 years, 4 = 11–15 years, and 5 = more than 15 years. The scale of the team is measured by the number of employees. The ownership of all companies is also controlled by using dummy variables, including 0 = state-owned enterprises, 1 = other types of companies.

4. Results

Since the sample contains 298 members of 46 teams, the sample presents a multi-level nested structure. Due to the difference of teams, different team leaders will show differences in evaluation criteria. In addition, for the sake of testing the cross-level moderate influence of green innovation strategy in H3, this study used hierarchical linear model to process the data. In order to get more accurate results, we separate intra-group and inter-group effects. To this end, the employee data

represents the first layer of the data structure, and the organization data represents the second layer, allowing the equation to have random slopes and intercepts at the organization level (see Appendix A: Reliability of the constructs and factor loadings of indicators). All statistical analysis of this study was done by Mplus 7.4.

Before the hypothesis test, we first calculated the intra-group correlation $ICC(1) = 0.33$ of the employee's green creativity, which indicates that the employee's green creativity evaluation has significant inter-group differences and requires multilevel analysis. For measuring the significance of moderated mediation effect, the Monte Carlo simulation is used to construct a confidence interval. The Monte Carlo simulation method can give an asymmetric confidence interval (CI) accurately and reliably, and is easy to implement [69]. In addition, when performing hypothesis testing, we simultaneously estimated all regression equations, thereby reducing the deviation of model parameters and standard error estimates.

In addition, we adopted a correlation analysis method to investigate the correlation among the variables. The statistical characteristics of all variables, such as standard deviation, the mean value, and correlation coefficients are described in Table 2. A strong correlation between the variables can be concluded, as Pearson coefficients are at a relative rational standard. Furthermore, we tested the discriminant validity by using Smart PLS 2.0, and we compared the correlations with the square root of the AVE among constructs, and the level turned out to be smaller in each case, indicating that there is sufficient discriminative validity among variables. In Table 2, some of the correlation coefficients are larger (above 0.5), which may lead to the problem of multicollinearity. Therefore, we further test the differential validity of each variable, that is, we test the size of the fully standardized correlation coefficient between each dimension of the potential variable and the square root value of AVE of each dimension involved. The results show that the former is smaller than the latter, which indicates that there is enough discrimination validity among dimensions, so there is no need to worry about the multicollinearity. The reason for the large correlation coefficient may be that the sample is single, because we investigated the research and development (R&D) team from steel enterprises. In recent years, the supply side reform carried out in China has urged the problem of overcapacity in the steel industry. The leaders of steel enterprises actively seek change, and employees have also invested a lot of energy in product innovation.

Our hypotheses imply a moderated mediation role in the first phase, i.e., the moderator enhances or weakens the effect that the mediator has on the dependent variable. In this study, the moderated mediation role is measured if the indirect influence that green transformational leadership affects the subordinate's green creativity through creative process engagement, which is conditional on a green innovation strategy.

To test Hypotheses 1 and 2, we first fit a single-level model. As shown in Table 3, the relationship between green transformational leadership and green creativity of employees is positive ($\gamma = 0.11$, $p < 0.05$). Creative process engagement can significantly predict employee creativity ($\gamma = 0.16$, $p < 0.05$). We use the Monte Carlo method to perform resampling to construct a confidence interval for indirect effects. The consequences exhibited the indirect affect that green transformational leadership on the subordinate's green creativity through creative process engagement is significant (indirect effect = 0.04, CI [0.012, 0.091]), therefore, Hypothesis 1 and Hypothesis 2 are supported.

Table 2. Descriptive statistical analysis of variables.

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1 Gender ^a	0.29	0.25											
2 Age ^a	32.53	5.42	−0.14 ^{**}										
3 Position ^a	2.47	0.81	−0.22 ^{**}	0.11 ^{**}									
4 Tenure with leader ^a	4.31	2.46	0.04	0.08 [*]	0.30 ^{**}								
5 Firm age ^b	11.45	3.69	0.02	0.03	0.01	0.03							
6 Team size ^b	4.86	1.05	0.01	0.02	0.04	0.01	0.06						
7 Ownership ^b	0.56	0.33	0.05	−0.01	0.01	0.01	0.02	−0.05 [*]					
8 Green transformational leadership ^a	4.79	1.01	−0.11	0.09	0.11	0.08	−0.03	0.03	−0.11	(0.871)			
9 Creative process engagement ^a	4.86	1.07	0.10	0.04	0.15	0.13	0.04	0.08	−0.09	0.59 ^{***}	(0.807)		
10 Green innovation strategy ^a	4.97	0.94	−0.12	0.13 [*]	0.16	0.04	0.02	0.06	−0.10	0.42 ^{**}	0.39 ^{**}	(0.822)	
11 Green creativity ^b	4.65	1.13	−0.07	0.02	0.05	0.07	0.03	0.07	−0.09	0.37 ^{**}	0.62 ^{***}	0.55 ^{***}	(0.872)

Note. ^{*}p < 0.05, ^{**}p < 0.01, ^{***}p < 0.001; For discriminant validity, the square roots of AVE are in parentheses along the diagonal. ^a These variables were measured from focal employees; ^b Managerial rating.

Table 3. Analysis results of single-level mediation effect ^a.

Predictor	Dependent Variable	
	Creative Process Engagement	Green Creativity
Gender	-0.08	-0.07
Age	-0.04	-0.03
position	0.09 [†]	0.06
Tenure with leader	-0.06	-0.05
Firm age	-0.07	-0.03
Company ownership	0.03	0.05
Green transformational leadership	0.24 ^{**}	0.11 [*]
Creative process engagement		0.16 [*]
Green transformational leadership→Creative process engagement→Green creativity ^b		
Mediation effect	95% CI lower limit	95% CI upper limit
0.04 [*]	0.012	0.091

Note: ^a individual level variable N = 298; for organization level variable N = 46; [†]p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001; ^b based on 20000 Monte Carlo simulation samples.

A multi-level model analysis is conducted in this paper to measure the moderation of the green innovation strategy. As shown in Table 4, the correlation between transformational leadership and creative process engagement is significantly predicted by green innovation strategy ($\gamma = 0.29, p < 0.01$). Under the circumstance of low (M-1SD) and high (M+1SD) values of the green innovation strategy, the product of simple effects is calculated, and the confidence interval is constructed by a Monte Carlo simulation (see Figure 2). The mediation effect of creative process engagement is significant, with a heightening of green innovation strategy (indirect effect = 0.07, $p < 0.05$, CI [0.015, 0.152]), and when the green innovation strategy is low, the mediation effect of creative process engagement is no longer significant (indirect effect = 0.01, CI [-0.031, 0.069]). The analysis results support the moderated mediation effect in the first phase proposed in this Hypothesis 3, so Hypothesis 3 is also supported.

Table 4. Hierarchical regression results for moderated mediation ^a.

Predictor	Dependent Variable		
	Creative Process Engagement	Green Creativity	
Gender	-0.08	-0.07	
Age	-0.04	-0.03	
position	0.09 [†]	0.06	
Tenure with leader	-0.06	-0.05	
Firm age	-0.07	-0.03	
Company ownership	0.03	0.05	
Team size		0.07	
Green transformational leadership (GTL)	0.24 ^{**}	0.10 [*]	
Green innovation strategy (GIS)	0.15 [*]	0.02	
GTL×GIS	0.29 ^{**}	0.12 [*]	
Creative process engagement		0.21 [*]	
Moderated mediation results for green creativity across levels of green innovation strategy:			
Green transformational leadership→Creative process engagement→Green creativity ^b			
Green innovation strategy	Conditional indirect effect	95% CI lower limit	95% CI upper limit
High(M+1SD)	0.07 [*]	0.015	0.152
Low(M-1SD)	0.01	-0.031	0.069

Note: ^a individual level variable N = 298; for organization level variable N = 46; [†]p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001; ^b based on 20000 Monte Carlo simulation samples.

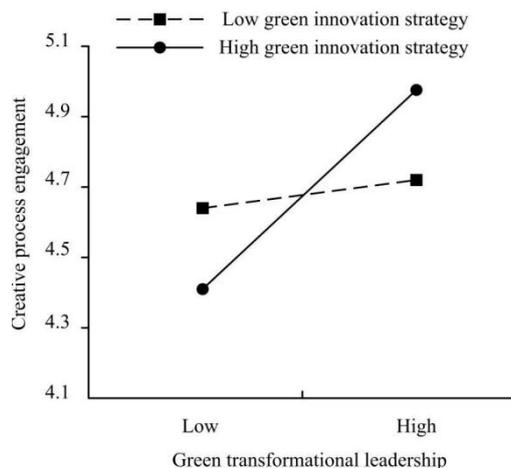


Figure 2. Interaction of green transformational leadership and green innovation strategy on creative process engagement.

5. Discussion

Targeted at China's steel enterprises, this study broadens our knowledge of beneficial aspects in transformational leadership, by demonstrating the active influence that green transformational leadership affects green creativity. The results reveal that green transformational leadership can not only directly affect employees' green creativity, but also indirectly affect green creativity through employees' creative process engagement. In this process, a green innovation strategy moderates the mediation that employees' creative process is engagement linked, so that this effect is strengthened when the level of green innovation strategy is high, rather than low.

5.1. Theoretical Implications

This study has four theoretical implications. First, this study verifies the promotion of green transformational leadership on employees' green creativity. As the main source of influence in the workplace, leaders play an important role in increasing or reducing employees' valuable resources, and predicting employees' creativity level [70], while green transformational leadership play a more refined role in promoting employees' green creativity, which is consistent with Chen et al., who found the same relationship when they inspected the electronics industry in Taiwan [16].

Second, this study confirms the mediating role of creative process engagement. Previous studies mostly analyzed the influence of creativity on the psychological level, ignoring the process of creative engagement. Although the psychological level is a necessary and insufficient condition that leads to innovative behavior, in order to better understand how creative ideas are generated, creative thinking itself should be paid more attention [19]. According to Gilson et al. [47], work engagement has become an important topic in the study of employee performance and organizational management [71]. Empirical research shows that work engagement not only reflects the positive attitude of employees, but also helps to directly improve employee performance [72]. The literature on complex system thinking proves that creativity is a process of blind change and selective retention, and in this process, employees conduct trial and error reconstruction of creative antecedents to pursue excellent creative solutions [73]. This study not only shows the key role of leaders in guiding employees' attention to the creative process, but also shows that employees' creative process engagement will further transfer the positive role of green transformational leadership to green creativity. We thus establish a new perspective and find empirical evidence that green transformational leadership promotes green creativity, by influencing employees' creative process engagement.

Third, this research opens the black box that affects employees' green creativity from a cross-level perspective. Previous studies focused on individual technical information, or the enterprises' own green dynamic capabilities [74], and rarely used a multi-level approach to make overall considerations.

Taking a hierarchical approach and considering both levels to extract information about groups and individuals is helpful to overcome compositional fallacies [75]. Therefore, a problem worthy of attention is how to stimulate the enthusiasm of employees at the micro level to improve their engagement in the creative process, and to improve the company's green strategic level at the macro level, thereby enhancing green creativity. We adopted a green innovation strategy as a variable on an organizational level to verify its moderate effect on the transmission mechanism of green creativity in enterprises. Different from Western countries, innovation is often driven from top to bottom in China's collectivism oriented cultural environment. If enterprises expect to achieve long-term development through green innovation, it is crucial to make changes at the organizational level [76]. To our best knowledge, previous studies did not take green innovation strategy as the restriction condition at the organizational level to investigate enterprise innovation. Therefore, our research expands the strategic-oriented green management theory.

Finally, an empirical study on China's steel enterprises was carried out. As a representative of emerging market economies and the Third World, the Chinese government's pursuit of green development causes the enterprises with high energy consumption and high pollution to face huge transformational pains. Therefore, research on steel enterprises is conducive to confronting the pressure and solving the problems, while providing a theoretical reference for the reform of other developing countries.

5.2. Managerial Implications

This research provides three practical management suggestions for the green development of enterprises. First, given the important role of green transformational leadership, if companies want to achieve outstanding green creativity, especially to "turn crises into opportunities" for environmental challenges, they need to appoint transformational leaders who are passionate about environmental issues, thereby contributing to the development of environmentally-friendly products or services.

Second, our results reflect the boundary of the mediation that affects creative process engagement from an organizational level. Enterprises can improve green awareness by implementing green innovation strategies, such as developing a positive green innovation culture, and then gaining benefits through the outstanding performance of green product development [77]. Due to the protracted nature of the competitive advantages of green innovation strategy [34], at the macro level, leaders must recognize that the cost problem caused by more short-term investment is conducive to the long-term vitality of enterprises in market reform; at the micro level, organizations can develop targeted training programs for executives, in accordance with immediate environmental policies to maintain a forward-looking political acumen. In addition, leaders can enhance green creativity by improving employees' expectations and understanding of the creative process. Specifically, managerial interventions, such as rewarding low-carbon creative design and team building, can be adopted to enhance employee motivation.

Finally, our research has important implications for public policy. Currently, China is committed to the harmonious development of economic construction and ecological environment [1], while our research verifies the cross-level relationship of environment-oriented from innovation strategy to creativity. External stakeholders can influence the company to formulate a green innovation strategy through regulations and policies, help the company determine environmental responsibility, improve environmental performance, and provide strategic consulting for large domestic and foreign companies to invest in China, such that, even though small and micro businesses are short of resources for sustainable development, they would still be able to engage in green innovative activities, and reap the benefits of environmental practice [77].

5.3. Current Limitations and Future Scope

The study has three limitations that are worth highlighting. First, our research is based on China's manufacturing represented by steel, and we need to conduct in-depth research in other

countries/regions (need to consider different cultural background) and other industries (such as other manufactures, cross industries such as IT, tourism) to generalize the results in the future. Second, although the multi-level analysis used in this study can provide some advantages [78], a cross-sectional design still limits our ability to explain causality. Therefore, more longitudinal studies (such as time-lagged studies) are necessary to better grasp the antecedents of green creativity. Third, this study considers the impact of green transformational leadership on green creativity, from the perspective of the individual's engagement in innovative behavior, and the level of green innovation strategy at the organizational level, ignoring the role of other variables (such as green self-efficacy, green dynamic ability). Future research can add more lenses to advance the competitiveness and sustainable development of the organization.

6. Conclusions

From the perspective of individuals and organizations, this study enriches the cognition that green transformational leadership affects green creativity, by considering the mediate effect of employees' creative process engagement within enterprises, and the moderate mechanism from a higher level of enterprises' green innovation strategy. The results provide a template for subsequent related research to verify its universality. Green development is widely concerned around the world, but companies must consider the path of enhancing employees' creativity to advance operational efficiency. On the other hand, the way of transforming social responsibility into a competitive advantage is also a problem worth exploring, while establishing a "green image" [79]. Our research is based on the China's pursuit of green development. As early as 2012, China has put forward the concept of "Beautiful China", and reflected it as the ruling concept, in a report of the 18th National Congress of the Communist Party of China, which has been also included in the "13th Five-Year Plan" of 2015. Therefore, this research provides valuable experience for enterprises' innovative practices and green management, by combining the unique background of China, and considering various green-related variables. At present, more and more senior managers realize the impact of green development on the long-term benefits of enterprises, but more studies are needed to provide new insights in the implementation of strategies.

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Appendix A

Table A1. Reliability of the Constructs and Factor Loadings of Indicators.

Constructs and Items	α	CR	AVE	MSV	ASV	FL	t
Green Transformational Leadership	0.941	0.940	0.759	0.162	0.117		
The leader of the green product development project inspires the project members with the environmental plans (GTL1)						0.851	13.983 ***
The leader of the green product development project provides a clear environmental vision for the project members to follow (GTL2)						0.917	14.095 ***
The leader of the green product development project gets the project members to work together for the same environmental goals (GTL3)						0.914	14.055 ***
The leader of the green product development project encourages the project members to achieve the environmental goals (GTL4)						0.845	12.886 ***
The leader of the green product development project acts with considering environmental beliefs of the project members (GTL5)						0.831	12.633 ***
The leader of the green product development project stimulates the project members to think about green ideas (GTL6)						0.877	13.442 ***
Creative process engagement	0.861	0.862	0.652	0.102	0.075		
I spend considerable time trying to understand the nature of the problem. (CPE1)						0.817	13.689 ***
I think about the problem from multiple perspectives. (CPE2)						0.772	11.451 ***
I decompose a difficult problem/assignment into parts to obtain greater understanding. (CPE3)						0.849	12.662 ***
I consult a wide variety of information. (CPE4)						0.812	12.205 ***
I search for information from multiple sources (e.g., personal memories, others' experience, documentation, Internet, etc.). (CPE5)						0.791	11.783 ***
I retain large amounts of detailed information in my area of expertise for future use. (CPE6)						0.825	12.509 ***
I consider diverse sources of information in generating new ideas. (CPE7)						0.860	13.899 ***
I look for connections with solutions used in seeming diverse areas. (CPE8)						0.794	11.855 ***
I generate a significant number of alternatives to the same problem before I choose the final solution. (CPE9)						0.857	13.996 ***
I try to devise potential solutions that move away from established ways of doing things. (CPE10)						0.841	12.452 ***
I spend considerable time shifting through information that helps to generate new ideas. (CPE11)						0.827	12.489 ***
Green Innovation Strategy	0.911	0.911	0.675	0.221	0.128		
To what extent has your firm modified its business practices or operations to reduce impact on animal species and natural habitats (GIS1)						0.874	13.193 ***
To what extent has your firm undertaken voluntary actions (i.e., actions that are not required by regulations) for environmental restoration (GIS2)						0.867	14.060 ***
To what extent has your firm modified its business practices to reduce wastes and emissions from operations (GIS3)						0.917	14.094 ***
To what extent has your firm modified its business practices or operations (e.g. through recycling) to reduce purchases of non-renewable materials, chemicals, and components (GIS4)						0.845	12.461 ***
To what extent has your firm reduced the use of traditional fuels by the substitution of some less polluted energy sources (GIS5)						0.788	11.779 ***
To what extent has your firm modified its business practices or operations to reduce energy consumption (GIS6)						0.825	12.486 ***
To what extent has your firm modified its business practices or operations to reduce the environmental impacts of its products (GIS7)						0.840	12.598 ***
Green Creativity	0.951	0.950	0.761	0.228	0.152		
This subordinate suggest new ways to achieve environmental goals (GC1)						0.918	14.137 ***
This subordinate propose new green ideas to improve environmental performance (GC2)						0.889	13.512 ***
This subordinate promote and champion new green ideas to others (GC3)						0.870	13.211 ***
This subordinate develop adequate plans for the implementation of new green ideas (GC4)						0.877	14.067 ***
This subordinate would rethink new green ideas (GC5)						0.833	12.553 ***
This subordinate would find out creative solutions to environmental problems (GC6)						0.844	12.618 ***

Note: individual level variable N = 298; organization level variable N = 46; Significance level, *** p < 0.001, ** p < 0.01, * p < 0.05. Cronbach's alpha value s = α ; Composite reliability = CR; Average variance extracted = AVE; Maximum Shared Variance = MSV; Average Shared Variance = ASV; Factor loadings = FL,.

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