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Employee green innovation behavior based on the ability-motivation-opportunity framework: fuzzy-set qualitative comparative analysis

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Purpose: The increasing emphasis on ecological responsibility within Chinese enterprises has underscored the critical role of employees' green innovation behavior in enhancing environmental performance and enhancing core competitiveness. Grounded in the Ability, Motivation, and Opportunity (AMO) theoretical framework, this study employs configuration analysis to investigate the driving mechanisms behind the multi-factorial interplay affecting employees' green innovation behaviors.

Methodology: Data was collected through questionnaires distributed among a random sample of 219 Chinese corporate employees. fuzzy-set Qualitative Comparative Analysis (fs-QCA) was then applied to identify the specific configurations contributing to high levels of green innovation behavior.

Findings: (1) There are three driving paths for employees' green innovation behaviors: a leadership-organization co-driving path composed of green self-efficacy, environmentally transformative leadership, and organizational support; a leadership-driving path composed of green self-efficacy, environmentally transformative leadership, internal motivation, and external motivation; and an organization-driving path composed of green self-efficacy, organizational support, internal motivation, and external motivation. (2) There are three non-green innovation behavior-driven paths: they are divided into organizational support lack type, leadership-organizational joint lack type, and capability lack type. (3) Under specific conditions, motivational factors and environmental change leadership, motivational factors and sense of organizational support can promote employees' green innovation through equivalent substitution.

Originality: (1) Significant emphasis is placed on examining how Ability, Motivation, and Opportunity synergize to shape employees' green innovation behaviors, addressing a gap in the literature regarding their collective influence. (2) The study applies a configural approach to unravel the complex causal linkages influencing employees' green innovation behaviors, offering detailed insights into the dynamics between individual attributes and contextual factors. (3) This research elucidates the combined effects of factors such as organizational support, leadership styles, and employees' intrinsic and extrinsic motivations, and how they collaborate to foster an environment conducive to green innovation.

Implications: The findings not only enrich the theoretical understanding of green innovation behavior but also provide strategic recommendations for Chinese enterprises to encourage such behavior. These insights are essential for guiding sustainable development and enhancing competitive advantage.

KEYWORDS

employee green innovation behavior, AMO theory, fs-QCA, environmental transformational leadership, green innovation behavior

1 Introduction

In today's trend of harmonious coexistence between enterprises and the environment under sustainable development, the awareness of ecological responsibility has prompted enterprises to continuously explore and practice business ecological models. Employees' green innovation behavior has become a crucial driving force for sustainable development and the acquisition of core competitive advantage (Ismail and Hilal, 2023). This behavior is closely related to the realization of corporate environmental sustainability goals and serves as an important source for companies to improve environmental performance and achieve core competitiveness (Calle et al., 2020). Therefore, how to stimulate employees' green innovation behavior has become an urgent problem to be solved.

Existing studies have significantly contributed to understanding the impact of individual and situational factors on employees' green innovation behavior. However, they have primarily focused on the net effect analysis of corresponding variables, adopting an isolated perspective that lacks an analysis of core conditions and configurations. This limitation makes it difficult to address the interaction between individual and situational factors (Yunzhou et al., 2022). Employees' green innovation behavior depends not only on the employees' personal ability such as green values (Al-Ghazali and Afsar, 2020), green knowledge management (Cai et al., 2023), workplace learning (Cai et al., 2023), and other motivations such as green internal motivation (Li et al., 2020), green external motivation (Li et al., 2020), but also rely on the provision of enterprise innovation platforms such as transactional leadership (Cai et al., 2023), green human resources management (Aftab and Veneziani, 2024). The so-called response to the situation, 'the wise change with the times, the wise move with the situation.'

The AMO theory, which integrates employees' individual-level ability, motivation, and organizational-level opportunity (Bos-Nehles et al., 2023), offers a configuration perspective to understand the causal complexity behind outcomes. This perspective highlights the interdependence of multiple influencing factors and their ability to achieve a common purpose through differentiated permutation and combination. It is particularly helpful in addressing causal complexity issues such as multiple concurrent causality, causal asymmetry, and multi-scheme equivalence (Zhang and Du, 2019). Therefore, it also has important explanatory power for the complex causality and path behind employees' green innovation behavior. Based on this, this paper empirically explores the influencing factors and promotion paths of employees' green innovation behavior with the help of 'configuration perspective' under the framework of AMO theory. Specifically, this study aims to solve the following problems:

First, is employee green innovation behavior the result of multi-factor synergy?

Second, what are the paths to promote employees' green innovation behavior and non-green innovation behavior?

Third, what is the substitution relationship between the paths that promote employees' green innovation behavior?

2 Literature review and model construction

2.1 Employees' green innovation behavior

Employee green innovation behavior is the deliberate innovation by employees in the design, service, processes, and production methods of products within an organization, aimed at reducing environmental impact and achieving ecological sustainable development (García-Machado and Martínez-Ávila, 2019). This behavior can enhance market share, improve financial performance, maintain a competitive edge (Algarni et al., 2022), and also increase environmental performance, conserve energy, and decrease environmental pollution (Albort-Morant et al., 2018). At present, the antecedents of employees' green innovation behavior are roughly divided into two levels: individual factors and situational factors. Individual factors include environmental responsibility (Ahmed et al., 2023), green work participation (Karatepe et al., 2022), environmental protection enthusiasm (Luu, 2021), environmental knowledge (Riva et al., 2021) and so on. Contextual factors include leadership style (Bhutto et al., 2021), green organizational support (Hameed et al., 2021), green human resource management (Muisyo et al., 2022), green creative atmosphere (Aboramadan et al., 2021), etc. However, most existing studies focus on the individual impact of personal or situational factors on employee green innovation behavior, primarily using statistical regression to explain the marginal net effect of single factors, thus overlooking the synergistic process between individual and situational factors in green innovation behavior. Therefore, this paper seeks to explore the driving mechanism behind the interaction of multiple factors on employee green innovation behavior from a configurational perspective.

2.2 Ability factor-green self-efficacy

Green self-efficacy refers to the individual's confidence and belief in the actions and programs needed to organize, implement and achieve environmental goals (Chen et al., 2015). Research indicates that self-efficacy positively influences individual behavior; individuals with high green self-efficacy can actively assess their abilities during the decision-making process, make full use of environmental information, and make rational judgments, thereby contributing to the implementation of green behaviors (Meirun et al., 2024). Specifically: employees with high green self-efficacy are more confident in their ability to influence the environment and solve environmental problems, believe that they have the ability to deal with environmental problems encountered in their work, and have the courage to explore and innovate around the above problems. Ways and methods of problem solving, thereby promoting employees' green innovation behavior; in addition, employees with high green self-efficacy have a stronger sense of environmental awareness and responsibility, that is, they can actively perceive and assume

environmental responsibility at work, which is more inclined to green innovation behavior (Gao et al., 2023).

2.3 Motivation factors-green internal motivation, green external motivation

2.3.1 Green internal motivation

Intrinsic motivation arises from an individual's perception of the work itself as challenging and interesting, fulfilling personal needs (Ryan and Deci, 2000). It encompasses cognitive and emotional aspects. Cognitively, a higher level of green intrinsic motivation leads to more flexible and systematic thinking about environmental issues, deeper understanding, and a greater propensity to adopt innovative methods to achieve environmental goals, fostering green innovation behavior (Hou and Lu, 2018). Emotionally, the pursuit of intrinsic motivation generates a sense of satisfaction and happiness through activities that align with one's interests (Li et al., 2020). Employees with strong green intrinsic motivation are more likely to invest effort and creativity into environmentally beneficial methods, driving their engagement in green innovation (Kim et al., 2016). Overall, a positive correlation exists between intrinsic motivation and green innovation behavior. The greater the individual's environmental awareness and emotional fulfillment, the more they are inclined to explore and implement green innovation behaviors beneficial to environmental protection.

2.3.2 Green external motivation

Extrinsic motivation is the drive that individuals perceive to meet their needs through external rewards for work, promotion, or the avoidance of coercion and punishment (Gagne and Deci, 2005). It includes the satisfaction derived from positive actions and outcomes and the avoidance of negative behaviors and their consequences. Organizations implement targeted incentive strategies to harness employees' extrinsic motivation. To encourage positive behaviors and results, organizations provide active feedback, recognizing employees' environmental contributions and encouraging active participation in finding innovative solutions to environmental issues, which strengthens employees' green innovation behavior (Li et al., 2020). Conversely, to deter negative behaviors and outcomes, organizations may impose penalties on employees who do not adhere to green conduct standards and responsibilities, compelling and incentivizing them towards green innovation (Graves et al., 2013).

2.4 Opportunity factors-environmental transformational leadership, perceived organizational support

2.4.1 Environmental transformational leadership

Environmental transformational leadership is a leadership style that motivates employees' green innovation to achieve corporate green development (Zhang et al., 2020). This leadership comprises four interrelated behaviors: inspiring environmental vision, influence through personal power and charisma, personalized care for employees' green innovation capabilities, and intellectual stimulation for environmental thinking (Robertson, 2017). Firstly, recognizing the strong ethical nature of green innovation behavior, transformational leaders actively promote it through compelling visions to uphold a

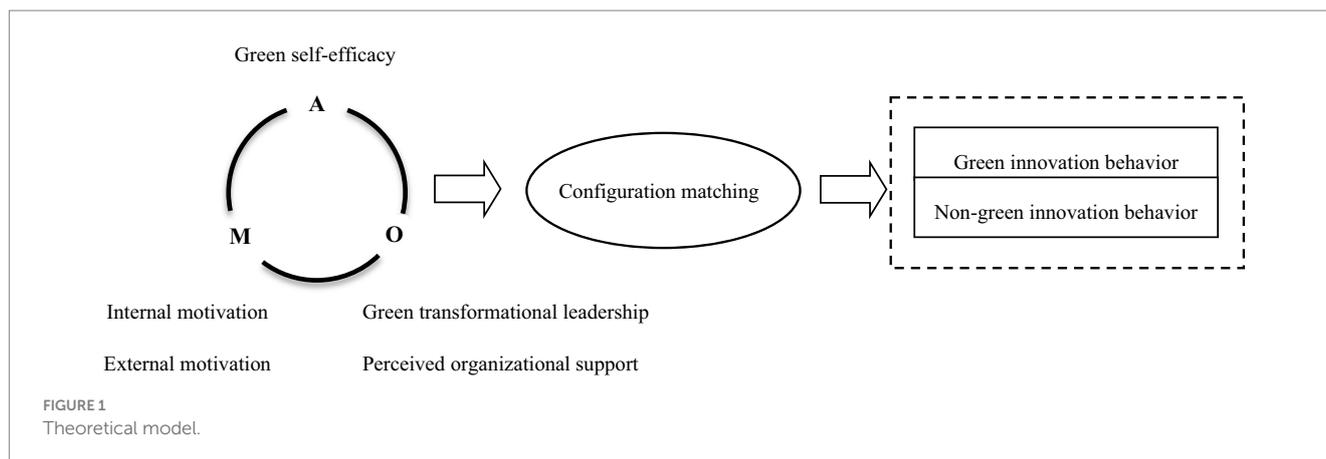
positive social and moral image for both individuals and organizations. Secondly, these leaders lead by example, using their authority and personal appeal to engage in environmentally beneficial initiatives, thereby influencing and inspiring employees to innovate greenly (Tian and Tian, 2020). Thirdly, they provide personalized support and resources, engaging in one-on-one communication to nurture employees' willingness and ability to innovate greenly (Robertson and Barling, 2017). Lastly, they foster a culture of critical thinking, encouraging employees to question and verify, to innovate boldly, take risks, and seek diverse solutions to environmental issues within the organization (Tian and Tian, 2020).

2.4.2 Perceived organizational support

Perceived organizational support refers to employees' perception of the extent to which the organization cares for and aids their actions and outcomes, as well as values their welfare benefits (Eisenberger et al., 1986). Organizational support for employees' green innovation behavior is expressed through emotional and instrumental support. Emotionally, the organization fosters employees' self-confidence in green innovation by showing care, recognition, affirmation, and tolerance for their environmentally beneficial attempts and creative work behaviors, thereby providing a nurturing "soft environment." Instrumentally, the organization offers a structural guarantee for green innovation through the establishment of relevant regulations and policies. It also ensures the execution of green innovation by supplying methods, technologies, and resources that support environmentally friendly actions, creating a supportive "hard environment" (Chung, 2017).

According to the AMO theory, predicting individual behavior requires consideration of ability, motivation, and opportunity, which are interrelated and collectively promote the emergence of individual actions (Blumberg and Pringle, 1982). Ability encompasses the comprehensive qualities of knowledge and skills that enable individuals to achieve specific goals or tasks. Motivation refers to the internal drive that stimulates or sustains specific behaviors. Opportunity denotes the circumstances or conditions that can either facilitate or hinder employees in exhibiting certain behaviors (Zhang et al., 2022). Integrating the theoretical analysis of employee green innovation behavior with the AMO theory, this study constructs a theoretical framework as depicted in Figure 1.

Employee green innovation behavior results from the interplay of green self-efficacy (ability), internal and external motivation (motivation), perceived organizational support, and environmental transformational leadership (opportunity). On one hand, employees' confidence and belief in environmentally innovative actions, along with the internal satisfaction derived from systematic thinking and understanding of environmental issues, indicate their capability and desire for green innovation. However, without the right opportunities, these are insufficient to ensure the genuine execution of such behavior. Despite organizations' attempts to motivate through rewards or punishments, green innovation becomes merely a choice driven by the instinctive need to seek benefits and avoid harm. On the other hand, the organization's environmental support, both "soft" and "hard," and environmental transformational leadership, which inspire through vision, example, personalized care, and encouragement of questioning and thinking, merely set the stage for green innovation by providing opportunities and conditions. Yet, without the employees' capability and willingness, these are inadequate to support the true implementation of behavior. As Mencius said, "Although there is wisdom, it is better to take advantage of the situation; although there are tools, it is



better to wait for the time.” Employee green innovation behavior is the outcome of being able, willing, and provided the opportunity to act. These three elements are essential: “able to do” reflects employees’ confidence and belief in green innovation, “willing to do” reflects their needs and motivations, and “provided the opportunity to do” reflects the conditions for their green innovation behavior. Green self-efficacy and internal and external motivation lay the foundation for becoming a “hero,” while environmental transformational leadership and organizational support provide the potential. Only by responding to the times and situations can success be achieved.

3 Research design

3.1 Data collection

This study uses the questionnaire survey method to collect data, and at the same time, with the help of alumni and relatives and friends resources, the electronic questionnaire links are distributed to enterprise employees in a snowball way. A total of 246 sample data were collected. After eliminating the questionnaires with short response time and high repetition rate, 219 valid questionnaires were remaining, and the effective rate of the questionnaire was 89.02%. In terms of gender structure, 129 male samples accounted for 58.9%, and 90 female samples accounted for 41.1%; in terms of age, the average age was 38 years; in terms of educational structure, 40 people with high school and below accounted for 18.30%, 68 people with junior college accounted for 31.10%, 68 people with undergraduate accounted for 31.10%, and 43 people with master’s degree and above accounted for 19.60%. In terms of working years, the average working years is 13.91 years.

3.2 Variable measurement

All the scales in this study are from foreign literature. The main variable scales are transformed into expressions that conform to the Chinese context through a two-way translation process, and 20 enterprise employees are invited to fill in the test. The revised scale is issued as a formal questionnaire to ensure that each item statement is smooth and unambiguous, consistent with corporate practice, and ensure the scientific and rigorous nature of the research. Detailed questionnaire items are listed in Table 1. Cronbach’s alpha is a key

measure of questionnaire reliability, which reflects the consistency between questionnaire items. A high Cronbach’s alpha value (usually greater than 0.7) indicates that the questionnaire has a high degree of internal consistency in the measurement of a particular concept, which is essential to ensure the reliability of the study results. In this study, the Cronbach’s alpha values of all questionnaire items exceeded 0.7, which verified the acceptable reliability of the questionnaire, thus enhancing the credibility of the findings.

Green self-efficacy was measured by the scale developed by Chen et al. (2015), which consisted of 6 items. Representative topics such as ‘I think I can successfully realize the concept of environmental protection’, Cronbach’s α coefficient is 0.927.

Environmental transformational leadership uses a scale developed by Robertson (2017), which has 12 items. Representative topics such as “My leadership has set an example for me in environmental protection”, Cronbach’s α coefficient is 0.933.

The perceived organizational support is a simplified version of the scale developed by Eisenberger et al. (1986), which has a total of 8 items. Representative topics such as ‘When I encounter difficulties, the organization can help’, etc. Two of the items were reverse questions, and the Cronbach’s α coefficient was 0.922.

The scale of intrinsic motivation and extrinsic motivation was developed by Gagné et al. (2010). There were three items of intrinsic motivation in the scale. Representative topics such as ‘because I like this job very much’, Cronbach’s α coefficient is 0.881. There were 3 items of extrinsic motivation in the scale, which represented topics such as ‘Because this job can make me maintain a certain standard of living’. The Cronbach’s α coefficient was 0.881.

The green innovation behavior of employees is based on the scale developed by Zhang et al. (2018), which has four items. Representative topics such as “I often put forward the idea of reducing waste and emission of harmful substances in my work”, Cronbach’s α coefficient is 0.868. See Table 1 for specific topics.

3.3 Reliability and validity and common method bias test

3.3.1 Reliability and validity analysis

This paper uses SPSS26.0 to test the reliability of the questionnaire, and the results are shown in Table 2. The Cronbach’s α coefficients of green self-efficacy, internal motivation, external

TABLE 1 Specific topics.

Green self-efficacy	We feel we can succeed in accomplishing environmental ideas
	We can achieve most of environmental goals
	We feel competent to deal effectively with environmental tasks
	We can perform effectively on environmental missions
	We can overcome environmental problems
	We could find out creative solutions to environmental problems
Environmental transformational leadership	My leader acts as an environmental role model
	My leader motivates me to work in an environmentally friendly manner
	My leader shows a commitment to improving our organization's environmental performance
	My leader encourages me to think about environmental issues in different ways
	My leader shows that (s)he values the natural environment
	My leader is open to my ideas about ways to improve our organization's environmental performance
	My leader recognizes my ability to improve our organization's environmental performance
	My leader takes note of my individual contributions to the organization's environmental performance
	My leader spends time developing my skills to contribute to our organization's environmental performance
	My leader is passionate about improving the future state of the natural environment
	My leader urges me to think creatively about improving our organization's environmental performance
	My leader is optimistic about the future of our organization's environmental performance
Perceived organizational support	The organization strongly considers my goals and values.
	Help is available from the organization when I have a problem.
	The organization really cares about my well-being.
	The organization is willing to extend itself in order to help me perform my job to the best of my ability.
	Even if I did the best job possible, the organization would fail to notice. (R)
	The organization shows very little concern for me. (R)
	The organization cares about my opinions.
	The organization takes pride in my accomplishments at work.
Internal motivation	Because I enjoy this work very much
	Because I have fun doing my job
	For the moments of pleasure that this job brings me
External motivation	Because this job affords me a certain standard of living
	Because it allows me to make a lot of money
	I do this job for the paycheck
Employee green innovation	I figure out ways to reduce waste and emission.
	I recycle waste and treats hazardous emission by all means.
	I conserve resources (e.g., water, electricity) in business activities.
	I effectively utilizes materials in business activities.

Reverse entries marked with R.

motivation, perceived organizational support and environmental transformational leadership were all greater than 0.70, indicating that the reliability of the questionnaire was good. In terms of validity, first of all, in terms of content validity, this paper adopts the foreign mature scale, and optimizes the item description in combination with the research content and the Chinese situation, indicating that the questionnaire has good content validity. Secondly, in terms of structural validity, this paper uses AMOS24.0 to conduct confirmatory factor analysis on the main variables. The factor loads of the measurement indicators corresponding to each variable are greater than 0.60. The AVE values of all construct

variables are greater than 0.50, and the CR values are greater than 0.80, which proves that the questionnaire used in this paper has good combination reliability and structural validity.

3.3.2 Common method bias test

In this paper, the Harman single factor method is used to test the common method bias, that is, all variables are loaded onto a single latent factor to test whether there is a common method bias. The results show that the variance interpretation rate of the first factor is 19.341%, which is much lower than 40%. Therefore, there is no serious common method bias problem (Morgeson et al., 2005).

4 Data analysis

4.1 Variable calibration

Variable calibration is the operation process of transforming the variables involved in the research into a set and giving the set membership degree to the research case. This method needs to preset three anchor points: complete membership, intersection and complete non-membership (Du and Jia, 2017). Due to the lack of mature theory and external standards, it is impossible to clearly define green innovation behavior and non-green innovation behavior and the level of each antecedent condition. Therefore, referring to the recommendation of Ragin (2009), the data is calibrated with the objective quantile as the standard. The 95, 50 and 5% quantiles of the sample data are selected as the anchor points of complete membership, intersection and complete non-membership. The data is calibrated to the membership degree between 0 and 1, and the calibration points of each variable are shown in Table 3. At the same time, in order to avoid the data with a fuzzy set membership score of 0.5 being difficult to classify and eliminated during the calibration process, this paper increases 0.001 on the basis of it.

4.2 Necessity analysis of single condition

The necessary condition is the condition that must exist to cause the result to occur, but its existence does not guarantee that the result will inevitably occur (Riehaux, 2017). It can be seen from Table 4 that the necessity of each single antecedent condition affecting employees' green innovation behavior or non-green innovation behavior does not exceed 0.90, indicating that the single antecedent condition has a weak explanatory power for employees' green innovation behavior. This result shows the complexity of the driving factors of employees' green innovation behavior, that is, ability, motivation and opportunity factors need to be matched with each other to jointly affect employees' green innovation behavior.

4.3 Adequacy analysis of conditional configuration

The results variable selects employees' green innovation behavior, sets the consistency threshold and PRI consistency threshold to be 0.8 and 0.7, respectively, and the case frequency threshold is set to 2. At the same time, in order to avoid the contradictory configuration situation, the PRI consistency threshold is set to the lowest acceptable standard 0.7, and the fs-QCA3.0 software is used to analyze the truth table. The operation results include complex solutions, simple solutions and intermediate solutions (Yunzhou et al., 2022). Since the relationship between the five conditional variables of this study and employees' green innovation behavior has not yet reached a consistent conclusion, there is a lack of clear theoretical expectations, and counterfactual analysis cannot be effectively carried out. Drawing on the practice of Zhang and Du (2019), this study chooses "existence or absence" when facing the problem of what state of the five conditions will lead to the result, and when reporting the output result, it is mainly based on the intermediate solution and supplemented by the simple solution. The configuration condition of the intermediate solution is set as the auxiliary condition, and the configuration condition that includes both the intermediate solution and the simple solution is set as the core condition. The specific results are shown in Table 5.

It can be seen from Table 5 that there are three equivalent paths to realize employees' green innovation behavior. The consistency of the three configurations is 0.909, 0.899 and 0.909 respectively, which is greater than the 0.8 critical value standard set by the research, showing a high level of consistency, indicating that the three configuration paths obtained in this study have substantial explanatory power for green innovation behavior. In addition, the consistency of the solution is 0.87, which is greater than 0.80, indicating that 87% of employees show higher employee green innovation behavior in all cases that meet these three types of conditional configurations. The coverage of the solution is 66.74%, which means that the three types of conditional configurations can explain 66.74% of the cases of high green innovation behavior, and have good explanatory power. There are four

TABLE 2 Results of reliability and validity analysis.

Variables	Minimum factor load coefficient	Cranbach's α	AVE	CR
Green self-efficacy	0.773	0.927	0.681	0.927
Environmental transformational leadership	0.660	0.933	0.539	0.933
Perceived organizational support	0.738	0.922	0.600	0.923
Internal motivation	0.816	0.881	0.713	0.882
External motivation	0.784	0.881	0.718	0.884
Employee green innovation	0.669	0.868	0.543	0.825

TABLE 3 Data calibration reference.

Anchor point	GSE	GTL	POS	IM	EM	EGCB
Completely subordinate	4.500	4.341	6.125	6.333	6.333	4.75
Crossing point	2.833	2.750	4.250	3.333	3.333	3.000
Completely not affiliated	1.333	1.583	2.125	1.333	1.333	1.250

GSE refers to green self-efficacy; GTL refers to environmental transformational leadership; POS refers to perceived organizational support; IM refers to internal motivation; EM refers to external motivation; EGCB refers to employees' green innovation behavior.

TABLE 4 Results of the univariate necessity test.

Antecedent conditions	Green innovation behavior		Non-green innovation behavior	
	Consistency	Coverage	Consistency	Coverage
High green self-efficacy	0.747	0.749	0.443	0.426
Low green self-efficacy	0.427	0.444	0.739	0.737
High environmental transformational leadership	0.703	0.744	0.441	0.447
Low environmental transformational leadership	0.478	0.472	0.748	0.707
High perceived organizational support	0.734	0.758	0.447	0.442
Low perceived organizational support	0.459	0.465	0.755	0.732
High internal motivation	0.789	0.749	0.478	0.435
Low internal motivation	0.405	0.447	0.725	0.768
High external motivation	0.798	0.751	0.484	0.437
Low external motivation	0.401	0.448	0.724	0.774

TABLE 5 Grouping results of employee green innovation behavior.

Conditions	Green innovation behavior			Non-green innovation behavior			
	L1	L2	L3	NL1	NL2	NL3a	NL3b
Green self-efficacy	●	●	●		⊗	⊗	⊗
Environmental transformational leadership	●	●			⊗		⊗
Perceived organizational support	●		●	⊗	⊗		⊗
Internal motivation		●	●	⊗		⊗	⊗
External motivation		●	●	⊗	⊗	⊗	
Consistency	0.909	0.899	0.909	0.868	0.906	0.865	0.898
Original coverage	0.534	0.528	0.526	0.550	0.444	0.555	0.444
Unique coverage	0.074	0.067	0.066	0.077	0.021	0.083	0.022
Total coverage	0.667			0.675			
Total consistency	0.871			0.839			

● represents the existence of conditional variables, and ⊗ represents the absence of conditional variables. Among them, the big circle represents the core condition, and the small circle represents the edge condition. Blank indicates that the configuration variable may or may not exist.

equivalent paths for non-green innovation behavior. The consistency of the four configurations is 0.868, 0.906, 0.865 and 0.898 respectively, which is greater than the 0.8 critical value standard set by the research. The overall coverage is 0.68, covering 68.52% of the case samples, which means that these four antecedent paths can explain more than 68.52% of the non-green innovation behavior cases in the observation samples. At the same time, the consistency is greater than the critical value of 0.8 set in the study, it shows that these four antecedent paths have substantial explanatory power for non-green innovation behavior, that is, these four paths are a combination of sufficient conditions for non-green innovation behavior.

4.4 Analysis on the configuration path of employees' green innovation behavior

QCA emphasizes the asymmetry of causality. This paper analyzes the antecedent configuration of green innovation behavior and non-green innovation behavior. At the same time, it analyzes the antecedent configuration and names the three antecedent configuration

paths of employees' green innovation behavior as leadership-organization co-driven, leadership-driven, and organization-driven (Yunzhou et al., 2022). The three antecedent configuration paths of non-employee green innovation behavior are named as lack of organizational support, lack of leadership-organization common, and lack of ability.

4.4.1 Configuration analysis of employees' green innovation behavior

Configure L1 Leader-Organization Co-Driven: This path shows that regardless of whether employees have internal and external motivations, employees with high green self-efficacy will show green innovation behavior under the incentive of environmental transformational leadership and the support of the organization. In this path, green self-efficacy, environmental transformational leadership and organizational support are the core conditions. This path can explain 53.4% of employees' green innovation behavior, and 7.4% of employees' green innovation behavior cases can only be explained by this path.

Configuration L2 leadership-driven: This path shows that regardless of whether the organization supports employees' green

innovation behavior, employees with high self-efficacy and high motivation level will also show green innovation behavior under the incentive of environmental transformational leadership. In this path, green self-efficacy, environmental transformational leadership, internal motivation are the core conditions, and external motivation is the supplementary condition. This path can explain 52.8% of employees' green innovation behavior, and 6.7% of employees' green innovation behavior cases can only be explained by this path.

Configuration L3 organization-driven: This path shows that regardless of whether environmental transformational leadership motivates employees' green innovation behavior, employees with high self-efficacy and high motivation level will show green innovation behavior under organizational support. In this path, green self-efficacy, organizational support and internal motivation are the core conditions, and external motivation is the supplementary condition. This path can explain 52.6% of employees' green innovation behavior, and 6.6% of employees' green innovation behavior cases can only be explained by this path.

4.4.2 Configuration analysis of non-green innovation behavior

Configuration NL1 lack of organizational support: This path shows that regardless of whether environmental transformational leadership motivates employees' green innovation behavior, once the organization has insufficient support for employees' green innovation behavior and employees lack green innovation motivation, employees will not show green innovation behavior. In this path, perceived organizational support and intrinsic motivation are the core conditions, and external motivation is the marginal condition. This path can explain 55% of non-high green innovation behavior, and 7.7% of non-green innovation behavior cases can only be explained by this path.

Configuration NL2 leadership-organization common lack type: this path shows that regardless of whether the employee's internal motivation exists, once the organization has insufficient support for the employee's green innovation behavior, the environmental transformational leadership lacks incentives for the employee's green innovation, and the employee's green self-efficacy and external motivation level is not high, the employee will not show green innovation behavior. In this path, green self-efficacy, environmental transformational leadership, organizational support, and external motivation are the core conditions. This path can explain 44.4% of non-high green innovation behavior, and 2.1% of non-high green innovation behavior cases can only be explained by this path.

NL3 ability deficiency type: NL3 a and NL3 b are collectively referred to as ability deficiency type (NL3b is a true subset of NL3a). Regardless of whether environmental transformational leadership and organization encourage or support employees' green innovation behavior, once employees' green self-efficacy and internal and external motivation levels are not high, employees will not show green innovation behavior. In the path NL3a, low green self-efficacy and low internal motivation are the core conditions, and low external motivation is the supplementary condition. This path can explain about 55.5% of non-high green innovation behavior, and 8.3% of non-high green innovation behavior cases can only be explained by this path. In the path NL3b, low green self-efficacy and low internal motivation are the core conditions, and low environmental transformational leadership and low organizational support are the

supplementary conditions. This path can explain 44.4% of non-high green innovation behavior, and 2.2% of non-high green innovation behavior cases can only be explained by this path.

4.5 Robustness test

In order to ensure the reliability of the research results, this paper draws on previous practices (Andrews et al., 2016) to test the robustness of the antecedent configuration that affects employees' green innovation behavior: (1) Adjust the calibration threshold. The calibration points were adjusted from 95, 50 and 5% to 90, 50 and 10%, respectively, representing the full membership threshold, the intersection point and the full non-membership threshold, and the variables were recalibrated. Compared with the aforementioned configuration results, only the coverage and consistency were slightly different; (2) By adjusting the consistency threshold from 0.7 to 0.75, the obtained configuration path is consistent with the configuration path obtained by the 0.7 consistency threshold; (3) By changing the case frequency and increasing the case frequency from 2 to 3, the configuration analysis results are basically the same as the previous configuration results. Therefore, the configuration results of employees' green innovation behavior and non-green innovation behavior in this paper are robust.

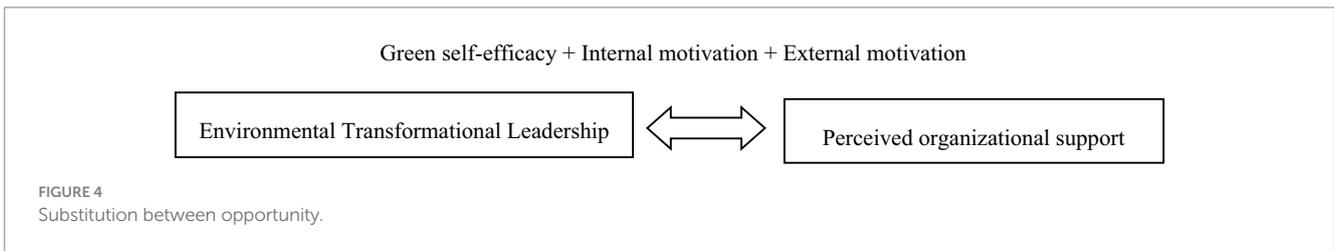
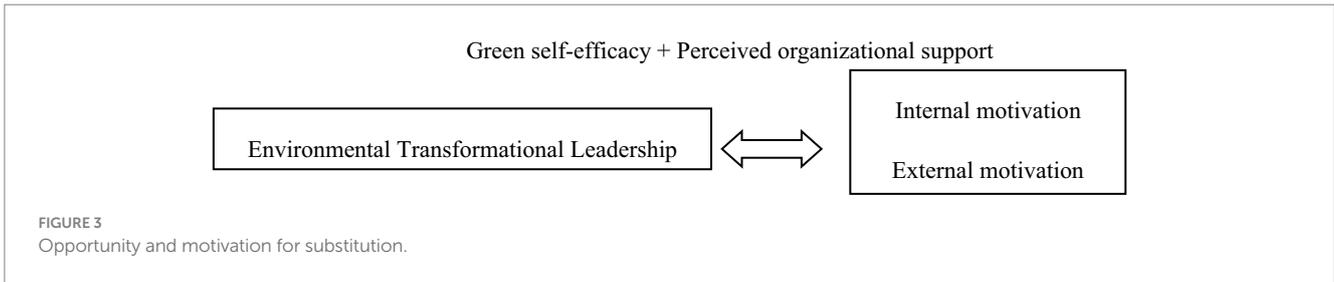
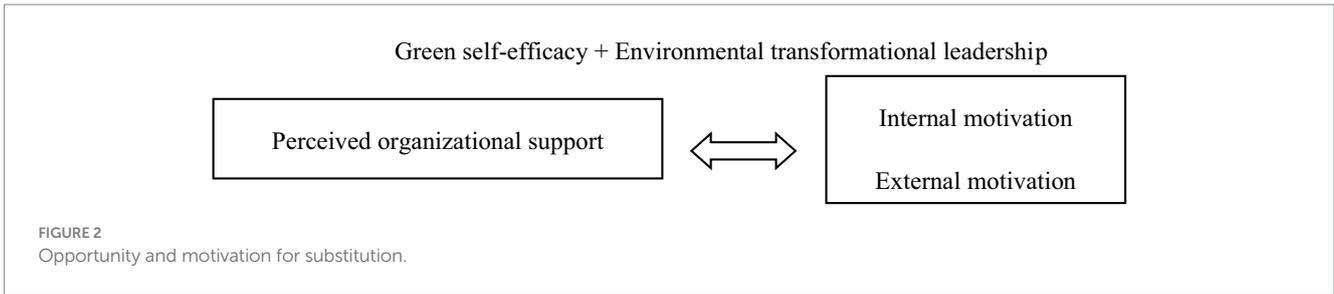
4.6 Potential substitution relationship between conditions

By comparing the similarities and differences of configuration 1~3, we can further discover the potential substitution relationship between opportunity and motivation factors. First of all, by comparing configuration 1 and configuration 2, this study finds that when employees with high self-efficacy have the support and help of environmental transformational leadership, the combination of internal motivation and external motivation can be replaced by organizational support to promote employees' green innovation behavior, as shown in Figure 2. Secondly, through the comparison of configuration 1 and configuration 3, it is found that when employees with high self-efficacy perceive a higher sense of organizational support for green innovation behavior, the combination of internal motivation and external motivation can be replaced with environmental transformational leadership to promote employees' green innovation behavior, as shown in Figure 3. Finally, the comparison between configuration 2 and configuration 3 shows that when employees with high self-efficacy have high internal motivation and external motivation, perceived organizational support can replace environmental transformational leadership to promote employees' green innovation behavior, as shown in Figure 4.

5 Conclusion and enlightenment

5.1 Conclusions and discussion

This study focuses on the green innovation behaviors of employees in Chinese firms, a context that provides a unique socio-cultural and



economic development environment for understanding employee behaviors. As the world's most populous and rapidly industrialising country, China faces the dual challenge of balancing economic growth and environmental protection. In this context, the green innovation behavior of employees is of particular importance. Based on the AMO theoretical framework, this paper uses fs-QCA to analyze the conditional configuration of the path that affects employees' green innovation behavior. This study finds that: First, green self-efficacy, internal motivation, external motivation, environmental transformational leadership and organizational support cannot alone constitute the necessary conditions for employees' green innovation behavior. The path of employees' green innovation behavior is embodied in the leadership-organization-driven path composed of green self-efficacy, environmental transformational leadership and organizational support; the leadership-driven path is composed of green self-efficacy, internal motivation, external motivation and environmental transformational leadership; an organization-driven path composed of green self-efficacy, internal motivation, external motivation and perceived organizational support. Secondly, the potential substitution relationship between opportunity and motivation factors shows that under certain conditions, opportunity and motivation factors can be equivalently substituted to promote employees' green innovation behavior. Thirdly, three equivalent paths are found to cause the lack of green innovation behavior of enterprise employees.

Employee green innovation behavior results from the interplay of internal capabilities and external opportunities. This study reveals that

in the three antecedent configurations (L1, L2, and L3), employee green innovation is influenced by a combination of ability, opportunity, and motivation. No single factor alone is sufficient for green innovation behavior. A deficiency in incentives or organizational support for environmental transformational leadership (as seen in paths NL2 and NL3b) leaves employees, despite their 'heroic traits' (capability and motivation), in a predicament akin to 'unfulfilled potential,' lacking the opportunity to engage in green innovation. This aligns with [Blumberg and Pringle's \(1982\)](#) findings that an individual's willingness and capability to perform a behavior are contingent upon their objective conditions and opportunities. Similarly, a lack of self-efficacy and internal and external motivation (as in paths NL1 and NL3a) means that even with leadership incentives or organizational support, employees find themselves in a 'difficult to assist' situation, unable to perform green innovation behavior. This is consistent with [Blumberg and Pringle's](#) research and echoes [Ryan and Deci's \(2000\)](#) point that opportunity alone, without capability, cannot ensure a change in employee behavior. It is evident that capability without opportunity remains latent, and opportunity without capability is unutilized. Employee green innovation behavior requires not only the 'foundation' of internal capability but also the 'favorable conditions' provided by external opportunities.

On the one hand, establishing a solid foundation is crucial for employees' green innovation. Employees should be confident, persistent, and eager to creatively address work-related, environmental, and sustainability issues. [Hmieleski and Baron \(2008\)](#) noted that employees with higher self-efficacy are more confident in

proposing new ideas and exhibit more innovative behaviors. [Chen et al. \(2015\)](#) further suggested that in the context of sustainable development, employees with high green self-efficacy will exert more effort to devise creative solutions to environmental challenges, fostering their green creativity. Secondly, the more urgent employees' cognitive needs regarding work, environment, and sustainability, and the greater the satisfaction they derive from meeting these needs, the more likely they are to engage in green innovation. According to [Amabile \(2011\)](#), among the factors affecting employee creativity—internal motivation, background knowledge and skills, creativity input process, and social environment—intrinsic motivation is the most influential. [Li et al. \(2020\)](#) confirmed that green intrinsic motivation can drive employees' green innovation behavior, as they are more inclined to show such behavior when they find tasks attractive, challenging, and enjoyable. Similarly, [Kim et al. \(2016\)](#) pointed out that external motivation sources synergistically affect employees' fundamental attitudes towards environmental issues. Overall, these studies align with the findings of this research, which show that green self-efficacy and both internal and external motivation are the basis for promoting employees' green innovation behavior. Employees should learn to accumulate energy, as opportunities favor the prepared. Conversely, as illustrated in path NL3a, even with support from environmental transformational leadership and organizations, employees lacking in green self-efficacy and motivation will miss opportunities and fail to perform green innovation behavior.

On the other hand, leveraging opportunities is essential for employees' green innovation. Firstly, environmental transformational leadership should inspire employees' vision for environmental protection, lead by example, provide personalized care, and encourage questioning and critical thinking. [Avolio and Bass \(2004\)](#) noted that transformational leadership aims to elevate subordinates' awareness through higher ideals like freedom, justice, fairness, and humanism, motivating them to prioritize organizational interests over personal gains. Building on this, [Jia et al. \(2018\)](#) suggested that environmental transformational leadership can foster employees' green innovation by focusing on the four behavioral elements of transformational leadership. Secondly, organizations should provide both "soft" and "hard" environmental support for employees. [Hameed et al. \(2021\)](#) found that when organizations clearly communicate their commitment to social responsibility and green sustainable development, employees feel compelled to actively engage in green innovation activities. This aligns with the findings of this study, which emphasize the importance of seizing opportunities by comparing the L1, L2, and L3 paths. Employees should adapt to the situation and actively pursue green innovation under the influence of transformational leadership and with the support of the organizational environment. Moreover, responsible employees should proactively seek opportunities. As Sun Tzu said, "The good fighter is he who seeks the favorable ground," employees should spontaneously seek the support of environmental transformational leadership and the organization to engage in green innovation. Additionally, enterprises should create momentum for employees. Green innovation by employees is a vital source for companies to achieve core competitiveness. Environmental transformational leadership and organizations should provide employees with the platforms and opportunities necessary to encourage and guide them in creatively proposing solutions to environmental problems, thereby stimulating green innovation behavior.

5.2 Management inspiration

First, it is ideologically recognized that employees' green innovation behavior is the result of the interaction of green self-efficacy, internal motivation, external motivation, environmental transformational leadership and organizational support. From the three paths found in this paper, it can be seen that a single factor cannot determine the green innovation behavior of employees, and it is necessary to focus on the collaborative matching between multiple conditions from the overall perspective. Therefore, managers should realize that when stimulating employees' green innovation behavior, they should comprehensively consider various factors to form a differentiated path to promote employees' green innovation behavior.

Second, pay attention to the cultivation of employees' ability. Leaders should convey to employees the idea of supporting and encouraging employees' green innovation, mobilize the enthusiasm of employees' green innovation, form a good atmosphere of green innovation within the enterprise, let employees actively participate in green innovation practice, encourage employees to tap their own potential, put forward new green innovation ideas, and enhance employees' green self-efficacy. At the same time, it provides employees with professional skills training, technology update courses and practical opportunities, so that employees can continuously improve their technical capabilities.

Third, enterprises should provide employees with opportunities and platforms for green innovation. Praise and encourage employees who dare to carry out green innovation behavior, tolerate employees who fail in green innovation, advocate employees' green innovation to the maximum extent, hold green innovation competitions and other activities, and encourage employees to actively participate; establish a green innovation group, form a good atmosphere for cooperation between groups, and take the lead in green innovation.

Fourth, create an enterprise atmosphere that focuses on green innovation. Enterprises should clarify the vision of green sustainable development, convey the core values of green sustainable development to all employees, and pass on the idea of encouraging employees' green innovation behavior to employees through daily management and employee education, and stimulate employees' green innovation behavior by establishing reward mechanism and promotion mechanism.

5.3 Limitations and future research

This study mainly has the following limitations: First of all, from the data acquisition, this paper adopts the questionnaire survey method. The questionnaire survey method may be affected by the subjective influence so that the research results are not objective enough to go deep into the inner depths and thoughts of the subjects. In the future, other methods such as experimental methods can be considered; secondly, from the method, this paper only uses the fs-QCA research method, which also has some limitations. In the future, other empirical methods such as regression analysis can be added to the data analysis process to expand the explanatory power of the research. Once again, from the perspective of variable selection and research, this paper only considers five antecedent variables at the three levels of ability, motivation and opportunity. In the future, we can consider the impact of other variables such as environmental knowledge on employees' green innovation behavior to further promote the development of this field. Finally, although this study provides insights into the green innovation behaviors

of employees in Chinese firms, we recognise that further research is needed to explore the differences in green innovation behaviors among firms of different regions and sizes. Future research could consider including a larger sample of Chinese firms to verify the generalisability and applicability of this study's findings.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The manuscript presents research on animals that do not require ethical approval for their study.

Author contributions

YM: Funding acquisition, Resources, Writing – review & editing. JW: Data curation, Formal analysis, Validation, Writing – original draft.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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