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Title: Driving Sustainable Engagement through Green Leadership: A Moderated-Mediated Model of Green Behaviors and Artificial Intelligence Support in Pakistan's Banking Industry

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Driving Sustainable Engagement through Green Leadership: A Moderated-Mediated Model of Green Behaviors and Artificial Intelligence Support in Pakistan's Banking Industry

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Abstract

The banking sector plays an important role in countries' economies and financial development. It operates in a highly competitive and technology-driven environment. Employee performance, customer satisfaction, and organizational performance are particularly important in this sector. The banking sector also employs a large workforce. Given its importance, we developed a conceptual framework that has one direct, two mediating, and two moderating relationships. The study adopted a quantitative approach, and the study's sample size was 200. We used convenience sampling and adopted questionnaires from previous studies similar to this one. Using Smart PLS for data analysis, we found that one direct and two moderating relationships were supported. However, we did not find support for two mediating relationships. We accepted Hypothesis 1: GTL "positively affects GEE. Our results do not support Hypothesis 2: "GEB mediates the relationship between GTL and GEE." We rejected Hypothesis 3: "GOCB mediates the relationship between GTL and GEE." We accepted Hypothesis 4: "AIT

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moderates the relationship between GTL and GEE.” Our results supported Hypothesis 5: “AIL moderates the relationship between GTL and GEE.” The direct and moderating hypotheses results align with the past literature. However, the mediating hypothesis results do not align with the past studies.

Keywords: *Paksitan banking sector, AI leadership, AI training, green transformational leadership, green employee engagement, green employee behavior, organizational citizenship behavior.*

Introduction

The world has actually become more oriented towards environmental responsibility, driven by regulations and societal pressure. Sectors such as chemicals and textiles are often blamed for their direct involvement in environmentally harmful activities and are also being pressed to embed sustainability in their organizational culture (Gupta et al., 2024; Ren et al., 2023). Moreover, contextual leadership behavior has proven significant for desired pro-environmental outcomes. Green transformational leadership (GTL) has become a core construct that inspires “employees toward ecological goals by establishing a vision” and enabling teams to embed sustainability into their functions (Abourokbah et al., 2024; Iqbal et al., 2023). Earlier research highlighted that GTL’s influence on the development of green employee behavior (GEB) and green organizational citizenship behavior (GOCB) is important, through which strategic sustainability translates into organizational performance (Liu et al., 2023; Paillé & Boiral, 2022). More importantly, in highly service-oriented sectors like banking, employee attitudes and behaviors directly affect organizational reputation and stakeholder trust. Therefore, green employee engagement (GEE) becomes a crucial determinant of long-term competitiveness. Haque et al. (2024) and Sharma (2025) emphasized the vital role of GEE in maintaining competitiveness over the long run.

Simultaneously, the rapid digitalization of organizational settings has occurred, with Artificial Intelligence (AI) serving as both a disruptor and an enabler. AI leadership (AIL) and AI training (AIT), both within and across organizations, “offer integration pathways that build employee resilience, knowledge, and performance” (Cheng et al., 2025; Jia et al., 2025). The growing literature identifies AIL as an “effective moderator of conventional leadership, signaling organizational readiness” for technological and sustainable change (Malik et al., 2024; Lu et al., 2023). Employees are trained on how best to use digital tools to inculcate green practices, thereby “strengthening the links between leadership and engagement outcomes” (Wang et al., 2023; Zhang et al., 2024).

In Pakistan's banking sector, GEE remains at a critically low level, limiting the industry's

ability to implement sustainable practices effectively (Umair et al., 2023). Researchers believe that employees in Pakistan have low motivation to adopt green behavior due to a lack of AI support systems (Unsworth et al., 2021). Alromeedy and El-Sis (2004) believe that addressing these fundamentals is essential for fostering a culture of environmental responsibility and enhancing sustainable outcomes within Pakistan's banking industry.

Despite the State Bank of Pakistan's Green Banking Guidelines, there is limited empirical evidence on how leadership practices translate into GEE in Pakistan's banking sector. Most research conducted in Pakistan has focused on general traits or emotional intelligence as predictors of engagement (Iqbal et al., 2023). They have failed to report any mechanism by which GTL leads to sustainable outcomes. Environmentally specific transformational leadership can foster GEB and GOGB as mediators (Iqbal et al., 2023; Liu et al., 2023). However, past studies have focused on the hospitality and manufacturing non-financial sectors rather than on Pakistan's banking industry. Meanwhile, equally little research has tested dual mediating mechanisms in the leadership-engagement link, thereby leaving a clear mechanism gap (Abourobah et al., 2024).

Other critical shortfalls include contemporary boundary conditions. Moreover, scholars have only recently begun to conceptualize AI-driven/digital leadership as an antecedent to employee outcomes (Jia et al., 2025; Cheng et al., 2025). No study has examined the moderating roles of AIL and AIT within GHRM frameworks. Addressing this issue is vital since the actual implementation of the SBP sustainability agenda depends on it (UNDP, 2023). To the best of the authors' knowledge, no research has been conducted on this integrative configuration (GTL →GEE, mediated by GEB and GOGB, and moderated by AIL and AIT) in Pakistan's banking sector, making this research novel and timely.

Given the above arguments and gaps in the literature, the study has articulated the following research objectives,

RO1: To examine the impact of GTL on GEE.

RO2: To examine the "mediating role of GEB on the relationship" between GTL and GEE.

RO3: To examine the "mediating role of GOGB on the relationship" between GTL and GEE.

RO4: To examine the "moderating effect of AIT on the relationship" between GTL and GEE.

RO5: To examine the “moderating effect of AIL on the relationship” between GTL and GEE.

Literature Review

Theoretical Background

This study is based on Social Exchange Theory (SET), as formulated by Blau (1964). SET explains how reciprocal exchanges between leaders and employees develop in the workplace. When organizations and supervisors provide support, recognition, and other valuable resources to employees, they return with positive attitudes and behaviors (Cropanzano et al., 2017). In sustainability, GTL “is a prime initiator of this exchange” as it sets forth a strong environmental vision, leading by example toward pro-environmental behavior and inspiring the workforce to internalize green values, hence establishing reciprocation from the staff in the form of GEB and GOCB. Recent empirical research is consistent with this reasoning. Transformational leadership styles can foster green behaviors through psychological processes. Employees reciprocate supportive and inspiring leadership by contributing to sustainability goals, empirically confirming the validity of the above reasoning (Iqbal, Hassan, & Malik, 2023; Liu, Zhang, & Zhou, 2023).

SET also enables understanding of how mediators operate and why they should operate, since, apart from direct relationships, reciprocity is explicitly accounted for within SET. For instance, GEB encompasses both routine and task-related pro-environmental behaviors that employees perform at work. In contrast, GOCB captures extra-role behaviors, such as voluntary participation in environmental initiatives or helping colleagues adopt green practices. These are highly pertinent exchange mechanisms linking GTL to GEE. Some very high-quality evidence supports this mechanism (Liu et al., 2023). Iqbal et al. (2023) documented that environmentally specific transformational leadership fosters pro-environmental behaviors through a psychologically green climate. Similarly, Abourobah et al. (2024) indicated that creativity could be achieved by harmonious passion and supportive climates, which further highlights the role of mediating mechanisms. However, these mechanisms have largely been tested in sectors such as hospitality, education, or manufacturing. Pakistan’s banking sector remains unexplored.

SET further contributes by explaining the effect of boundary conditions. Reciprocity can be strong or weak, depending on contextual and organizational factors that enhance or reduce it. In this study, AIL and AIT are conceptualized as moderators that can enhance the GTL-GEE relationship by “signaling additional organizational investment in employees’ digital competencies.” This creates a stronger sense of obligation among

employees to engage more in green initiatives. This is entirely consistent with SET's premise that when organizations offer valuable and rare resources, employees respond with high loyalty and commitment (Cropanzano & Mitchell, 2005). Recent studies from the first quarter of 2025 support this finding. For instance, Jia, Wang, and Chen (2025) found that AI-supported transformational leadership increases employee engagement and sustainable performance. Cheng, Sun, and Liu (2025) highlighted the growing importance of digital leadership in shaping employee behavior. Their study results show that "technological enablers serve as exchange enhancers, making employees receptive" to transformational leadership messages related to environmental goals.

The application of SET is apt for Pakistan's banking sector. Banks face regulatory pressure from the State Bank of Pakistan (SBP) regarding green banking, and the success of these initiatives again depends on employees' willingness to go above and beyond compliance requirements to actively engage in green practices. UNDP (2023) reports that "while regulatory frameworks are in place, employee-level engagement with sustainability initiatives remains inconsistent," suggesting low GEE. For example, AIL and AIT act as contextual moderators, enhancing the exchange process. Therefore, SET not only offers an integrated theoretical foundation for the proposed model but also elucidates why these relationships matter most in Pakistan's banking sector. To conclude, SET provides an appropriate explanatory framework for this study's conceptual framework. It describes how leadership behavior elicits reciprocal employee engagement and pro-environmental responses, thus explaining the mediating roles of GEB and GOCB and justifying AIL and AIT as moderators. Previous empirical studies in top-ranked journals have applied SET to explain the relationship between leadership and sustainability-related outcome dimensions (Iqbal et al., 2023; Liu et al., 2023; Abourokbah et al., 2024; Jia et al., 2025; Cheng et al., 2025). However, no research to date has applied SET to a model with dual mediators and dual moderators in the context of Pakistan's banking sector. This makes this research both interesting and important.

Variables Used in the Study.

Green Transformational Leadership (GTL)

GTL may be "defined as the integration of environmental values into core transformational behaviors," articulating green vision, inspiring employees toward sustainability, and modeling eco-friendly actions. GTL inspires employees to strongly internalize and pursue environmental objectives beyond the traditional organizational goals (Chen et al., 2023). Very recent evidence indicates that GTL fosters a "psychological climate conducive to green innovation, motivating pro-environmental behavior" among employees by strengthening support at all levels (Iqbal et al., 2023). Abourokbah et al.

(2024) report that “creativity and harmonious passion” for green initiatives initiated by GTL are important for engaging employees in sustainable work processes. Sharma (2025) distinguishes shades of GTL behaviors that play a role in shaping employee engagement and, ultimately, environmental performance.

Green Employee Behavior (GEB)

Researchers believe GEB directly supports the organization's green strategies. These are routine resource conservation and ecological footprint reduction activities integrated into normal job roles (Gupta et al., 2024). Empirical evidence shows that GTL styles inculcate and enhance employees' voluntary green behaviors by aligning their values with organizational sustainability objectives (Iqbal et al., 2023). Ren et al. (2023) report that GEB is vital for translating corporate sustainability strategies into operational outcomes.

Green Organizational Citizenship Behavior (GOCB)

GOCB may be defined as discretionary, extra-role behaviors that employees engage in to achieve the organization's environmental objectives, such as helping coworkers practice green acts, promoting eco-initiatives, or voluntarily participating in sustainability projects. Most scholars consider GOCB an extension of conventional OCB regarding ecological outcomes (Liu et al., 2023). Empirical evidence supports a positive relationship between GTL and GOCB through mechanisms such as green climate and employee identification (Iqbal et al., 2023). The findings by Abourobkbah et al. (2024) revealed that supportive leadership enhances employees' willingness to engage in beyond-role behaviors to achieve environmental goals.

Green Employee Engagement (GEE)

GEE may be defined as the energy, dedication, and absorption in sustainability-related tasks and initiatives that employees display as part of their general work engagement (Haque et al., 2024). GTL significantly enhances green work engagement by fostering a supportive culture for sustainability, as Sharma (2025) found. The findings of Khairy et al. (2024) also confirm that organizational support for environmental practices remains sustained among the workforce highly engaged in eco-oriented roles. Gupta et al. (2024) emphasized GEE as a significant outcome of green HRM practices.

AI Leadership (AIL)

AIL style focuses on “integrating, applying, and strategically using artificial intelligence” to empower employees, reduce bureaucracy, and support leaders in their responsibilities. It is an updated version of digital leadership customized for the AI age (Cheng et al., 2025). According to Jia et al. (2025), transformation into an “AI-based leader

will enhance EE and sustainable performance. Malik et al. (2024) empirically found in Technological Forecasting & Social Change that AI adoption is an important antecedent of innovation and sustainable organizational outcomes. Lu et al. (2023) reported that AIL styles “serve as technological resources that enhance employee adaptability,” thereby serving as vital moderators within green technology-driven frameworks.

AI Training (AIT)

AIT is the “systematic transfer of knowledge, skills, and competencies to employees to enable them” to use artificial intelligence systems and tools in performing their duties. It implies the workforce's preparedness for technological transformation and sustainability practices (Zhang et al., 2024). There is evidence that AI-oriented training significantly enhances employees' capacity for innovation and adaptability (Wang et al., 2023). Training amplifies the effect of leadership on engagement by providing workers with digital resources, as Jia et al. (2025) show. Capability development related to AI is increasingly viewed as a boundary condition that shapes the effectiveness of leadership in achieving strategic and sustainability outcomes, Cheng et al. (2025) emphasize.

Hypothesis Development

Green Transformational Leadership and Green Employee Engagement

GTL articulates an inspiring environmental vision, serves as a role model for green behaviors, provides intellectual stimulation focused on the environment, and delivers individualized consideration in the context of sustainability, thereby enhancing employees' job resources and work meaning. Job resources and work meaning are known antecedents of GEE, which comprises vigor, dedication, and absorption related to environmental tasks (Schaufeli & Bakker, 2004; Inceoglu et al., 2018). Empirical results show that environmentally specific transformational leadership raises environmental passion and autonomous motivation among employees, which later translates into persistent, self-initiated green effort (Robertson & Barling, 2013; Li et al., 2020). Other daily diary evidence has reported same-day increases in follower engagement, thereby supporting GTL as a proximal motivational resource that translates into GWE when the leader's focus is on environmental sustainability (Breevaart et al., 2014; Berger et al., 2019). Moreover, past literature collectively supports the claim that GTL “positively predicts GEE” (Schaufeli & Bakker, 2004; Inceoglu et al., 2018; Robertson & Barling, 2013; Li et al., 2020; Breevaart et al., 2014; Berger et al., 2019).

GTL channel mechanisms affect and motivate environmental passion, promote clarity of green goals, and shape identity. These outcomes are linked to higher engagement and other adjacent green outcomes which empirically intertwine with GEE (Li et al., 2020; Al-

Ghazali et al., 2022; Inceoglu et al., 2018; Montano et al., 2023). Moreover, past studies found sustained green investment increases intrinsic green motivation and creativity (Li et al., 2020; Inceoglu et al., 2018). Thus, we argue that by supporting employees, leaders, in return, receive eco-based discretionary behaviors and green solutions from employees.

H1: GTL has a "positive impact on GEE."

Transformational Leadership, Green Employee Behavior, and Green Employee Engagement

GTL can be "theorized to clarify green goals, model eco-behaviors, and provide autonomy and learning supports that cue GEB in daily work routines, thereby energizing employees' environmental self-regulation and action. The enactment of self-concordant green behaviors creates meaning, efficacy, and positive activation of GEE, forming a motivational chain (i.e., from GTL → GEB → GEE). Each link is robustly supported both theoretically and empirically. For example, GTL predicts pro-environmental passion and enacted green behaviors among employees across contexts (Robertson & Barling, 2013; Li et al., 2020; Liu et al., 2023; Ding et al., 2023).

Contemporary meta-analyses and several recent reviews describe "GEB as a compound performance phenomenon that explains the association between job attitudes and states of activation or energy." Researchers found consistent associations between the types of outcome climates that activate engagement and actual GEB, thus making it plausible that this mechanism links leadership antecedents to GEE. Moreover, researchers argue that when employees have and use pro-environmental resources, they experience vigor, dedication, and absorption toward environmental initiatives—precisely the hallmarks of GEE. Evidence shows that pro-environmental support drives pro-environmental engagement and that proximal behavioral enactment is a key carrier of these effects from more distal influences, such as leadership (Albrecht, 2023; Albrecht, 2024).

Multilevel studies within the green leadership stream also find that GTL's influence typically unfolds indirectly through more proximal states and actions, supporting a mediated logic for engagement outcomes. Moreover, leaders promote green energy and green behaviors, thereby leading employees to act green, feel energized, and be absorbed in green work (Li et al., 2020; Liu et al., 2023; Norton et al., 2014; Composto et al., 2023).

The theory and available evidence clearly support the proposition that GEB mediates

the relationship between GTL and GEE: "GTL develops the motivational climate and cues that foster employees' green actions and engagement. This pattern of findings aligns with recent leadership-green behavior findings, state-of-the-science reviews on EGB, and emerging green engagement models.

H2: GEB mediates "the relationship between GTL and GEE."

Green Transformational Leadership, Green Organizational Citizenship Behavior, and Green Employee Engagement

GTL covers environmental goal clarification, role modeling of eco-behaviors, and autonomy and learning supports. Moreover, GTL inspiration and motivation elevate GOCB. As a result, employees' engagement in green behavior increases significantly (Boiral & Paillé, 2012; Paillé & Boiral, 2013; Robertson & Barling, 2013). Recent empirical evidence clearly supports a large direct effect of OCB on GEE that promotes green climate (Li et al., 2020; Liu et al., 2023). Social learning and information-processing mechanisms support the phenomenon discussed above.

Discretionary green acts tend to heighten meaning, pride, and self-concordant motivation, which are core psychological ingredients of GEE. Empirical evidence shows that pro-environmental resources and meaningful work predict domain-specific environmental engagement, while enacting pro-environmental behaviors (Albrecht, 2021; Albrecht, 2023; Koopman et al., 2016). Empirically, GOCB and GEE are highly correlated in green settings. Moreover, GTL and GEE co-vary, indicating a reinforcing motivational loop that supports GOCB as a proximal conduit to GEE (Abdou et al., 2023; Pohl et al., 2023).

Green leadership is found to influence distal outcomes through proximal discretionary green actions, in which green creativity and voice are predicted by GTL indirectly via GOCB, as explained by the mediating structure where leader cues first translate extra-role environmental enactment carrying effects to motivational and performance outcomes (Liu et al., 2023; Yang et al., 2025). Hospitality evidence has established GOCB links between energized, meaningful investment in environmental tasks and the establishment of a good transmission position for GTL's influence on GEE. Therefore, there is sound theoretical and empirical evidence in the literature supporting the hypothesis that GOCB mediates the relationship between GTL and GEE. Boiral & Paillé, 2012; Paillé & Boiral, 2013; Li et al., 2020; Liu et al., 2023; Albrecht, 2021, 2023; Abdou et al., 2023; Pohl et al., 2023; Koopman et al., 2016).

H3: GOCB "mediates the relationship between GTL and GEE."

Green Transformational Leadership, AI Training, and Green Employee Engagement

From a resource-based perspective, training directly enhances GEE and has varying effects on the association between GTL and GEE. AI adoption uplifts engagement-relevant resources such as task optimization and safety (Valtonen et al., 2025). Training also acts on personal resources. It builds mastery and efficacy with AI and boosts GTL's motivational levers. Marvi et al. (2025) documented how AI-employee collaboration raises an AI mastery goal, which in turn enhances user engagement (Marvi et al., 2025). Another reason training is important is that it buffers technostress—a well-documented inhibitor of engagement. Training was highlighted as a strategic lever that can increase or decrease the effect size of the association between GTL and GEE (Kumar et al., 2024).

Marvi et al. (2025) pointed out that AI-employee collaboration raises an AI mastery goal, which in turn enhances user engagement and capability development, thereby energizing day-to-day involvement with AI-enabled work. (Marvi et al., 2025). Another reason training is important is that it buffers technostress, a well-documented inhibitor of engagement when new technologies are introduced without support. Moreover, training was highlighted as a strategic lever to reduce the negative effects of AIT on GEE (Kumar et al., 2024). To add to this finding, Liṭan et al. (2025) report that AIT has a varying effect on the relationship between GTL and GEE.

H4: AIT “moderates the relationship between GTL and GEE”.

Green Transformational Leadership, AI Leadership, and Green Employee Engagement

When leaders allocate resources and advocate the use of AI, this enriches employees' job resources through decision support, real-time feedback, learning cues, and safer, optimized tasks. These enriched job resources are known antecedents of work engagement. Recent empirical studies have found that “digital/AI-savvy” leadership reliability increases employee work engagement through empowerment and commitment channels.

Techno-leadership and techno-capabilities function as boundary conditions in the relationship between leadership and outcomes. Yang et al. (2025) provide evidence, supported by a moderated-mediation model of digital leadership, showing that outcome psychological mechanisms have substantial conditional effects, thereby emphasizing digital leadership as a contextual amplifier. More recent studies show AI has a double-edged effect on engagement, depending on task characteristics and nuances in implementation mode, with effect sizes varying by context (Liu et al., 2025; Chuang et al., 2025). Ye et al. (2025) and Wang et al. (2025) show that employees' techno/

job crafting capabilities, as well as organizations’ techno-maturity, catalyze technology performance and leadership motivation pathways, thereby supporting the moderation logic. These results support the conclusion that the relationship between GTL and GEE becomes stronger under high AI leadership. (Yang et al., 2025; Liu et al., 2025; Chuang et al., 2025; Ye et al., 2025; Wang et al., 2025; Xu et al., 2024).

Evidence also shows that AI capability strengthens green innovation and sustainable performance, knowledge-sharing cultures, and data-driven practices (Gazi et al., 2024; Al-Halbusi et al., 2025; Kumar et al., 2025; JIC study, 2024). In GTL contexts, AI-enabled dashboards track progress toward environmental goals, improve efficiency, and personalize guidance. Thus, we argue that AI leadership should amplify the association between GTL and GEE (Gazi et al., 2024; Al-Halbusi et al., 2025; Kumar et al., 2025; JIC study, 2024).

H5: AIL “moderates the relationship between GTL and GEE.”

Conceptual Framework

Based on the theoretical and empirical evidence, we have developed a conceptual framework. It has “one independent, two mediating, and two moderating hypotheses” depicted in Figure 1.

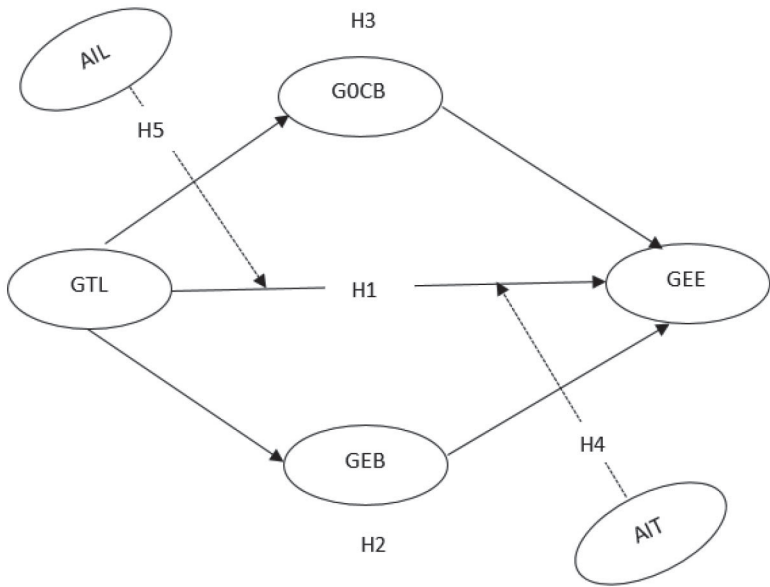


Figure 1: Conceptual Framework

Methodology

Research Design

We adopted a quantitative research approach to meet the research objectives. This technique allows the researcher to draw inferences from statistical and numerical analyses (Creswell et al., 2018). Compared with other techniques, it offers objectivity and is free of personal bias (Sekaran & Bougie, 2016). We collected the data using a structured questionnaire, and we analyzed the responses using statistical techniques, including descriptive statistics (Saunders et al., 2019). Researchers believe this design is appropriate for identifying the relationship between the latent variables, which helps draw meaningful conclusions (Bryman, 2016).

Population

The study has focused on the banking sector, as it significantly contributes to a country's economic and financial development (Sekaran & Bougie, 2016). According to Ahmad and Raja (2021), this sector operates in a highly competitive, technology-driven market. Moreover, employee performance, customer satisfaction, and organizational effectiveness are important in the banking sector (Naz et al., 2021). In addition to the above, the banking sector is well organized and has a large workforce, enabling researchers to collect measurable, reliable quantitative data (Ghayas & Dgidiya, 2021).

Sample and Sampling Technique

Creswell and Creswell (2018) assert that a sample size of 200 is appropriate for a quantitative research design, as it provides reliable data necessary to draw statistically meaningful results. In addition, researchers believe this sample size reduces sampling error, improves accuracy, and enhances the credibility necessary to generalize the findings (Saunders et al., 2019). Moreover, the selected sample size is manageable and efficient, enabling valid conclusions to be drawn (Malhotra, 2010). Since the sampling frame for the banking industry was unavailable, we adopted a convenience sampling technique to collect the data (Saunders et al., 2019). Since we adopted convenience sampling, we selected the respondents based on their willingness to participate in the study and their availability (Creswell & Creswell, 2018). Many past studies similar to the present one have used convenience sampling (Sekaran & Bougie, 2016).

Scale and Measures

We have adapted the questionnaire from previous studies conducted in contexts similar to this research. We measured the responses based on a five-point Likert Scale: "5 showing strong agreement and 1 showing low agreement." We have adopted a 5-point scale because researchers believe it is easy for respondents to comprehend (Sekaran &

Bougie, 2016). Table 1 shows the summary of scales and measures.

Table 1: Scale and Measure

Construct	Sources	Items
Green Transformational Leadership	Chen and Chang (2013), validated by Iqbal et al. Malik (2023).	6
Green Employee Behavior	Robertson and Barling (2013), validated by Gupta et al. (2024).	6
Green Org.Citizen Behavior	Boiral and Paillé (2012), used by Liu et al. (2023)	7
Green Employee Engagement	Schaufeli et al. (2006), adapted for a green context by Sharma (2025)	9
AI Leadership	Jia, et al. (2025)	5
AI Training	Zhang et al. (2024)	4

Statistical Analysis

The study has used Smart PLS for data analysis. Many past studies have used this software when the sample size is small, and there is no requirement for data normality (Hair et al., 2022). It has also been used to examine the relationship between latent variables and empirically test the articulated hypotheses. (Becker, et al. 2023)

Results

Respondent Profile

The respondent profile is a summary of the respondents' characteristics. This study's respondent profile “comprises gender, age group, education level, job position, and work experience.” Researchers believe these characteristics are necessary to interpret the data. Table 2 depicts the respondent profiles.

Table 2 Respondent Profiles

Demographic Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	120	60%
	Female	80	40%
Age Group	20–30 years	70	35%
	31–40 years	85	42.5%
	41–50 years	35	17.5%
	Above 50 years	10	5%
Education Level	Bachelor’s Degree	90	45%
	Master’s Degree	95	47.5%
	MPhil / Professional Cert.	15	7.5%
Job Position	Customer Service Officer	80	40%
	Operational Staff	70	35%

	Branch Manager	50	25%
Work Experience	Less than 5 years	65	32.5%
	5–10 years	90	45%
	More than 10 years	45	22.5%

Measurement Model

A measurement model measures the “association between the latent variables and the indicator variables.” The generated model provides results “on reliability, convergent validity, discriminant validity, fit indices, and R-squared and Q-squared values.” Figure 2 depicts the measurement model, followed by the other results.

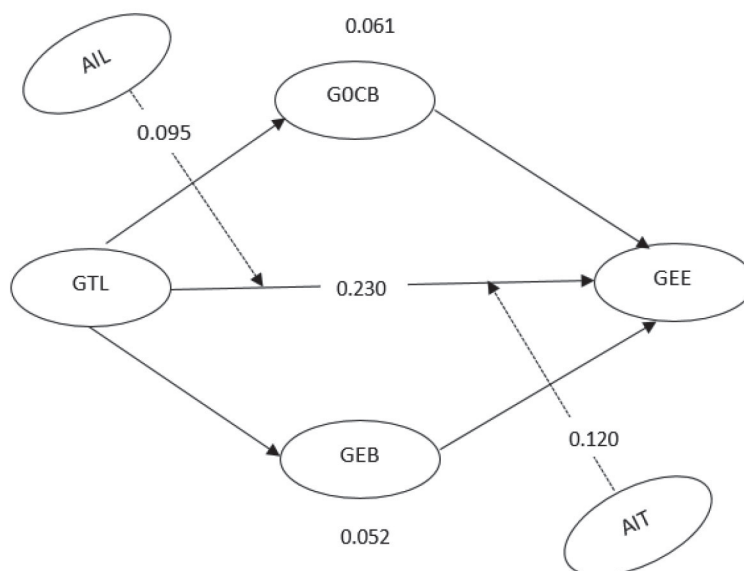


Figure 2: Measurement Model

Descriptive Analysis

We conducted a descriptive analysis to examine the patterns of the variables used in the study. Table 3 shows the “means, standard deviation, skewness, kurtosis and Conbatch’s Alpha values” of the constructs. They were used to assess the internal consistency and univariate normality of the constructs.

Table 3: Descriptive

Construct	Mean	SD	Skewness	Kurtosis	Cronbatch's Alpha Values
Green Transformal Leadership	3.980	0.680	-0.620	0.410	0.810
Green Employee Behavior	3.850	0.720	-0.470	0.120	0.832
Green Org.Citizen Behavior	3.760	0.700	-0.380	-0.210	0.855
Green Employee Engagment	3.920	0.650	-0.590	0.350	0.835
AI Leadership	3.700	0.750	-0.330	-0.300	0.880
AI Training	3.620	0.780	-0.280	-0.450	0.813

The results in Table 3 show that all “Cronbach's Alpha values are greater than 0.800, and Skewness and Kurtosis values are between ± 2.5 .” Based on these results, we have inferred that the constructs have acceptable internal consistency and univariate normality.

Convergent Validity

Convergent validity describes the theoretical association between each construct and its indicator variables (Fornell & Larcker, 1981). We have assessed convergent validity “using Composite Reliability (CR), factor loadings, and Average Variance Extracted (AVE)” (Hair et al., 2017). CR “measures the internal consistency of the construct's indicator variables. According to Fornell and Larcker (1981), the “acceptable threshold level should be greater than 0.700.” AVE “measures the amount of variance captured by a construct relative to the variance due to measurement error” (Kline, 2016). According to Fornell and Larcker (1981), the “threshold level should be greater than 0.50.” Some researchers believe that its threshold level should be more than 0.70. Table 4 shows that the constructs fulfill all the discussed threshold levels, “confirming that the constructs used in the study have acceptable convergent validity.”

Table 4: Construct Reliability and Validity

Construct	Items	Loading	CR	AVE
Green Transformal Leadership	GTL1	0.842	0.941	0.726
	GTL2	0.876		
	GTL3	0.861		
	GTL4	0.835		
	GTL5	0.882		
	GTL6	0.814		
Green Employee Behavior	GEB1	0.802	0.903	0.609
	GEB2	0.791		
	GEB3	0.774		

	GEB4	0.759		
	GEB5	0.786		
	GEB6	0.768		
Green Org.Citizen Behavior	GOCB1	0.803	0.913	0.601
	GOCB2	0.781		
	GOCB3	0.765		
	GOCB4	0.788		
	GOCB5	0.771		
	GOCB6	0.752		
	GOCB7	0.767		
Green Employee Engagment	GEE1	0.851	0.951	0.684
	GEE2	0.823		
	GEE3	0.837		
	GEE4	0.814		
	GEE5	0.826		
	GEE6	0.808		
	GEE7	0.833		
	GEE8	0.819		
	GEE9	0.829		
AI Leadership	AIL1	0.834	0.914	0.680
	AIL2	0.812		
	AIL3	0.848		
	AIL4	0.826		
	AIL5	0.801		
	AIT1	0.825	0.881	0.649
	AIT2	0.807		
	AIT3	0.789		
	AIT4	0.802		

Discriminant Validity

Discriminant validity measures whether the constructs used in the study “are unique and distinct” (Fornell & Larcker, 1981). If the constructs are not unique and distinct, the results would be inflated or deflated (Hair et al., 2022). The results of discriminant validity based on the Fornell and Larcker (1981) criteria, depicted in Table 5, show that “the AVE values of the constructs are greater than correlation values,” suggesting that the constructs are unique and distinct. The results of discriminant validity based on the HTMT ratio, depicted in Table 6, also confirm that the constructs are unique and distinct since HTMT ratios are below 0.85.

Table 5 Discriminant Validity (Fornell Larcher Criterial)

Constructs	GTL	GEB	GOCB	GEE	AIL	AIT
Green Transformal Leadership	0.852					
Green Employee Behavior	0.620	0.780				
Green Org.Citizen Behavior	0.590	0.610	0.775			
Green Employee Engagement	0.670	0.640	0.600	0.827		
AI Leadership	0.560	0.500	0.490	0.580	0.824	
AI Training	0.520	0.470	0.450	0.540	0.520	0.806

Table 6: Discriminant Validity HTMT

Constructs	GTL	GEB	GOCB	GEE	AIL	AIT
Green Transformal Leadership						
Green Employee Behavior	0.682					
Green Org.Citizen Behavior	0.649	0.671				
Green Employee Engagement	0.737	0.704	0.660			
AI Leadership	0.616	0.550	0.539	0.638		
AI Training	0.572	0.517	0.495	0.594	0.572	

R and Q Squared Values

According to Hair et al. (2022), the “R-squared values demonstrate the explanatory power of the Model.” And according to Hensler (2009), the “Q-squared values indicate the predictive relevance” of the construct. Table 7 shows that the R-squared value of GEE is 0.615. This indicates that 61.5% of the variance in GEE is explained by the predictors, which falls in the acceptable threshold level (Hair et al., 2022). Similarly, the Q-squared value of 0.452 indicates “strong predictive relevance of the constructs” (Fornell & Lacher, 1981).

Table 7: Adjusted R² and Q²

Endogenous Construct	R ²	Q ²
Green Employee Engagement	0.615	0.452
Green Employee Behavior	0.166	0.124
Green OCB	0.127	0.107

Hypothesis Result

We have empirically tested five hypotheses. One direct, two mediating, and two moderating. We found support for the direct hypothesis but not for the mediating hypotheses. However, we found support for the moderating hypotheses. Table 8 shows the results.

Table 8 Hypothesis Results

Hypothesis	B	T	p	Decision
GTL→GEE (H1)	0.230	4.520	0.000	Accepted
GTL→GEB→GEE (H2)	0.052	1.430	0.153	Rejected
GTL→GOCB→GEE (H3)	0.061	1.740	0.082	Rejected
GTL×A1T→GEE(H4)	0.120	2.160	0.031	Accepted
GTL×A1L→GEE(H5)	0.095	2.450	0.014	Accepted

Of the three accepted hypotheses, we found the strongest effect size on the association between TL and GEE ($\beta=0.230$). And the lowest between the moderating effect of AIL on GTL and GEE ($\beta=0.095$).

Discussion and Conclusion

Discussion

We accepted Hypothesis 1: GTL positively affects GEE. GTL channel mechanisms increase environmental passion, green clarity, green autonomy, and feedback. These outcomes are linked to higher engagement and other adjacent green outcomes, such as pro-environmental behavior, green voice, and green creativity, which empirically intertwine with GEE (Li et al., 2020; Al-Ghazali et al., 2022; Inceoglu et al., 2018; Montano et al., 2023). If GTL increases intrinsic green motivation and creativity, then there is a sustained, energized investment in green roles. Team-level research provides evidence that GTL clarifies pro-environmental goals at the team level while fostering harmonious passion, an antecedent to vigorous, dedicated environmental effort (Li et al., 2020; Inceoglu et al., 2018). When employees provide a compelling, clear green purpose and role-model eco-friendly behaviors to leaders, leaders, in turn, empower employees to make decisions about eco-based discretionary behaviors and green problem-solving.

We rejected H2: GEB “mediates the relationship between GTL and GEE.” Multilevel studies within the green leadership stream also find that GTL’s influence typically unfolds indirectly through more proximal states and actions and support a mediated logic for engagement outcomes (Li et al., 2020; Liu et al., 2023; Norton et al., 2014; Composto et al., 2023). The theory and available evidence clearly support the summary proposition that GEB mediates the relationship between GTL and GEE. This pattern of findings aligns with recent leadership-green behavior findings, state-of-the-science reviews on EGB, and emerging green engagement models.

The study rejected Hypothesis 3: “GOCB mediates GTL and GEE.” Green leadership

is found to influence distal outcomes through proximal discretionary green actions, in which green creativity and voice are predicted by GTL indirectly via employees' citizenship-like green behaviors or related outcomes (Liu et al., 2023; Yang et al., 2025). Hospitality evidence has established GOCB links between energized, meaningful investment in environmental tasks and the establishment of a good transmission position for GTL's influence on GEE. Therefore, there are sound theoretical and empirical shreds of evidence in the literature to support the hypothesis that "GOCB mediates the relationship between GTL and GEE." Boiral & Paillé, 2012; Paillé & Boiral, 2013; Li et al., 2020; Liu et al., 2023; Albrecht, 2021, 2023; Abdou et al., 2023; Pohl et al., 2023; Koopman et al., 2016).

We accepted Hypothesis 4: AIT "moderates GTL and GEE." Evidence also shows that AI capability strengthens green innovation and sustainable performance, knowledge-sharing cultures, and data-driven practices (Gazi et al., 2024; Al-Halbusi et al., 2025; Kumar et al., 2025; JIC study, 2024). In GTL contexts, AI-enabled dashboards increase efficacy and personalize guidance. Past studies document that AIT can either increase or decrease the effect size between GTL and GEE (Gazi et al., 2024; Al-Halbusi et al., 2025; Kumar et al., 2025; JIC study, 2024). DigitallyAI-astute leaders consistently secure and activate the asset that inspires energy. Moreover, several studies document conditional (moderating) effects of AIT on the relationship between GTL and GEE.

We accepted Hypothesis 5: AIL "moderates the relationship between GTL and GEE." More recent studies show that AI has a double-edged effect on engagement, depending on task characteristics and nuances in implementation mode, with effect sizes varying by context (Liu et al., 2025; Chuang et al., 2025). Ye et al. (2025) and Wang et al. (2025) show that employees' techno/job crafting capabilities, as well as organizations' technomaturity, catalyze technology performance, and leadership motivation pathways are important in understanding the moderation logic. These results support the conclusion that the relationship between GTL and GEE becomes stronger under high AIL (Yang et al., 2025; Liu et al., 2025; Chuang et al., 2025; Ye et al., 2025; Wang et al., 2025; Xu et al., 2024).

Implication

Our study has several theoretical implications. Overall, it contributes to the literature on employee engagement (Sidani et al., 2022), transformational Leadership Theory (Meng et al., 2020), and green organizational behavior (Lai et al., 2020) by confirming that "GTL positively influences GEE". Based on the empirical results, we have inferred that bank leaders can enhance employees' emotional and psychological involvement in a bank by encouraging sustainability practices and by inspiring employees toward eco-

friendly goals. We did not find any support for the two mediating Hypotheses. The results suggest that employees' green behavior and organizational citizenship behavior do not, theoretically, explain the mechanism by which leadership affects engagement. We found support for the moderating effects, AIT and AIL strengthen the relationship between GTL and GEE. Thus, the study extends the existing literature by showing that GEB and GOGB function more effectively as supportive contextual factors rather than as intermediary mechanisms.

In addition to the theoretical aspects discussed above, the study has several practical implications. These implications will help banks to improve employee engagement and sustainability. Therefore, banks should focus on developing leaders who can inspire and motivate employees to adopt sustainable practices (Afsar & Umrani, 2020). We suggest that banks regularly organize workshops and seminars focused on sustainability-oriented management practices and environmental responsibility (Khan et al., 2021). Therefore, we recommend that banks and other financial institutions encourage environmentally responsible actions and employees' voluntary participation in green initiatives (Robertson & Barling, 2021). To make it more effective, the banks may reward the employees who adopt sustainable practices. This could be monetary and non-monetary. Additionally, banks must implement environmental training, green teamwork activities, recycling initiatives, and employee involvement in sustainability programs (Khan et al., 2021).

Conclusion

GEE is the energy, dedication, and absorption toward sustainability-related tasks and initiatives that employees display within their general work engagement (Haque et al., 2024). GTL significantly enhances green work engagement by fostering a supportive culture for sustainability, as Sharma (2025) found. The findings of Khairy et al. (2024) also confirm that organizational support for environmental practices enhances GEE. Gupta et al. (2024) emphasized GEE as a significant outcome of green HRM practices.

Given its importance, the study focused on the banking sector, as it significantly contributes to a country's economic and financial development (Sekaran & Bougie, 2016). According to Ahmad and Raja (2021), this sector operates in a highly competitive, technology-driven market. Moreover, employee performance, customer satisfaction, and organizational effectiveness are important in the banking sector (Naz et al., 2021). In addition to the above, the banking sector is well organized and has a large workforce, enabling researchers to collect measurable, reliable quantitative data (Ghayas & Dgidiya, 2021). The study adopted a quantitative approach, with a sample size of 200. We used convenience sampling and adopted questionnaires from previous studies

similar to this one. Using Smart PIS for data analysis, we found that one direct and two moderating relationships were supported. However, we did not find support for two mediating relationships. We accepted Hypothesis 1: GTL positively affects GEE. Our results do not support Hypothesis 2: GEB mediates the relationship between GTL and GEE. We supported Hypothesis 3: GOCB mediates the relationship between GTL and GEE. Our results supported Hypothesis 4: AIT moderates the relationship between GTL and GEE. We accepted Hypothesis 5: AIL moderates the relationship between GTL and GEE. The direct and moderating hypotheses align with the past literature. However, the mediating hypotheses do not align with past studies.

Limitations and Future Research.

The study used one antecedent to green employee engagement. Future studies may use other antecedents such as eco-based rewards and incentives, ethical leadership, and sustainability norms. The study has used green organizational citizenship behavior and green employee behavior as mediators between transformational leadership and green employee engagement. Future studies may use mediators such as green psychological climate, environmental passion, and green self-efficacy. The study has used AI leadership and AI training as the moderators between green transformational leadership and green employee engagement. Other studies may use moderators such as environmental awareness, employee environmental values, and Green HRM. Incorporating the suggested mediators and moderators may provide further insight into the phenomenon under discussion. The study has focused on the banking sector with a sample size of 200 respondents. Future studies may examine other sectors, such as chemicals and textiles, with a larger sample size. The study used a closed-ended questionnaire for collecting the data. Despite its advantages, it has several limitations. Other studies may use a qualitative or mixed research design, rather than a closed-ended questionnaire; these research designs explore respondents' feelings and help explain why people behave in certain ways. The study used a cross-sectional design, in which respondents' data is collected at one specific time. Future studies may use a longitudinal design, as it examines changes over time and more directly assesses cause and effect.

Annexure 1

Constructs and Items used in the Questionnaire

Transformational Leadership

1. My leader talks about protecting the environment as a core organizational goal.
2. My leader inspires employees to achieve green objectives.
3. My leader provides a vision of environmental sustainability.
4. My leader encourages employees to develop new green initiatives.
5. My leader shows personal commitment to environmental issues.
6. My leader supports employees who engage in environmental behaviors.

Green Employee Behavior

1. I turn off unused lights/equipment to conserve energy at work.
2. I reduce paper and resource usage whenever possible.
3. I participate in voluntary environmental initiatives at work.
4. I encourage others to recycle and save resources.
5. I support green campaigns beyond my job duties.
6. I promote awareness about environmental protection.
7. I take the initiative to improve workplace sustainability.

Green Employee Behavior

1. I turn off unused lights/equipment to conserve energy at work.
2. I reduce paper and resource usage whenever possible.
3. I recycle materials in the workplace when I can.
4. I reuse office supplies to minimize waste
5. I conserve water and energy resources consciously at work.
6. I choose eco-friendly methods when available.

Green Organizational Citizenship Behavior

1. I voluntarily suggest new practices to improve environmental performance.
2. I help colleagues adopt eco-friendly behaviors.
3. I participate in voluntary environmental initiatives at work.
4. I encourage others to recycle and save resources
5. I support green campaigns beyond my job duties.
6. I promote awareness about environmental protection.
7. I take the initiative to improve workplace sustainability

Green Employee Engagement

1. I feel energized when I work on environmental tasks.
2. I am enthusiastic about contributing to environmental goals.
3. I feel proud of the sustainability work I do.
4. I find green initiatives meaningful in my job.
5. I devote extra effort to supporting environmental projects.

- 6. I feel absorbed when working on green assignments.
- 7. I am dedicated to supporting organizational sustainability goals.
- 8. I show persistence in completing environmental responsibilities
- 9. I am engaged in contributing to organizational green outcomes.

AI Leadership

- 1. My leader encourages us to use AI tools in our work.
- 2. My leader guides us in integrating AI into daily tasks.
- 3. My leader motivates employees to adopt AI for sustainability.
- 4. My leader provides vision for using AI in work processes.
- 5. My leader supports training and resources for AI adoption

AI Training

- 1. My organization provides training for using AI technologies.
- 2. I have received formal training on AI tools at work.
- 3. The AI training I receive is relevant to my job tasks.
- 4. AI training helps me adopt sustainable practices in my role.

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