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ARTICLE

The influence of transformational leadership for environmental sustainability on organizational citizenship behaviors

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Abstract

Purpose – To investigate the influence of transformational leadership for the environment (TLE) in the context of Brazilian industries, testing the hypothesis that workers engage in organizational citizenship behaviors (OCBs) through organizational citizenship behaviors for the environment (OCB-Es).

Theoretical framework – Transformational leadership for the environment and voluntary behaviors are essential elements for developing more efficient environmental management.

Design/methodology/approach – Using the perceptions of 1068 workers, a structural equation model (SEM) was created to test the hypotheses.

Findings – The results obtained in this study reveal four main findings. (1) TLE significantly influences OCB-Es; (2) TLE has a direct influence on OCBs; (3) OCB-Es significantly influence OCBs; (4) OCB-Es moderate the indirect influence of TLE on OCBs.

Practical & social implications of the research – It was noted that there is a need for Brazilian organizations to develop policies and practices aimed at people management and its interface with environmental management, enabling the qualification of workers in the topics and pointing to sustainability in the work environment. In addition, the constructs studied are useful for understanding workers' perceptions of environmental performance, stimulating actions aimed at environmental improvement and providing opportunities for training that leads to the resolution of problems related to the environment.

Originality/value – The study offers suggestions to help leaders promote voluntary cooperative behavior among their subordinates, thereby reducing the pollution caused by Brazilian industries.

Keywords: Transformational leadership for environmental sustainability, organizational citizenship behavior for the environment, organizational citizenship behavior, environmental management, industries.

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1 Introduction

Transformational leaders manage resources in a sustainable work environment, ensuring that the organization and the team feel supported and achieve the set goals (Abu Afifa & Nguyen, 2023; Darni, 2023; Fareed et al., 2022; Rao-Nicholson & Mohyuddin, 2024; Teoh et al., 2022). Such leaders set an example for their subordinates by demonstrating responsibility in decision making; moreover, these professionals stimulate creativity and skills in their subordinates because creative actions can lead to numerous benefits for everyone involved (Fareed et al., 2022).

In this context, leaders focus on managing resources and people to best meet environmental practices (Asghar et al., 2022). Leaders have been developing strategies that address environmental behaviors to produce more sustainable goods and services. Industrial companies are experiencing a new reality in which transformational leadership is fundamental to sustainable development (Gull et al., 2022). Based on this concept, we investigated transformational leadership for environmental sustainability in industries to verify its effects on voluntary cooperation behaviors.

Transformational leadership for environmental sustainability has shown positive results in the new way of managing activities (Chen & Yan, 2022; Cui et al., 2022; Du & Yan, 2022; Li et al., 2020; Maitlo et al., 2022; Perez et al., 2023; Priyadarshini et al., 2023; Tu et al., 2023; Zhao & Huang, 2022). This leadership is based on environmentally-oriented behaviors (Awan et al., 2023; Chen & Chang, 2013; Robertson, 2018) and influences workers to engage in such behaviors in their activities (Robertson, 2018). Hence, it is relevant to understand the effects of TLE in industries since it can influence the voluntary behaviors of workers and contribute to organizational development (Asghar et al., 2022; Gurmani et al., 2021).

Given this scenario, it is possible to emphasize that TLE influences organizational citizenship behaviors for the environment (OCB-Es). Various researchers have highlighted this leadership style as an antecedent of OCB-Es (Asghar et al., 2022; Li et al., 2022; Priyadarshini et al., 2023). Daily et al. (2009, p. 246) stated that OCB-Es consist of "[…] employee discretionary acts, not rewarded or required within the organization, that are directed toward environmental improvement".

Furthermore, the literature has demonstrated that TLE influences OCBs (Srour et al., 2020), which are identified as discretionary, spontaneous, and innovative behaviors (Abdullah & Wider, 2022; Suryani et al., 2023; Vuong, 2022), and their effects can contribute to organizational development (Katz & Kahn, 1970). According to Organ (1988), OCBs are not recognized by the formal reward system, and these behaviors are developed voluntarily and are not functions prescribed in the job description.

Our study aimed to investigate the influence of transformational leadership on environmental sustainability in the context of Brazilian industries, testing the hypothesis that workers engage in organizational citizenship behaviors through organizational citizenship behaviors for the environment. Organizational citizenship behaviors developed by workers can bring significant results for those involved and environmental sustainability (Darni, 2023; Dekas et al., 2013; Haass et al., 2023; Kao et al., 2023; Khairy et al., 2023; Srour et al., 2020; Suryani et al., 2023).

From this perspective, environmental efforts promoted by managers can benefit the whole of society and lead workers to engage in behaviors that exceed the initial job requirements and benefit environmental sustainability (Li et al., 2022). Measuring the impact of TLE on OCB-Es and OCBs can help organizations in environmental development, since the adoption of voluntary environmental practices and behaviors that exceed the initial job requirements can lead to savings and improve the environmental sustainability of industries.

Our research is innovative in at least three aspects. First, it presents new evidence for the literature on the effects of transformational leadership on environmental sustainability, thus promoting environmental management in the work context. Second, it demonstrates the direct effects of TLE on OCB-E, aiming to explore actions that promote more conscious management in terms of reducing carbon emissions. Third, it sheds more light on how TLE affects OCBs and how OCB-E plays a mediating role between relationships. This innovation extends the theory of TLE in relation to OCBs with the mediation of OCB-E for the first time, bringing a new perspective to the existing literature. It is worth adding that our study sought to understand the perceptions of workers in the five major regions of Brazil, all of which are full of particularities. This is one of the few empirical studies that presents the effects of TLE in Brazil, developing the theory of this leadership in the Brazilian context. On a practical level, the research offers suggestions to

help leaders stimulate voluntary cooperation behaviors in their subordinates and reduce pollution caused by Brazilian industries.

Conducting a study on the Brazilian scenario is essential for several reasons. Brazil is responsible for 3% of CO_2 emissions in the atmosphere and is one of the largest polluters in the world, leading the category of deforestation and emissions related to land use (Brasil, 2023). In addition, Brazil is a developing country, and no studies have been found that highlight these relationships in Latin American countries.

2 Theory and hypothesis development

We sought to examine TLE and its effects on the voluntary behaviors of workers in industrial firms. Figure 1 presents the conceptual model of the research, which indicates four effects of TLE on OCB-E and OCB. First, (H1) TLE has a direct positive effect on OCB-E. Second, (H2) TLE has a direct positive effect on workers' OCB. Third, (H3) OCB-E has a direct positive effect on OCB. Finally, (H4) the model suggests that OCB-E has a mediating effect between TLE and OCB. The information presented in Figure 1 is better elucidated in the next section.

2.1 Transformational leadership for environmental sustainability and organizational citizenship behaviors for the environment

Organizations invest in actions aimed at green innovation to present a different strategy from the competitive environment and to meet the needs imposed by the environmental market (Chen, 2008; Sheu, 2014). Given this reality, environmentally-focused transformational leadership contributes to the implementation of environmental actions (Chen & Chang, 2013; Chen et al., 2014; Çop et al., 2021; Farrukh et al., 2022; Kura, 2016; Perez et al., 2023; Priyadarshini et al., 2023; Robertson & Barling, 2013; Sun et al., 2022).

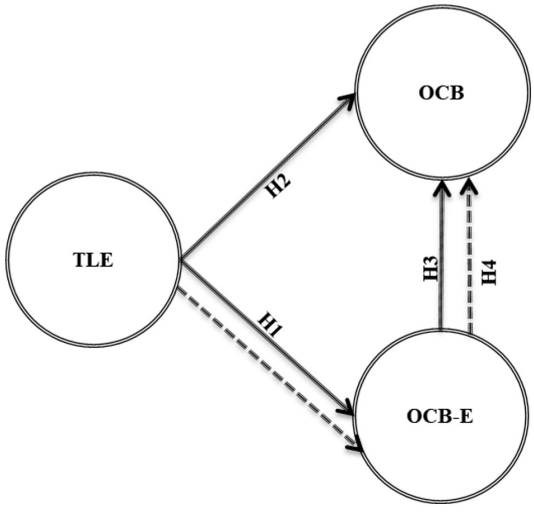

Figure 1. Conceptual framework

Environmentally-focused transformational leadership seeks to achieve environmentally-focused goals and inspire workers to perform their activities in the organizational context (Chen & Chang, 2013); this leadership is characterized by strategies and behaviors aimed at environmental actions (Asghar et al., 2022). In the context of green behaviors in the organizational environment, we can perceive the relationship between TLE and OCB-E in the literature (Liu & Jie, 2020; Li et al., 2022). According to Liu and Jie (2020), TLE can be seen as an example of workers exhibiting environmental behaviors. Leaders who develop such behaviors in their activities can influence staff to engage in voluntary behaviors for environmental sustainability (Gurmani et al., 2021; Li et al., 2022).

Workers' voluntary environmentally-friendly behaviors are OCB-Es (Abbas et al., 2022; Luu, 2024; Wu et al., 2022). Liu and Jie (2020) reported that workers who develop OCB-Es are more likely to express concern for environmental sustainability and adopt the concept of the importance of conserving resources in the work environment. In the study by Priyadarshini et al. (2023), it was highlighted that environmentally-focused leadership helps workers promote green empowerment and OCB-E. Furthermore, employees' environmental passion contributes to eco-help and eco-initiative behaviors related to green practices in the workplace. In support of this perspective, Liu and Yu (2023) state that green transformational leadership has a positive impact on OCB-E by enabling employees to foster the sustainable development of companies. Thus, it is understood that this leadership style plays an important role in promoting OCB-E. Leaders who take on this responsibility in their organizational environment contribute to sustainable practices that benefit environmental sustainability and future generations.

From this perspective, the relationship between TLE and OCB-E can promote more conscious management, with guidelines directed toward the environment. Based on these discussions, we formulated the following hypothesis:

H1. Transformational leadership for environmental sustainability positively impacts the organizational citizenship behaviors for the environment of workers in industrial firms.

2.2 Transformational leadership for environmental sustainability and organizational citizenship behaviors

Transformational leadership for environmental sustainability is part of an essential process for employee development because it is what moves resources to achieve green goals (Chen & Yan, 2022; Du & Yan, 2022; Cui et al., 2022; Perez et al., 2023; Priyadarshini et al., 2023; Tu et al., 2023; Zhu et al., 2022). Research on this leadership style is considered a central topic in organizational studies (Çop et al., 2021; Singh et al., 2020). Moreover, TLE has been analyzed in different organizations (Du & Yan, 2022; Tu et al., 2023; Zhu et al., 2022). The current research presents essential evidence on the adoption of this leadership style in the work environment (Chen & Yan, 2022; Zhao & Huang, 2022). When leaders demonstrate green behaviors, the team follows and develops such behaviors because leaders tend to be perceived as role models. In this context, leaders share their environmental values and communicate the importance of practicing green behaviors (Robertson & Barling, 2013; Robertson, 2018).

Transformational leadership for environmental sustainability also stimulates creativity, innovation, environmental concern, organizational identity, and green values; these actions can solve environmental problems in the context of organizations. Chen and Chang (2013) showed the relationship between this leadership style and green creativity, which can stimulate the organization to achieve savings, improve the organizational environment, and promote environmental practices. TLE represents a structure that encourages workers to engage in voluntary behaviors.

It is worth noting that OCB has been studied in the context of balancing social, economic, and environmental interests (Pradhan et al., 2020; Zhang et al., 2024). It is understood that these actions are aimed at ensuring the well-being of future generations. In this regard, the study by Pradhan et al. (2020) found that voluntary behaviors promoted by employees are positively associated with environmental actions carried out in the organizational environment. Another important point to mention is that OCB can stimulate sustainability initiatives through both individual and collective behaviors. According to Camacho et al. (2024, p. 193), "[…] incorporating sustainability into key organizational strategies will result in a dedicated workforce that actively engages in OCB and energy-saving initiatives". In this context, it is understood that workers who demonstrate OCB help create an organizational culture that can promote practices that balance the company's objectives with collective well-being and environmental preservation.

The effects of TLE on OCB were demonstrated by Srour et al. (2020). The authors highlighted that the relationship between these two constructs leads to gains in people management and strengthens the development of leaders at various "strategic, tactical, and operational" levels. Therefore, this leadership style promotes workers' OCB. Considering this reality, we formulated the following hypothesis:

H2. Transformational leadership for environmental sustainability positively impacts the organizational citizenship behaviors of workers in industrial firms.

2.3 Organizational citizenship behaviors for the environment and organizational citizenship behaviors

The market imposes a new management proposal that stimulates organizations to implement a management system focused on ecological awareness (Yu & Ramanathan, 2015). Whether private or public, this system becomes part of the business strategies of organizations (Çop et al., 2021). Climate change has fostered this management model in all countries, as it poses risks to the well-being of society and the environment.

Adopting green practices aims to reduce adverse environmental effects. Through them, it is possible to develop strategies for energy convergence and waste reduction, and organizations can promote healthy environmental practices (Vandenbrande, 2019). These practices contribute to environmental development by promoting green innovations.

In order to implement successful environmental management, some actions concentrate on a voluntary cooperation model in which workers present voluntary efforts to help the organization develop environmentally-focused actions (Boiral, 2009; Paillé et al., 2014). There is a body of research on organizational citizenship behaviors for the environment (OCB-Es) (Abbas et al.,

2022; Çop et al., 2021; Iqbal & Piwowar-Sulej, 2023; Luu, 2024). Boiral and Paillé (2012) emphasized that these behaviors are associated with eco-initiatives (EIs), eco-civic engagement (ECE), and eco-help (EH).

According to Boiral (2009), OCB-Es are discretionary voluntary behaviors that are not rewarded or required by the organization and are focused on the environment. The author also indicated that the possible interfaces of environmental actions were analyzed with the OCB dimensions proposed by Smith et al. (1983): sporting behavior, helping, individual initiative, organizational loyalty, self-development, and organizational compliance.

With regard to OCBs, Katz and Kahn (1970) described the importance of distinguished actions. The authors expanded the concepts of OCBs and understood these behaviors as discretionary and aimed at good organizational performance (Darni, 2023; Haass et al., 2023; Kao et al., 2023; Khairy et al., 2023; Organ, 1997; Suryani et al., 2023; Vuong, 2022). According to Lee and Allen (2002), OCBs can be divided into two dimensions: individual-oriented OCBs (OCB-Is) and organization-oriented OCBs (OCB-Os).

According to Katz and Kahn (1970), workers should be respected for their rights and responsibilities, and the system should reward them fairly. With this applied to the organizational environment, workers would manifest voluntary cooperation attitudes in favor of their colleagues and the organization. Hence, since the concepts of OCB-Es align with the principles of OCBs, we formulated the following hypothesis:

> H3. Organizational citizenship behaviors for the environment positively impact the organizational citizenship behaviors of workers in industrial firms.

To achieve the desired success, an organization needs leaders who seek to empower their team and aim to achieve results through effective management and a healthy and lasting relationship among all involved (Khan et al., 2013). Moreover, business management requires leaders who provide a positive and healthy work environment for all workers (Malik et al., 2016). Following this perspective, TLE is gaining prominence in the literature (Maitlo et al., 2022; Zhao & Huang, 2022).

Transformational leadership that emphasizes environmental sustainability can inspire followers (Chen et al., 2014). The study of Liu and Jie (2020) showed that TLE has a positive relationship with OCB-E, and that the leader can influence employees' voluntary behaviors toward the environment. Srour et al. (2020) investigated the positive effects of TLE on OCB, and the results are significant for the OCB dimensions.

In view of the above, the consultation carried out in the research related to TLE was essential for organizing the hypotheses presented; it was possible to observe that this leadership style is an antecedent of OCB-Es and OCBs. Therefore, TLE can have positive effects on OCBs through OCB-Es. Based on this correlation, we formulated the following hypothesis:

> H4. Organizational citizenship behaviors for the environment mediate the relationship between transformational leadership for environmental sustainability and organizational citizenship behaviors.

3 Research methodology

3.1 Sample and procedures

This study was conducted online with 1,068 workers from several industries in Brazil (Supplementary Data 1 – Database - Supplementary Material). The choice of employees working in industrial companies was made because these organizations have an increasing environmental impact. According to Muisyo and Qin (2021), industries need a better history of environmental management. Cai et al. (2019) highlighted that there is pressure on industries from various stakeholders to develop environmental management to minimize the effects of pollution.

Industrial companies contribute to the social and economic development of Brazil. Their impact stimulates the creation of jobs, the development of innovation and technology, economic growth, the improvement of people's living standards, exports, and the reduction of regional inequalities. In general, these industries represent 20.4% of Brazil's GDP, corresponding to 69.2% of exports of goods and services, generate 33% of federal taxes, and contribute 69.2% to business investments in research and development (Brasil, 2023).

Regarding environmental aspects, Brazilian industries have developed principles focused on sustainability, transparency, ethics, and respect for the environment. Consequently, it is possible to understand

that investments in environmental projects result in economic and social gains and contribute to consolidating a low-carbon economy. In the energy sector, Brazil stands out for having an energy matrix with a significant share of renewable sources (Brasil, 2021).

These industries have implemented practices to take advantage of natural resources, develop cleaner production, and increase process efficiency. The intention is to optimize them using circular inputs and adopting resource recovery practices. For example, several tools have been adopted, such as the ISO 14,000 series standards, reverse logistics, life cycle assessment, design for environment, industry symbiosis, and biomimicry (Brasil, 2023).

In this context, our research seeks to understand the effects of leadership and voluntary behaviors on environmental sustainability management. Table 1 shows the profile of the respondents. Most of the workers investigated were male (80.9%), married (46.7%), and the predominant age was between 31 and 40 years old (40.2%). Notably, most employees had completed graduate studies (42.9%).

3.2 Measures

Data collection was carried out using a questionnaire composed of four main sections. In the first section, questions concerning the profile of the respondents were asked. Then, the TLE scale developed by the authors, inspired by the studies of Avolio et al. (1999), Al-Ghazali et al. (2022), Awan et al. (2023), Podsakoff et al. (1990), Chen and Chang (2013), Cui et al. (2022), Robertson and Barling (2013), Robertson (2018), Sobaih et al. (2022), and Tu et al. (2023), was used. TLE is unidimensional and consists of 21 items scored on a five-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). In the third section, we used Lee and Allen's (2002) scale to measure the OCBs. The OCBs consist of two dimensions and sixteen items on a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Finally, we used the OCB-E scale developed by Boiral and Paillé (2012). This scale consists of three dimensions and ten items, with five points ranging from 1 (strongly disagree) to 5 (strongly agree). Notably, all scales showed Cronbach's alphas greater than 0.8 (TLE = 0.978,

Table 1
Profile of the workers studied

Variable	Category	Percentage
Gender	Male	19.0
	Female	80.9
	I prefer not to answer	0.1
Age	≤20 years	1.4
	21-30 years	37.0
	31-40 years	40.2
	41-50 years	18.4
	≥50 years	3.0
Marital Status	Single	37.1
	Married	46.7
	Judicially separated/divorced	3.7
	Widow(er)	0.1
	Common-law marriage	12.5
Education	Incomplete elementary school education	0.2
	Elementary school education	0.5
	Incomplete high school education	0.2
	Complete high school education	3.8
	Incomplete undergraduate degree	16.6
	Complete undergraduate degree	24.5
	Incomplete graduate degree	10.7
	Complete graduate degree	42.9
	Other	0.7

OCB-E = 0.931, and OCB = 0.863). The instrument was applied using Google Forms and the respondents were contacted via LinkedIn. We emphasize that the instrument was anonymous and did not collect the internet protocol of the workers studied.

We used descriptive statistics, confirmatory factor analysis, and structural equation modeling as data analysis techniques. Descriptive statistics were used to analyze the profile of the respondents, and confirmatory factor analysis was used to validate the TLE, OCB-E, and OCB constructs. The models were estimated in AMOS 23 (Arbuckle, 2014) using the variance-covariance matrix estimated by maximum likelihood through the direct procedure. For validity, we sought to analyze the magnitude and significance of the standardized coefficients, average variance extracted (AVE), comparative fit indexes (Comparative Fit Index [CFI], Tucker-Lewis Index [TLI], and Normed Fit Index [NFI]), and absolute fit indexes (root mean square error of approximation [RMSEA], root mean square residual [RMR], and Chi-square statistic [χ^2]).

As parameters, we used the value obtained in x^2/ degrees of freedom to be less than five. For GFI, NFI, and TLI, it is recommended that the value be greater than 0.950, the value generated in RMSEA should be less than 0.060, and the RMR value should be less than 0.080 (Byrne, 2010; Hair et al., 2019; Hooper et al., 2008; Kline, 2015). The estimated values for AVE should be greater than or equal to 0.500 (Fornell & Larcker, 1981). To assess discriminant validity, we followed the suggestions of Bagozzi et al. (1991), and to have discriminant validity, the Chi-squared difference (restricted model versus free model) should be greater than 3.84.

Hair et al. (2019) recommend assessing unidimensionality by the standardized residuals associated with the indicators corresponding to each latent variable. Therefore, it is possible to understand that constructs with a significance level of 5% with low standardized residuals are perceived as unidimensional.

To analyze the results, the models were fitted to obtain a statistically significant and well-adjusted pattern (Jöreskog, 1993). Adjustments were made to obtain acceptable values for the models that did not achieve the established estimates. Model adjustments can be made through the correlations between the errors and the elimination of variables (Hair et al., 2019).

4 Results

The sample consists of 1,068 workers from industrial companies (Table 2), of whom 43.3% had worked in the companies between 1 and 5 years. Most respondents did not have a managerial position (53.4%). In addition, there was a predominance of employees who worked in the food industry (40.3%) and in the South of Brazil (44%).

After briefly contextualizing the workers and the Brazilian industries, we validated the measurement model and the reliability analysis. Following the recommendations of Henseler et al. (2009), we analyzed the factor loadings of each item, Cronbach's alpha, and composite reliability (see Figure 2).

To obtain satisfactory indexes, the factor loadings should be greater than 0.70. Therefore, the items corresponding to dimensions OCB-I (item 22 "0.488", item 24 "0.579", item 25 "0.550", and item 29 "0.493") and OCB-O (item 30 "0.438", item 31 "0.506", item 32 "0.557", and item 34 "0.561") were eliminated. Furthermore, all constructs have an alpha value greater than 0.70: TLE (0.978), EIs (0.778), ECE (0.845), EH (0.894), OCB-I (0.756), and OCB-O (0.810), indicating satisfactory internal consistency.

We then assessed the convergent validity of the model based on the coefficients of each item and the AVE of the dimensions. According to Henseler et al. (2009), convergent validity is a set of indicators that represent the similarity of the dimensions. Fornell and Larcker (1981) recommend that the estimated value for the AVE threshold be more significant than 0.50. Therefore, all items that make up the dimensions of this research (TLE "0.683", OCB-O "0.517", EIs "0.546", ECE "0.579" and EH "0.738") presented satisfactory results in terms of AVE, except for OCB-I (0.416), which was reasonably adjusted.

The criterion of Bagozzi et al. (1991) was used for discriminant validity by analyzing the Chi-square difference test. Table 3 shows that all dimensions of the OCB and OCB-E constructs are discriminant.

The analysis of the integrated model was performed using the fit indexes and the statistical significance of the standardized coefficients (Table 4). The initial integrated model presented satisfactory fit indexes and did not require further adjustments. According to the indexes presented, the Chi-square/degrees of freedom obtained a value (2.706) less than five. Regarding the comparative indexes, CFI (0.970), NFI (0.954), and TLI (0.966) presented

Table 2
Occupational specifications of the workers

Variables	Categories	Percentage (%)
Time in the industry	<1 year	17.4
	1 to 5 years	43.3
	6-10 years	15.4
	11-15 years	11.3
	16-20 years	6.3
	21-25 years	3.3
	26-30 years	1.6
	>30 years	1.5
Holds a managerial position	Yes	46.6
	No	53.4
Industry	Clothing	0.9
	Food	40.3
	Machinery and equipment	9.7
	Metallurgy	21.5
	Chemicals	3.1
	Construction	5.5
	Cosmetics	3.7
	Other	15.2
Brazilian region of residence	North	1.0
	Northeast	7.0
	Midwest	5.1
	Southeast	42.9
	South	44.0

Table 3
Discriminant validity of OCB and OCB-E dimensions

Constructs	Dimensions	Restricted model		Free model		Chi-square difference
		Chi-square	dof	Chi-square	dof	
OCB	OCB-I – OCB-O	794.063	21	49.725	20	744.338
OCB-E	EIs – ECE	384.104	12	118.829	11	265.275
	EIs – EH	351.152	9	80.129	8	271.023
	ECE – EH	204.567	12	193.957	11	10.61

Note. dof: degrees of freedom.

Table 4
Fit indexes of the final integrated model

Fit indexes	Limit[1]	Final integrated model
Chi-square (value)	-	1740.095
Chi-square (probability)	>0.050	0.000
Degrees of Freedom	-	643
Chi-square / Degrees of Freedom	< 5.000	2.706
CFI - Comparative Fit Index	> 0.950	0.970
NFI - Normed Fit Index	> 0.950	0.954
TLI - Tucker-Lewis Index	> 0.950	0.966
RMR - Root Mean Square Residual	< 0.080	0.037
RMSEA - RMS Error of Approximation	< 0.060	0.040

Note. [1]Appropriate levels for the fit statistics based on Hooper et al. (2008) and Hu and Bentler (1999).

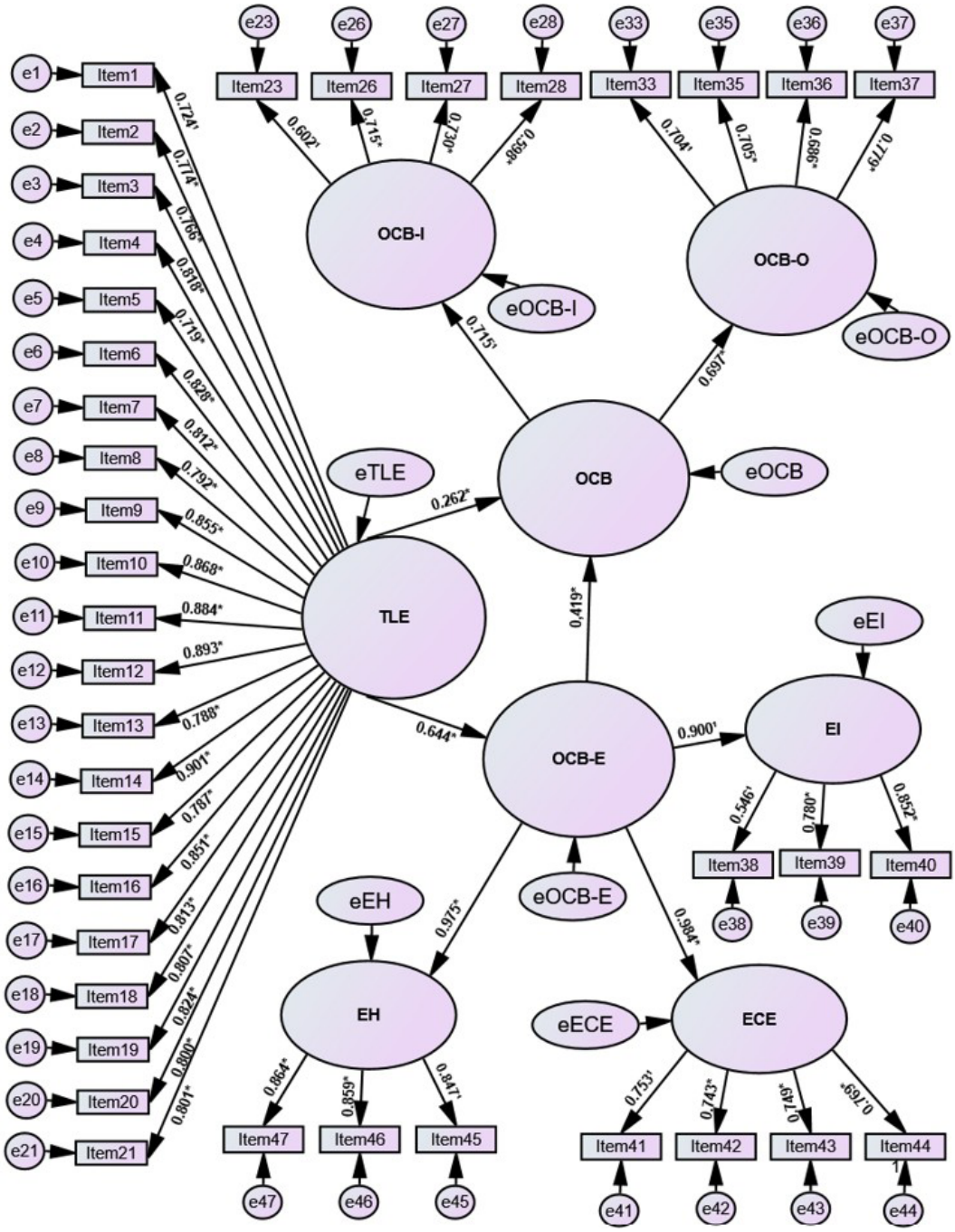

Figure 2. Structural model

values higher than 0.950. Regarding the absolute fit indexes, RMR (0.037) and RMSEA (0.040) had values lower than 0.080 and 0.060, respectively, which were within the estimated limits. The correlations between the errors of the integrated model are shown in Appendix A (Supplementary Data 2 – Appendices - Supplementary Material).

Considering the relationships in Figure 2, we observed that TLE positively and significantly influenced OCB-E. Therefore, the results indicate that this leadership style can influence workers to engage in voluntary environmental behaviors in Brazilian industries. From this perception, it can be concluded that the presence of TLE in industries encourages employees to perform environmental actions and practice OCB-E. Similar results were reported by Li et al. (2022), highlighting the relationship between this leadership style and OCB-E in the reality of leaders and followers.

We verified that TLE has a direct and indirect influence on OCBs. This leadership style promotes the development of voluntary actions in favor of coworkers and behaviors of defense, loyalty, image improvement, and organizational development. The positive relationship between TLE and OCBs is consistent with other studies (Srour et al., 2020).

The research advances the literature since this study is characterized as pioneering in terms of the significant relationship between OCB-E and OCB in environmental management. In Brazilian industries, workers who develop OCB-E are likely to engage in OCB in general. Workers who are concerned about the environment may also demonstrate cooperative behaviors toward their colleagues and the organization (Boiral & Paillé, 2012), aiming at industry performance and productivity.

Another point to highlight is that TLE indirectly influences OCB through OCB-E. Therefore, we inferred that a leader who shows voluntary environmental behaviors could influence other workers to engage in individual discretionary behaviors, thus contributing to organizational efficiency. In general, this research provides evidence that contributes to the theory of transformational leadership for environmental sustainability and the voluntary behaviors of workers.

Finally, we analyzed the three constructs through the weighted average of the coefficient weights based on the perceptions of the workers studied. These results are presented in Table 5.

The mean values indicate that the workers perceived the existence of TLE, OCB-E, and OCB, with agreement for the TLE and OCB-E items and the closest rating to full agreement for OCB. The means for each item belonging to the constructs are presented in Appendices B and C (Supplementary Data 2 – Appendices - Supplementary Material). Regarding the dimensional analysis, we verified that the workers had a higher perception of OCB-I. In contrast, they had the lowest perception of EH.

5 Conclusion and managerial implications

The results indicate the influence of TLE on OCB-E and OCB through the perceptions of employees of Brazilian industries. With 1,068 responses, a structural equation model was developed to understand the significant relationships between green leaders and voluntary environmental behaviors and OCBs. The results showed that: a) TLE significantly influences workers' pro-environmental behaviors; b) TLE has a direct influence on OCB; c) OCB-E significantly influences OCB; and d) TLE indirectly influences OCB through OCB-E.

Our findings are highly relevant as they provide a new reality about the effects of this leadership style in the organizational environment, showing that the influence of green leaders on their subordinates can promote cooperative behaviors and environmental actions that contribute to more efficient management. We verified that TLE helps industries achieve green goals and elicits voluntary behaviors from workers. Although previous research has highlighted the influence of TLE on OCB-E (Liu & Jie, 2020; Li et al., 2022) and OCB (Srour et al., 2020), our study is innovative in presenting the significant influences of TLE on OCB through OCB-E. Therefore, employees who care about the environment are more likely to engage in voluntary behaviors that contribute to the development of coworkers and the organization in both the environmental and general contexts.

In practice, this study contributes to the development of actions related to leadership with green strategies. Furthermore, our findings may help professionals, managers, and executives to direct actions that strengthen the presence of TLE in the organizational environment. The results also provide some suggestions for industries to put into practice. First of all, leaders should develop planning focused on environmental management and provide green training to their subordinates, since this action promotes environmental literacy. According to

Table 5
Construct analysis

Constructs	Industrial workers (n = 1,068)	
	Mean	Standard deviation
Transformational leadership for environmental sustainability	3.85	0.910
Organizational citizenship behavior for the environment	3.87	0.811
Organizational citizenship behavior	4.60	0.398

Chen and Yan (2022), green training can help workers overcome difficulties and stimulate them by increasing their "green hope", "green self-efficacy", "green optimism", and "green resilience" when obstacles and problems arise.

Leadership must strengthen teamwork because collective action increases worker performance and reinforces the creation of a more productive and collaborative environment. Leadership must always highlight the importance of the worker in the actions taken and try to keep them informed about work planning and decisions. Industries must adopt the principles of OCB (sportsmanship, courtesy, conscience, civic virtue, and altruism) in their internal strategies, since acts of cooperation contribute to the performance of professionals. By following these recommendations, workers will inspired by the organization to have confidence. The effects of these actions can lead workers to present OCB and OCB-E, contributing to the development of industries.

5.1 Limitations and directions for future research

This study contributes to the literature by addressing the effects of TLE on the voluntary behaviors of industrial workers. Nevertheless, we must highlight some limitations that should be addressed in future research. First, this study was developed in Brazil, which is considered an economically developing country with specific cultural characteristics. We suggest that further research be conducted in different countries.

Another area for improvement is the cross-sectional nature of the research. We recommend that new research conduct longitudinal studies to understand the impacts of TLE on the voluntary behaviors of workers. Another gap to be filled is related to the target audience, so we suggest research with professionals from different areas, such as public, commercial, and service management. Finally, we recommend further research on other constructs related to the elements studied, such as environmental commitment, learning, and values.

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Supplementary Data 2 – Appendices
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