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The Hidden Cost of Automation: How Robot Adoption Impacts Employees' Sustainable Behavior and Environmental Practices

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Abstract:
Organizations are increasingly adopting robots, reshaping various aspects of employee behavior. This study examines the impact of robot adoption on employees' green behavior—a vital component of corporate sustainability. Grounded in Conservation of Resources (COR) theory, we propose that resource depletion or threat prompts individuals to prioritize essential tasks, reducing engagement in discretionary behaviors. We identify job stress as a mediator and openness to experience as a moderator in this relationship. Through experimental and survey studies, we find that robot adoption negatively affects employees' green behavior. Study 1 (N = 109), using experimental methods, demonstrates this negative impact. Study 2 (N = 265), conducted in the hospitality industry, further validates these findings via survey methods. Study 2 also reveals that job stress mediates the relationship between robot adoption and green behavior, while openness to experience moderates this effect. Specifically, high openness to experience weakens the positive relationship between robot adoption and job stress, thereby mitigating its negative effect on green behavior. These findings make significant theoretical contributions to the literature on robot adoption and green behavior, while also providing practical guidance for sustainable development in organizations.

Keywords: robot adoption; conservation of resources theory; job stress; green behavior; openness to experience, sustainability.

INTRODUCTION

As workplaces increasingly adopt robots, employee behavior undergoes significant shifts [1-9]. The adoption of robot can lead to shifts in job roles, task execution, and workplace dynamics, prompting employees to adapt their daily practices and interactions [2-5]. These behavioral changes may include increased collaboration with machines, altered task prioritization, and adaptations in problem-solving strategies [1,7,10]. While automation can enhance productivity and operational efficiency [4,9], it can also trigger job stress and resource allocation challenges as employees navigate new workflows and responsibilities [1-3]. Such shifts in behavior are especially significant in areas requiring discretionary effort [1], like green behavior, where employees' capacity and motivation to engage in sustainability initiatives may be impacted. Employee green behavior, encompassing actions such as resource conservation, energy-saving measures, recycling, and other sustainable practices[11,12], plays a pivotal role in supporting corporate sustainability efforts[13,14]. By actively engaging in these environmentally responsible behaviors, employees contribute to a culture of sustainability within the organization, which not only enhances the company's environmental performance but also aligns with broader corporate social responsibility (CSR) goals.

However, current studies on automation predominantly focus on performance and well-being, overlooking this environmentally impactful behavior. We plan to expand on the gap in the existing literature regarding the impact of robot adoption on employees' green behavior, with a particular focus on the hotel industry, where automation is becoming increasingly prevalent. While previous studies have explored the effects of robot adoption on outcomes such as job performance, turnover intentions, and workplace interactions [2,4,5,9,15,16], limited research has addressed its impact on discretionary, pro-environmental behaviors. Green behavior, often a voluntary action influenced by individual initiative, plays a crucial role in supporting organizational sustainability goals [13,14,18], especially in sectors like hospitality that emphasize resource conservation and environmental responsibility [17]. This oversight leaves a gap in understanding how robot adoption influences employees' engagement in green behavior, which are essential for supporting corporate environmental goals. Understanding the effects of automation on environmental sustainability is essential for companies aiming to balance technological advancement with ecological responsibility. By addressing this gap, our study contributes to both the sustainability and technology management literature. Understanding how robot adoption affects green behavior can provide valuable insights into the nuanced effects of automation at the individual level, as opposed to purely organizational outcomes. This focus allows for a deeper understanding of how technological change intersects with employee engagement in sustainability practices, offering implications for managing robot adoption in a way that aligns with corporate environmental objectives.

To address these research questions, we build on Conservation of Resources (COR) theory to frame our research model. COR theory suggests that when faced with resource loss, individuals tend to reduce resource usage to conserve existing resources [19]. Robot adoption will result in a series of resource losses [1,2,3,5,7], including a reduction in job opportunities, the consumption of time and energy, and financial losses. First, the application of robots reduces job opportunities for human employees, leading to greater job insecurity [2]. Compared to humans, robots have significant advantages in performing repetitive routine tasks. Robots work faster, are stronger, and can operate for longer hours. These advantages lead companies to prefer assigning routine tasks to robots. This replacement of human workers disrupts job continuity and stability for employees. Secondly, the application of robots forces employees to acquire new knowledge and skills [3,7]. On one hand, since robotic technology is new, employees must acquire related knowledge and skills to collaborate with robots [3]. This requires a substantial investment of time, energy, and money, which consumes existing resources, including energy, time resource, cognitive capacity, job skill and emotional resilience et al. The expenditure of these resources encroaches upon personal reserves, directly or indirectly increasing job stress. On the other hand, as robots replace certain tasks, employees are forced to acquire new job skills to adapt to new roles [19]. This significantly increases job stress. Integrating existing research, robot adoption exerts a strong negative impact on employees' existing resources, disrupting resource inflow and increasing resource expenditure (time and energy loss). Based on COR theory, individuals facing resource loss will actively reduce the use and expenditure of existing resources [20]. Employees' green behavior is an important pro-environmental action that requires the use of existing resources [19]. In this situation, to conserve sufficient resources, employees may actively reduce green behavior. Therefore, we propose that robot adoption increases job stress, which in turn reduces green behavior.

The COR theory posits that the extent to which an event leads to resource loss depends on employees' subjective perceptions and evaluations [20]. Personality traits are among the primary factors influencing these subjective perceptions and evaluations [21]. To explore in depth of the link between robot adoption and resource loss, we examine employees' personality as a boundary condition. Empirical studies indicate a significant positive correlation between openness to experience and the acceptance of robots [22]. Therefore, we focus on openness to experience, one of the five factors constituting personality structure, as it is regarded as the trait most closely associated with the exploration of new experiences [23].

Openness to experience is an important personality trait that measures an individual's acceptance of new ideas, experiences, and technologies [24]. Individuals with high openness to experience are more imaginative, creative, curious, and explorative, while those low in openness to experience tend to be more traditional, conservative, and adhere to established habits. Individuals with high openness to experience are more willing to accept new perspectives, try new technologies, and explore unknown fields [23]. When encountering robots, they do not view them as competitors taking away jobs but rather as effective tools or partners. They actively learn robotic technologies, seek to collaborate with robots, and enhance their job capabilities while exploring new work domains together [22]. In this context, the application of robots does not lead to significant resource loss or a significant increase in job stress, thereby mitigating the negative impact on green behavior. In contrast, low-openness to experience individuals prefer to maintain the existing work environment, perceive robots as disrupting established work processes, encroaching on job opportunities, and forcing them to update their knowledge and skills. These factors exacerbate resource depletion, increase job stress, and hinder employees from engaging in green behavior. Specifically, openness to experience will weaken the job stress induced by robot adoption, thereby alleviating its negative effects on green behavior. Our research model is illustrated in Figure 1.

Our study contributes to the literature in three significant ways. First, our studies build on COR theory by applying it to the unique context of robot adoption and its impact on green behavior, extending COR theory [20]. Second, while some studies have shown that certain psychological interventions can reduce the negative impacts of robot adoption [2], we introduce personality traits as moderators in the context of automation our research demonstrates that openness to experience can also alleviate these adverse effects. This finding has the potential to hold lasting practical implications for research and practice in robot adoption. Finally, our studies broaden the scope of robot adoption literature by examining its impact beyond traditional work outcomes, such as productivity and job satisfaction, to include discretionary, pro-environmental behaviors like green behavior. While much of the existing research focuses on how robot adoption affects performance metrics, turnover intentions, or job attitudes, our study explores a less commonly studied area: the influence of automation on employees' voluntary engagement in sustainability practices.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Conservation of Resources (COR) theory

This paper utilizes Conservation of Resources (COR) theory to explain how robot adoption impacts employees' green behavior, including its underlying mechanisms and boundary conditions. The central premise of COR theory argue that individuals are

motivated to acquire, protect, and conserve valuable resources—such as energy, time, and emotional well-being—to support their goals and manage stress [19,20]. Based on COR theory, when individuals experience resource loss or perceive a threat to their resources, they experience stress and shift their behaviors accordingly to preserve what remains [19]. In response to such resource depletion, individuals tend to prioritize essential tasks directly tied to their job performance and minimize discretionary or voluntary actions [20]. This perspective is especially relevant in the workplace, where resource demands can fluctuate based on changes such as technology adoption. In situations where resources are threatened or strained, COR theory suggests that individuals will focus their remaining energy on core job responsibilities, potentially reducing engagement in additional, non-essential behaviors [19,20], such as green practices. By framing our study with COR theory, we aim to explain how resource demands introduced by robot adoption might influence employees' tendency to engage in green behavior, which is typically voluntary and requires additional cognitive and emotional investment.

The Impact of Robot adoption on Employees' Green Behavior

Our study will explicitly apply COR theory to the context of robot adoption, illustrating how the introduction of automation can lead to job stress by increasing cognitive and emotional demands on employees. When robots are introduced in the workplace, employees often face the challenge of adapting to new workflows, learning technical skills, and managing interactions with robotic systems [1,3,7]. Additionally, automation can raise concerns about job security, as employees may fear potential redundancy or changes to their roles [2]. The adoption of robots in workplaces can have both positive and negative impacts on employees [1,7]. On the one hand, robots enhance efficiency, reduce the need for human intervention in repetitive tasks, and can potentially create new roles centered around robot maintenance and oversight [4,6,9]. This technological advancement can lead to improved productivity and operational gains, which may foster a more positive work environment. On the other hand, the adoption of robots may trigger job insecurity and cognitive burdens as employees adapt to new workflows and learn to interact with the technology [2,3,7,8]. These stressors can deplete resources, leading to heightened job stress.

While robots can increase overall workplace efficiency, the unique nature of green behavior—as a discretionary, voluntary activity—makes it particularly susceptible to the impacts of job stress. According to Conservation of Resources (COR) theory, when employees perceive that their resources (e.g., time, energy, psychological capacity) are threatened or depleted, they prioritize core job functions over non-essential behaviors [19,20]. Green behavior, which involves activities like conserving energy, recycling, and promoting sustainability practices, often falls into this category of non-essential behavior [11,12]. Thus, under conditions of robot-induced stress, employees may reduce their engagement in these environmentally supportive practices as they conserve resources for essential work tasks. Based on this, we hypothesized:

Hypothesis 1: Robot adoption is negatively associated with employees' green behavior.

The Mediating Role of Job Stress

Our study will clarify how job stress functions as a mediating mechanism in the relationship between robot adoption and green behavior. According to COR theory, when employees experience resource depletion due to job stress, they tend to prioritize essential job responsibilities over discretionary, voluntary actions [19,20]. Green behavior—such as recycling, energy conservation, and other pro-environmental practices—is typically a voluntary effort that requires additional cognitive and emotional resources [11,12]. In the context of robot adoption, employees face increased demands as they adapt to new technology, manage interactions with robots, and navigate potential job insecurity. This situation depletes their available resources (e.g., time, energy, cognitive capacity, job skill and emotional resilience), leading to heightened job stress [20]. As a result, employees may choose to conserve their remaining resources for core responsibilities, reducing their engagement in green behaviors that are not directly required for job performance. Thus, COR theory suggests that resource depletion due to job stress leads employees to deprioritize voluntary, pro-environmental actions, underscoring job stress as a key mediator in the impact of robot adoption on green behavior. Based on this, we hypothesized:

Hypothesis 2: Job stress mediates the negative relationship between robot adoption and employees' green behavior.

Moderating Role of Openness to Experience

Openness to experience refers to an individual's level of acceptance toward new ideas, experiences, and cultural diversity [24]. Our study proposes that openness to experience may mitigate stress responses and subsequent negative outcomes resulting from robot adoption. COR theory posits that the extent to which a particular event results in resource loss depends on employees' subjective perceptions and evaluations [19]. Personality traits are a primary factor influencing these subjective perceptions and evaluations [21]. To know more of the link between robot adoption and resource loss, our study examines employees' personality

as a boundary condition. Empirical research indicates a significant positive correlation between openness to experience and the acceptance of robots [22]. In other words, individuals with higher levels of openness to experience perceive and evaluate robot adoption more positively. Therefore, our study focusses on openness to experience, one of the five factors that constitute the personality structure, as it is regarded as the trait most closely associated with the exploration of new experiences [23].

Openness to experience is a personality trait characterized by a high degree of creativity, intellectual curiosity, flexibility, and a willingness to engage in new experiences. Highly open individuals are more imaginative, creative, curious, and explorative, and are more willing to accept new perspectives, try new experiences, and explore unknown areas [23]. Conversely, individuals low in openness to experience tend to be more traditional, conservative, and habitual, resisting new ideas and avoiding unfamiliar environments. When organizations introduce robots, highly open individuals are more willing to interact with them, attempt collaboration, and experience less job stress as a result [22]. They perceive less of a threat from potential job displacement by robots and are proactive in learning robot-related knowledge and trying new experiences brought by them. Individuals with high levels of openness to experience are also more tolerant of robots' shortcomings and are willing to explore and improve upon these deficiencies. In contrast, individuals low in openness to experience are more likely to resist robots, which leads to increased job stress. They tend to be more conservative, preferring to maintain existing workflows and avoid learning new technologies and knowledge [22,23]. The application of robots disrupts established work habits, pushing employees into unfamiliar territory and resulting in significant job stress. Based on this, we propose the following hypothesis:

Hypothesis 3: Openness to experience moderates the relationship between robot adoption and job stress. Specifically, openness to experience weakens the positive relationship between robot adoption and job stress.

Openness to experience plays a significant role in influencing how employees respond to job stress, particularly in contexts involving technological change such as robot adoption [22]. Employees with high levels of openness are typically more adaptable and willing to engage with new ideas and technologies [23,24]. This adaptability allows them to perceive robot adoption not as a disruptive force but as an opportunity for growth, skill development, and innovation. Their natural curiosity and positive outlook help them reframe challenges associated with robot adoption, viewing them as manageable or even beneficial. The ability to reframe challenges means that employees high in openness to experience are likely to experience lower levels of job stress when adapting to new robotic technology [22]. This reduction in perceived stress preserves their mental and emotional resources, allowing them to maintain engagement in discretionary activities such as green behavior [11,20]. By contrast, employees with lower openness may perceive robot adoption as a threat or a source of anxiety, leading to higher job stress and a greater likelihood of reducing non-essential activities to conserve resources. Green behavior, which requires voluntary effort and a commitment to sustainability practices, can be particularly vulnerable to resource depletion caused by stress [11,12]. When job stress is lower, employees have more resources available to engage in these behaviors [19]. Employees with high openness to experience are therefore more likely to maintain their green behavior even in the face of robot adoption, as their stress levels are moderated by their positive perception and adaptability. Based on this, we propose the following hypothesis:

Hypothesis 4: Openness to experience moderates the relationship between robot adoption and employees' green behavior through job stress. Specifically, openness to experience weakens the indirect relationship between robot adoption and employees' green behavior through job stress.

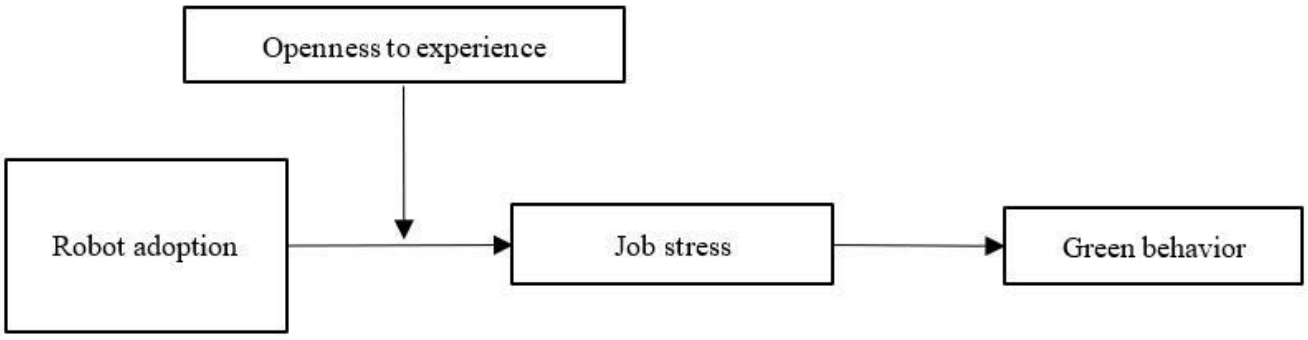

Figure 1. Theoretical model

STUDY 1: THE IMPACT OF ROBOT ADOPTION ON GREEN BEHAVIOR

Study 1 aims to explore the impact of robot adoption on employees' green behavior. To address this question, we designed a scenario-based experiment.

Method

Sample

To conduct the experiment, we recruited participants from a university in Eastern China through faculty members. Each participant received 15 yuan as compensation. We recruited 113 students and randomly assigned them to either an experimental group or a control group. Ultimately, 109 participants completed all tasks, resulting in an effective response rate of 96.5%. Among them, 55 were in the experimental group and 54 in the control group. In the final sample, 65 participants were female (59.6%), with an average age of 18.07 years (SD = 0.94).

Experimental Design and Procedure

Study 1 employed a between-group experimental design (experimental condition vs. control condition) to examine the impact of robot adoption on green behavior. Before the experimental tasks began, researchers distributed a recruitment announcement and the first phase of the questionnaire, which included demographic and control variables. Drawing on experimental manipulations from previous research [2], we prepared the corresponding experimental materials and manipulation check items. This study employed a scenario simulation, where the setting was a four-star hotel named "Shengrong Hotel," and the participants acted as employees. The experimental procedure was as follows: First, the research assistant distributed the experimental materials and presented participants with either a high or low level of robot adoption in the hotel. Second, after the experimental treatment, participants reported their perceived level of robot adoption to check the manipulation. Finally, participants were instructed to complete a task involving retrieving documents from an adjacent floor.

Measurement

To minimize bias due to language differences, this study utilized validated scales tested for reliability and validity in the Chinese context.

Green Behavior: Participants' environmental behavior during the "Delivery of paper documents" task was measured. The task incorporated the environmental measurement paradigm developed by Cornelissen, Pandelaere et al. [25], requiring participants to choose between taking the stairs or using the elevator [25]. If participants chose the elevator, their green behavior was coded as 0 (low level). If they chose the stairs, their green behavior was coded as 1 (high level).

Control Variables: Following Robertson and Barling's [26] recommendations, we needed to control for gender, age, and education level. In study 1, participants were all college students with identical academic qualifications. Therefore, we controlled for gender and age. Additionally, following Chou [27], who found that personal environmental beliefs significantly influence individual green behavior [27], we included participants' environmental beliefs as a control variable.

Manipulation Check: Drawing on previous research [2], we developed an item to perform a manipulation check. Participants were asked to report the extent of robot adoption in the hotel. The item was rated on a 7-point Likert scale, ranging from "1 = strongly disagree" to "7 = strongly agree."

Results

Manipulation Check

T-test results indicated that the reported level of robot adoption in the experimental group ($n = 55$, $M = 5.05$, $SD = 0.83$) was significantly higher than in the control group ($n = 54$, $M = 2.93$, $SD = 0.54$): $t(94) = 15.92$, $p < 0.001$. In summary, the manipulation of robot adoption in this study proved effective.

Hypothesis Testing

First, we conducted descriptive statistics and a correlation analysis. Table 1 presents the results of the descriptive statistics and correlation analysis. The results indicate that robot adoption is significantly negatively correlated with green behavior ($r = -0.51$, $p < 0.05$). These correlation results partially support Hypothesis 1 and provide a foundation for subsequent hypothesis testing. In the second step, we employed general linear regression analysis to test the hypothesis. In Model 1, we found personal environmental beliefs is positively affect employees' green behavior ($b = -0.08$, $p < 0.05$). As shown in Model 2 (Table 2), after controlling for gender, age, and personal environmental beliefs, robot adoption has a significant negative impact on employees' green behavior ($b = -0.47$, $p < 0.05$). Taken together, these results support Hypothesis 1.

Table 1. Descriptive statistics (N = 109)

Variables	*M*	*SD*	1	2	3	4
1. Gender	0.40	0.49				
2. Age	18.07	0.94	0.38***			
3.Environmental beliefs	4.32	1.21	-0.16	-0.21*		
4.Robot adoption	0.50	0.50	0.07	0.01	0.11	
5.Employee green behavior	0.26	0.44	-0.14	-0.05	0.23*	-0.51***

Note. p < 0.05, ** p < 0.01, *** p < 0.001.

Table 2. Hierarchical regression results (N = 109)

	Employee green behavior	
	M_1	**M_2**
Constant	-0.42	-0.31
Control variables		
Gender	-0.11	-0.07
Age	0.02	0.02
Environmental beliefs	0.08*	0.10***
Independent variable		
Robot adoption		-0.47***
R^2	0.07	0.35
ΔR^2		0.28***
F	2.44	13.85***

Note. Coefficients are unstandardized. p < 0.05, ** p < 0.01, *** p < 0.001.

Discussion

The results of Study 1 indicate that robot adoption negatively impacts employees' green behavior. Study 1 preliminarily confirmed that robot adoption had a negative impact on employee green behavior through COR perspective. However, Study 1 has some limitations. First, Study 1 used only taking the stairs to a nearby floor as an indicator of green behavior, which is not comprehensive enough to fully assess participants' green behavior. Second, Study 1 did not reveal the underlying mechanism linking robot adoption and green behavior. Third, although Study 1 explored the causal relationship between robot adoption and employees' green behavior, all scenarios were laboratory-based, and the participants were students, resulting in insufficient external validity.

To address these limitations, we designed Study 2. First, we expanded the measurement indicators for green behavior. Study 2 employed six indicators to measure employee' green behavior [11], including "recycling items," "sorting waste," "taking the stairs," "reducing the use of disposable plastic cups," "avoiding unnecessary printing," and "reusing printed paper for note-taking." Second, Study 2 included the measurement of mediating variables, enabling us to explore the underlying mechanisms between robot adoption and green behavior. Finally, Study 2 selected incumbent workers from the hotel industry as the sample, thereby enhancing the study's external validity.

STUDY 2

Method

Procedure and Method

The hotel industry widely uses robots to serve customers; therefore, we selected hotel staff as the subjects for this study. To collect reliable information, we contacted the managers of Hanting Hotels and distributed questionnaires through them. To minimize bias, we did not rely on hotel managers to recruit employees for the survey. Instead, we posted a recruitment notice and placed T1 paper-based questionnaires on the employee information board. Consequently, employees completed the T1 questionnaires on a voluntary and random basis. To encourage genuine responses, we distributed electronic red envelopes that required

real-name verification for redemption. Two weeks later, managers used the list of names from the T1 responses to contact employees for the T2 questionnaire. In Study 2, participants received 15 RMB for completing the T1 questionnaire and 20 RMB for completing the T2 questionnaire. The T1 questionnaire included a statement on confidentiality, assuring participants that all data collected would remain strictly confidential. At Time 1, we gathered information from 310 employees. Employees self-reported their basic information (including gender, age, education, and tenure) along with their perceptions of robot adoption and job stress. Two weeks later, we distributed a follow-up questionnaire to assess participants' green behavior and openness to experience. After matching the data, we obtained 265 valid questionnaires, yielding an effective matching rate of 85.5%. Among the samples, 26% were male and 74% were female, with an average age of 32.12 years (SD = 5.63) and an average tenure of 5.26 years (SD = 2.65).

Measurement

Study 2 adopted the "translation-back translation" procedure to translate the English scales into Chinese. All scales were scored using a 7-point Likert scale.

Robot adoption: This scale was developed by Yam [2], consisting of four items evaluated by employees. An example item for robot adoption is, "Many problem-solving activities in my job are automated or assisted by robots." In this study, the Cronbach's α coefficient for this scale was 0.88. Cronbach's α coefficient" is a measure of internal consistency used to assess the reliability of a scale, indicating how closely related the items in the scale are as a group.

Job Stress: The scale developed by Motowidlo [28] was used, consisting of four items [28]. Example items include "I feel a lot of stress because of my job" and "My job is very stressful." In this study, the Cronbach's α coefficient for this scale was 0.95.

Green Behavior: The scale developed by Kim [11] was used, consisting of six items. Typical items include "I avoid unnecessary printing to save paper" and "I use a personal cup instead of a disposable cup." The Cronbach's α coefficient for this scale was 0.88.

Openness to experience: The openness to experience subscale developed by Gosling[24] was used, consisting of two items. In study 2, the Cronbach's α of this scale was 0.75.

Control Variables: Kim [11] controlled for demographic variables such as gender, age, and education in their study. These variables are considered fundamental predictors of employee behavior in organizational behavior research and can be effectively measured. Accordingly, this study included employees' gender, age, education, and tenure as control variables.

Statistical Analysis

Study 2 utilized SPSS 26.0 software for descriptive statistics and correlation analysis of the main variables, while the PROCESS plugin in SPSS was employed for model testing.

Results

Descriptive Statistics and Correlation Analysis Results

Table 3 shows that robot adoption is significantly positively correlated with job stress ($r = 0.37$, $p < 0.001$) and significantly negatively correlated with employees' green behavior ($r = -0.13$, $p < 0.05$). Openness to experience is not significantly correlated with job stress ($r = -0.03$, $p > 0.05$) or employees' green behavior ($r = 0.05$, $p > 0.05$). These results provide preliminary support for Hypothesis 1.

Table 3. Descriptive statistics (N = 265)

Variables	*M*	*SD*	1	2	3	4	5	6	7
1. Gender	0.26	0.44							
2. Age	32.12	5.63	0.02						
3. Education	3.97	1.23	-0.02	0.11					
4. Tenure	5.26	2.65	0.07	0.02	0.04				
5.Robot adoption	5.08	1.08	0.04	0.07	-0.06	-0.08			
6.Job stress	6.07	1.22	0.02	0.06	-0.04	-0.06	0.37***		
7. Green behavior	3.57	0.97	-0.02	0.02	-0.03	-0.02	-0.13*	-0.22***	
8.Openness to experience	3.61	1.26	0.02	0.08	0.01	0.06	0.01	-0.03	0.06

Note. $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Hypothesis Testing

Before testing the hypotheses, all variables were standardized. Table 4 shows that, after controlling for gender, age, education, and tenure, robot adoption has a significant negative relationship with employees' green behavior ($b = -0.14$, $p < 0.05$). Thus, H1 is supported. After controlling for gender, age, education, and tenure, the interaction between robot adoption and openness to experience has a significant negative relationship with self-reported job stress ($b = -0.41$, $p < 0.05$), suggesting that openness to experience moderates the direct relationship between robot adoption and job stress. A simple slope analysis shows that (see Figure 2), under conditions of high openness to experience, there is no significant relationship between robot adoption and job stress ($b = -0.09$, $p > 0.05$). In contrast, under conditions of low openness to experience, robot adoption is significantly positively related to job stress ($b = 0.88$, $p < 0.05$). Thus, H3 is supported.

Table 4. Results of hypothesis testing (N = 265)

Variables	Employee green behavior		Job stress	
	M_1	M_2	M_3	M_4
Constant	-0.01	0.02	-0.01	0.03
Control variables				
Gender	-0.01	-0.01	0.01	-0.02
Age	0.03	0.04	0.04	0.07
Education	-0.04	-0.04	-0.02	-0.01
Tenure	-0.03	-0.03	-0.03	0.01
Independent variable				
Robot adoption	-0.14*	-0.07	0.37***	0.36***
Mediator				
Job stress		-0.20**		
Moderator				
Openness to experience			-0.03	-0.12*
Interaction				
Robot adoption ×Openness to experience				-0.41***
R^2	0.02	0.05	0.14	0.41
ΔR^2	-	0.03		0.27
F	1.09	2.51*	7.09***	25.83***

Notes. Coefficients are unstandardized. * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

Table 5. Mediating results

	Dependent Variable: Employee green behavior			
Mediator	**Indirect Effect**	**SE**	**95% CI**	
			LL	**UL**
Job stress	-0.08	0.03	-0.14	-0.03

Table 6. Results of moderated mediation

		Dependent Variable: Employee green behavior		
Moderator	**Level**	**Indirect Effect**	**95% CI**	
			LL	**UL**
Openness to experience	Low (−1 SD)	-0.18	-0.29	-0.07
	Mean	-0.08	-0.13	-0.03
	High (+1 SD)	0.02	-0.01	0.06

Table 5 shows that job stress mediates the relationship between robot adoption and employees' green behavior (Indirect Effect = -0.08, SE = 0.03, $p < 0.05$). Although the magnitude is small, it is consistent with findings in similar studies that examine indirect

effects of psychological mechanisms on discretionary behaviors. Thus, H2 is supported. Finally, we tested the moderated mediation model. The results indicate that the moderated mediation index is significant, with an index of 0.09. Table 6 presents the indirect relationship between robot adoption and employees' green behavior through job stress at different levels of openness to experience. Specifically, under conditions of high openness to experience, robot adoption does not negatively impact green behavior through job stress (Indirect Effect = 0.02, SE = 0.02, $p > 0.05$). Under conditions of low openness to experience, robot adoption significantly negatively impacts green behavior through job stress (Indirect Effect = -0.18, SE = 0.06, $p < 0.05$). Thus, H4 is supported.

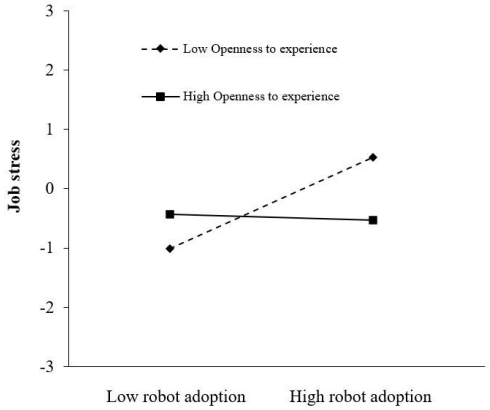

Figure 2. The moderating effect

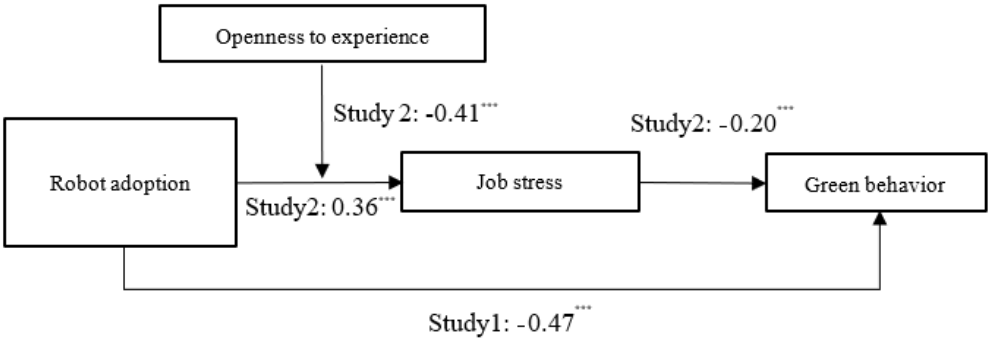

Figure 3. the summary of all the results

DISCUSSION

Drawing on the Conservation of Resources (COR) theory [19,20], our work employed a mixed-method research design to explore the impact of robot adoption on employees' green behavior (see Figure 3). First, our findings extend COR theory by identifying job stress as a key mechanism linking robot adoption to reduced green behavior. Our study shows that robot adoption introduces resource demands that lead to resource depletion, aligning with COR theory's premise that individuals under resource strain prioritize essential tasks. This contribution helps refine COR theory by applying it to the specific context of automation and discretionary green behavior, showcasing how resource depletion influences not only job performance but also voluntary, pro-environmental actions [20]. Second, while existing research on robot adoption largely focuses on outcomes like job performance, turnover intentions, and productivity, our study broadens this perspective by exploring the impact on green behavior, a discretionary action. This shifts the conversation around automation's effects to include employees' pro-environmental engagement, providing a more comprehensive view of how robot adoption affects behavior beyond core job functions [1,7,8]. Third, our findings add to the understanding of personality's role in moderating responses to automation. By identifying openness to experience as a buffer against job stress, we contribute to the body of knowledge on individual differences in adapting to technological changes. This insight suggests that personality traits can influence employees' ability to manage stress in the face of automation, thereby preserving their engagement in green practices. Lastly, our study underscores the need for organizations to consider both the environmental and employee-level impacts of automation [29,30]. By demonstrating that robot adoption may hinder employees' green behavior due to resource depletion, we highlight the importance of providing support mechanisms—such as training

and stress management resources—to help employees adapt to new technology without compromising discretionary behaviors that align with sustainability goals.

Theoretical Implications

Our studies contribute to the literature in three ways. First, our work extends COR theory by applying it to the unique context of robot adoption and its impact on green behavior [19,20]. We show that robot adoption creates resource demands—such as the need for cognitive adaptation and emotional adjustment—that can lead to resource depletion and increased job stress. By demonstrating that job stress mediates the relationship between robot adoption and green behavior, our findings highlight that resource depletion does not only impact core job performance but also influences discretionary, pro-environmental behaviors. This extension provides a new application of COR theory in understanding how resource constraints impact voluntary actions that are not directly required by job roles [20].

Second, our studies introduce personality traits as moderators in the context of automation. Our findings contribute to the literature on individual differences in responses to technological change by highlighting openness to experience as a moderating factor. Previous research has confirmed that self-affirmation interventions can mitigate the negative effects of robot adoption [2]. Our studies focus on openness to experience as a moderating trait opens up avenues for examining additional personality traits, such as conscientiousness and agreeableness, in shaping responses to automation. Future research could explore how these traits interact with COR theory to predict both green and adaptive behaviors. This expanded focus could deepen understanding of individual differences in coping with automation, contributing to the broader theoretical literature on personality and job stress [23].

Third, our studies broaden the scope of robot adoption literature [1,7,8,31]. While much of the existing research on robot adoption focuses on outcomes like productivity, job satisfaction, and turnover intentions [4,9,15], our study addresses a less explored area: the impact of automation on pro-environmental behavior. By focusing on green behavior, we expand the conversation around automation to include its effects on sustainability-oriented actions, offering a more holistic view of how technological changes influence both job and non-job behaviors in the workplace. Another hand, existing researches have found that robot adoption helps companies improve energy efficiency and green performance at the organizational level [32,33]. However, our studies found that robot adoption does not enhance employees' green behavior but rather hinders it by increasing job stress. Thus, it is evident that robot adoption has differing effects on green performance at the organizational level and green behavior at the individual employee level. These effects should not be conflated; rather, the impact of robot adoption on organizational outcomes and employee-level outcomes should be explored separately.

Practical Implications

The results of our studies indicate that robot adoption significantly reduces employees' green behavior through job stress, while openness to experience weakens this negative relationship. These findings have important practical implications for organizational green management. First, our work provides guidance for hotel managers on employee sustainability engagement. Our findings offer actionable insights for hotel managers. While automation can enhance operational efficiency, it can also inadvertently reduce employees' engagement in green behaviors due to job stress. Managers may not be fully aware of this indirect impact on sustainability initiatives, and our study highlights the importance of supporting employees in adapting to robot adoption to maintain their engagement in green practices. Second, our findings leverage individual differences in automation adaptation. Our studies suggest that employees with high openness to experience are better equipped to handle the demands of robot adoption without reducing their commitment to green behavior. Managers can use this insight by identifying and supporting employees who may re-quire additional resources to adapt, or by fostering a culture of adaptability and open-ness to encourage resilience across the workforce.

Lastly, we offer organizations potential solutions to avoid the negative effects of robot adoption. Organizations could design training that not only addresses technical skills related to robotics but also emphasizes sustainable practices in using these technologies. Training employees to operate robots in environmentally responsible ways—for example, by minimizing energy usage or using resources efficiently—can promote green behavior alongside technological adaptation. Given the increased stress that employees may experience as they adapt to automation, offering mental health resources, such as stress management programs, counseling, or resilience-building workshops, could support employees in navigating these changes. This support can help employees manage job stress more effectively, reducing the likelihood that stress will inhibit their engagement in green behavior. Recognizing and rewarding employees who demonstrate consistent green practices, even as they adapt to new technologies, can

reinforce the organization's commitment to sustainability. For example, companies could implement sustainability-focused recognition programs or offer small incentives for environmental contributions, thereby encouraging employees to continue their discretionary green behaviors amidst technological transitions.

Limitations and Future Research Directions

Our studies have several limitations that should be acknowledged to provide context for the findings and inform future research. The first one, the research primarily focuses on the hospitality industry, which limits the generalizability of the findings to other sectors. While this industry provides a relevant context for examining robot adoption due to its increasing use of service robots, the results may not fully extend to industries where the nature of work and employee interactions with technology differ significantly. Next one, the study's reliance on specific samples, such as university students in experimental settings or employees from a single hotel chain, may limit its external validity. The findings may not represent the broader workforce, particularly in industries with different technological adoption rates or employee demographics. Third, owing to self-reported data in study2, participants may have overstated their engagement in green behavior or understated their job stress levels due to social desirability concerns or fear of negative repercussions in a workplace context. And the absence of pre- and post-adoption assessments also is a limitation of study2. Lastly, our findings may be influenced by the single chain, specific cultural and regional context of China, where environmental values and attitudes toward robot adoption may differ from those in other regions. Consequently, our results may not fully generalize to other cultural settings, where variations in green behavior and perceptions of robot adoption could produce different outcomes.

To build on our work and address its limitations, future research could explore the following. First, conducting studies across various industries, such as manufacturing, healthcare, and retail, could provide more comprehensive insights into how robot adoption impacts employee behaviors, including green practices. Different sectors have unique challenges and technological environments that may influence the relationship between automation, job stress, and employee discretionary behaviors. Second, while this study emphasizes openness to experience as a moderating factor, future research should consider examining other personality traits, such as conscientiousness or agreeableness. Traits like conscientiousness could affect how employees respond to automation, as highly conscientious individuals may maintain their commitment to green behaviors despite increased job stress. Moreover, the current two-item scale for measuring openness to experience may be too limited to fully capture the complexity of this trait. A more detailed scale, such as the full openness subscale from the Big Five Inventory, would allow for a more thorough assessment of aspects such as creativity, curiosity, and willingness to embrace new experiences. Using a more comprehensive measure would improve the scale's reliability and validity, providing a clearer picture of how openness influences responses to robot adoption and green behavior. Additionally, the self-reported measurement of green behavior has its limitations. Future research could benefit from utilizing peer or supervisor observation reports as an alternative.

Third, additional contextual factors, such as leadership style, organizational culture, and green HRM practices, should be studied to understand their influence on employee behavior amid robot adoption [34]. For example, supportive leadership or a strong culture of sustainability may buffer the negative effects of job stress and promote green behavior. Fourth, implementing longitudinal designs that track employee behavior and perceptions over time could provide deeper insights into how robot adoption impacts green behavior in the long run. This would help to identify whether initial stress responses are mitigated as employees adapt to new technologies or if they persist and continue to impact discretionary behaviors. Fifth, future studies could benefit from using mixed-methods approaches that combine quantitative data with qualitative insights. This could offer a more nuanced understanding of why certain behaviors change in response to automation and reveal underlying mechanisms that surveys alone may not capture. By addressing these limitations and pursuing these future research directions, the field can deepen its understanding of the complex interplay between robot adoption, employee well-being, and discretionary behaviors such as green practices. Finally, to enhance the generalizability of our findings, we recommend that future research examine this topic across organization s, diverse regions and cultural contexts. Expanding the sample to include participants from various geographical areas and cultural backgrounds would provide a broader perspective, allowing for comparisons across cultural contexts. Such cross-cultural studies could offer deeper insights into how regional and cultural factors shape the relationship between robot adoption and green behavior, thereby supporting a more comprehensive understanding of these dynamics.

CONCLUSIONS

Taken together, our work comprises two studies that investigate the causal relationship between robot adoption and employees' green behavior, as well as the mediating mechanisms and boundary conditions. Study 1 employed an experimental approach to confirm the significant negative effect of robot adoption on employees' green behavior. Study 2 utilized a survey method to explore the mediating role of job stress between robot adoption and employees' green behavior and tested the moderating effect

of openness to experience on this indirect relationship. Overall, our studies indicate that only employees with low and medium levels of openness to experience are likely to experience severe stress responses due to robot adoption, which in turn reduces green behavior (moderated mediation).

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