

# Green sparks: do AI robot or human employees better ignite customer pro-environmental behavioral intention?

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## Abstract

**Purpose** – In light of the increasing adoption of AI in service industries and the growing societal emphasis on sustainability, this study examines the differential effects of green creative behaviors performed by human employees compared to AI robot employees on customer pro-environmental behavioral intentions.

**Design/methodology/approach** – Three scenario-based, between-subjects experimental studies, conducted via Credamo, tested the hypotheses. Study 1 ( $n = 181$ ) examined the effect of employee green creative behavior (EGCB), categorized by actor type, on customer pro-environmental behavior intentions. Study 2 ( $n = 167$ ) investigated the mediating role of moral identity centrality. Study 3 ( $n = 195$ ) assessed the differential impacts of highly anthropomorphic AI robot employees versus their less anthropomorphic counterparts on customer pro-environmental behavioral intentions, mediated by moral identity centrality.

**Findings** – Green creative behaviors performed by human employees trigger higher customer pro-environmental behavioral intention compared to those exhibited by AI robot employees. This effect is mediated by customer moral identity centrality. Furthermore, green creative behaviors performed by highly anthropomorphic AI robot employees elicit greater moral identity centrality in customers, resulting in an even stronger enhancement of their pro-environmental behavioral intention than behaviors displayed by less anthropomorphic robots.

**Originality/value** – This research deepens our insight into the impact of EGCB from the customer perspective. It also enriches the research on the antecedents of customer pro-environmental behavioral intention.

**Keywords** Employee green creative behavior, Customer pro-environmental behavioral intention, Moral identity centrality, Anthropomorphic AI robot

**Paper type** Research article

## 1. Introduction

In recent years, the adoption of artificial intelligence (AI) within the service industry has grown significantly (Cui and Zhong, 2023). AI-driven solutions, including AI chatbots and service robots, are progressively replacing or complementing traditional human resources, leading to cost reductions and improved service efficiency (Schepers *et al.*, 2022). At the same time, sustainable development has become a global imperative and the service sector is actively responding. Many service companies are integrating AI into environmentally sustainable practices. For instance, a type of recyclebot can transform post-consumer plastic

**Funding:** This work was supported by the National Natural Science Foundation of China [grant number 72202182].

**Conflict of interest:** The authors declare that there are no conflicts of interest.



waste to creative artworks using 3D printing technology. This exemplifies green creative behavior, which has garnered considerable attention in the context of human employees. Specifically, employee green creative behavior (EGCB) refers to the generation or implementation of novel and useful ideas or solutions by employees to protect or enhance the environment (Cho and Yoo, 2021). For example, McDonald's employees recycle wastes, such as plastic products and coffee grounds, into creative items needed by the restaurant or their customers, thus reducing wastes and achieving green recycling. Nevertheless, it remains unclear whether the effectiveness of EGCB enacted by AI robots differs from that performed by humans.

EGCB brings several benefits, including strengthening a company's competitive advantage by meeting the increasing demand for sustainable products and services from eco-conscious customers. It also generates value for various stakeholders by fostering new partnerships and business relationships, enhancing investor confidence and benefiting community residents and society at large (Asghar *et al.*, 2023; Luu, 2021; Mittal and Dhar, 2016). Hence, research interest in this topic has been growing across various service contexts (Zhao *et al.*, 2023). Most studies have concentrated on exploring the antecedents of EGCB. For instance, employees' green mindfulness has been shown to promote EGCB by stimulating their green intrinsic motivation toward environmental issues (Zhao *et al.*, 2023). Additionally, an organization's green entrepreneurial orientation and customers' green engagement play crucial role in activating EGCB (Luu, 2021, 2024). However, the consequences of EGCB have largely been overlooked.

In high-contact service industries, engaging with customers is a fundamental aspect of employees' roles. Employee behaviors are highly visible to customers and can directly impact their experiences and actions (Beatson *et al.*, 2008; Gorji *et al.*, 2021; Pounders *et al.*, 2015). For example, employee citizenship behaviors toward customers can enhance customer satisfaction, encouraging customers to participate in similar behaviors like offering feedback and positively endorsing the brand (Chan *et al.*, 2017). Likewise, employee environmental organizational citizenship behavior can inspire customers to participate in environmental improvement activities (Tuan, 2018). Research also indicates that employee eco-friendly behaviors lead to increased green consumption by customers. These studies confirm that employees' altruistic behaviors can induce similar actions in customers. Nevertheless, it remains unknown whether and how EGCB affects customer pro-environmental behavioral intention. Given our focus on the service industry and the potential impact of EGCB on customer behavior, we refine the definition of EGCB to emphasize behaviors that are observable and perceptible to customers. In this study, EGCB is defined as the implementation of innovative and practical solutions by employees that contribute to environmental conservation or enhancement.

Although the application of AI technology in promoting environmental sustainability is becoming more common, the effects of these applications – particularly human responses to AI-driven interventions – remain insufficiently explored. Previous research indicates that customers may react differently to services provided by AI robots compared to human employees across various contexts, such as telemarketing (Li *et al.*, 2023), product recommendations (Xu *et al.*, 2024), online shopping assistance (Ruan and Mezei, 2022) and restaurant services (Song *et al.*, 2022). Since AI robots primarily depend on data analytics and algorithms, lacking the emotional insight and intuition inherent in human interactions, they may evoke different customer responses when performing EGCB compared to human employees. Thus, it is essential to investigate whether and how EGCB performed by AI robots differs from that enacted by human employees in influencing customer pro-environmental behavioral intentions.

Grounded in social cognitive theory, this study seeks to reveal the potential mechanisms by which the actor type of EGCB (humans vs. AI robots) influences customer pro-environmental behavior intention. Social cognitive theory suggests that external environmental factors stimulate an individual's cognition, which subsequently influences their behaviors to align

with the external environment (Bandura, 1986). Given the variations in customers' understanding and empathy toward human versus AI robot employees (Li *et al.*, 2023; Wang *et al.*, 2022), we hypothesize that EGCB demonstrated by humans will elicit higher pro-environmental behavioral intention from customers compared to that demonstrated by AI robots. Furthermore, EGCB conveys employees' moral attributes such as eco-consciousness, environmental friendliness and dedication to waste reduction, potentially triggering customers' ethical awareness. Thus, we propose that moral identity centrality mediates the aforementioned main effect. Moral identity centrality refers to the extent to which an individual's moral self-concept is integral to their self-view, highlighting the importance of being perceived as a moral person. This centrality significantly influences their moral behavioral tendencies. Additionally, social cognitive theory posits that certain characteristics of environmental stimuli can influence the cognitive regulatory processes they evoke in individuals (Bandura, 1986). Highly anthropomorphic AI robots may evoke feelings and judgments similar to those directed toward humans (Yam *et al.*, 2021), affecting customers' attitudes and behaviors during service interactions (Blut *et al.*, 2021). Therefore, we expect that EGCB demonstrated by highly anthropomorphic AI robots will elicit a higher level of customer moral identity centrality, leading to stronger pro-environmental behavioral intention compared to that implemented by less anthropomorphic robots.

This study aims to contribute to the literature in several ways. First, it advances the EGCB research by shifting the focus from antecedents to outcomes. Second, by examining the distinct effects of EGCB performed by humans versus AI robots on customer pro-environmental behavioral intentions, this work expands our understanding of the factors influencing customer pro-environmental behavior in a service context increasingly characterized by AI technology. Third, this study enhances the social cognitive theory framework by integrating moral identity centrality as a crucial cognitive process and applying it within AI-driven service contexts. Fourth, by identifying role of anthropomorphic features in shaping customer responses, this study enriches the literature on human-AI interactions. Additionally, the findings offer valuable practical insights for service companies on how to effectively manage the actor of EGCB to encourage customer pro-environmental behaviors.

## 2. Review of literature and conceptual framework

### 2.1 *Employee green creative behavior (EGCB)*

EGCB, defined as creative actions implemented by employees to protect or enhance the environment, highlights the significant role employees play in fostering sustainable development within companies and society (Asgar *et al.*, 2023; Liu *et al.*, 2024b). Although this topic has received extensive research attention, most of the focus has been on its antecedents. Relevant studies can be categorized into three main groups: individual, organizational and external factors. Individual antecedents of EGCB include employees' environmental values (Al-Hawari *et al.*, 2021), green mindfulness (Zhao *et al.*, 2023) and perceived value of green creativity (Liu *et al.*, 2024a). At the organization level, factors influencing EGCB include green transformational leadership (Mittal and Dhar, 2016), green inclusive leadership (Bhutto *et al.*, 2021) and green entrepreneurial orientation (Luu, 2021). External factors primarily relate to customers, such as customer pressure (Cho and Yoo, 2021) and customer involvement (Luu, 2024).

Surprisingly, only a few studies have investigated the potential consequences and underlying mechanisms of EGCB. In these studies, EGCB primarily functions as a mediator to examine its impact on certain organizational outcomes, including green service innovation (Luu, 2022), sustainability performance (Lyu *et al.*, 2022) and circular supply chain performance (Agyabeng-Mensah *et al.*, 2024). Additionally, research has shown that employees' environmental organizational citizenship behavior can encourage customers to engage in similar behaviors (Tuan, 2018). While EGCB represents a novel approach to green

behaviors (Luu, 2022), it is unclear whether and how customers exhibit pro-environmental behavioral intention in response to it.

In today's digital era, AI robots are increasingly employed to perform service tasks traditionally carried out by human employees. However, they often elicit different customer attitudes and behaviors (Giroux *et al.*, 2022). For example, Li *et al.* (2023) demonstrated that human telemarketers evoke higher levels of empathy from customers than AI salespersons. Moreover, Wang *et al.* (2023) found that during service failures, apologies from human employees enhance travelers' willingness to revisit, whereas apologies from robot employees do not yield the same effect. Similarly, EGCB enacted by humans versus AI robots may have varying impacts on customer perceptions and their subsequent intentions to engage in environmentally friendly behaviors. This highlights the need for more comprehensive research into these differences and their implications.

### 2.2 Social cognitive theory

Social cognitive theory, a fundamental framework for understanding individual behavior patterns, asserts a dynamic interaction among the external environment, individual cognitions and behaviors (Bandura, 1986). This perspective emphasizes that individuals do not passively accept environmental influences; instead, they actively adjust their self-cognitions by observing and interpreting their surroundings, which ultimately shapes their subsequent actions. Research contends that after observing a series of target behaviors, individuals may undergo intrinsic cognitive transformations, leading them to adopt similar behaviors (Bandura, 1986). For example, within this framework, unethical pro-organizational behavior exhibited by leaders has been shown to elicit similar unethical behavior from subordinates, mediated by moral disengagement (Lian *et al.*, 2022). Furthermore, social cognitive theory suggests that the influence of external environmental factors on individuals depends on certain characteristics of that environment (Bandura, 1986). For instance, Zhao and Zhou (2021) found that responsible leadership moderates the mediated relationship between socially responsible human resource management and employee organizational citizenship behavior for the environment via moral reflectiveness.

### 2.3 EGCB and customer pro-environmental behavioral intention

Social cognitive theory argues that external environmental stimuli can influence or alter an individual's behavior (Bandura, 2002). Research has shown that in service interactions, employee behaviors serve as a significant external factor that shapes customer behavior (Pounders *et al.*, 2015). Accordingly, we contend that EGCB, as a crucial environmental stimulus, has the potential to enhance customer pro-environmental behavioral intention. Previous studies indicate that identical behaviors performed by human and AI robot employees lead to different attitudinal and behavioral responses from customers (Li *et al.*, 2023). Thus, we propose that the EGCB demonstrated by humans and AI robots impacts customer pro-environmental behavioral intention to varying degrees.

First, as suggested by social cognitive theory, individuals can acquire new skills and exhibit similar behaviors through the observation of target behaviors (Bandura, 1986). When human employees engage in green creative behavior, customers are likely to perceive it as peer behavior, enhancing their feelings of identification and increasing their likelihood of imitation (Bandura, 1986). In contrast, EGCB demonstrated by AI robots may be regarded as a programmed output from a non-human entity (Garvey *et al.*, 2023), leading to a disconnect from customers' life experiences and reducing their motivation to adopt similar environmentally friendly behaviors. As a result, EGCB performed by humans is more effective in stimulating customer pro-environmental behavioral intentions than that performed by AI robots.

Second, human employees can foster a social environment through language, facial expressions and personalized interactions, facilitating mutual understanding and emotional

contagion. When human employees demonstrate green creative behaviors, they communicate positive sentiments regarding environmental protection (Tuan, 2018), which enhances customers' perceptions of environmentally friendly behavior. In contrast, AI robots are typically perceived as executing tasks in a standardized manner, lacking the dynamic social cues that human interactions provide (Guan *et al.*, 2024). This absence of social cues can limit customers' empathy toward AI robots (Li *et al.*, 2023). Consequently, EGCB performed by humans is likely to elicit stronger pro-environmental behavioral intentions among customers compared to that performed by AI robots.

Third, when customers observe EGCB demonstrated by humans, they may be motivated to adopt similar pro-environmental actions to enhance their own image. In contrast, AI robots are frequently perceived as lacking the capacity for thought and judgment regarding the behaviors of others (Bigman and Gray, 2018), which means they cannot form impression of individuals. As a result, customers may display a lower pro-environmental behavioral intention when faced with EGCB performed by AI robots, as they do not perceive the same necessity to manage their personal image in these interactions (Pitardi *et al.*, 2024).

*H1.* Customers are likely to exhibit stronger pro-environmental behavioral intention when they encounter EGCB from humans than from AI robots.

#### *2.4 The mediating effect of moral identity centrality*

Social cognitive theory highlights that external stimuli – such as observed behaviors – shape individuals' cognitive states, which in turn guide their behavioral intentions (Bandura, 1986). Considering the moral characteristics of EGCB, we propose that moral identity centrality – the extent to which moral traits (e.g. responsibility, integrity, care for others) are central to an individual's self-concept (Aquino *et al.*, 2009) – mediates the relationship between the actor type of EGCB and customer pro-environmental behavioral intention. Moral identity centrality can be influenced by external cues, particularly through customers' perceptions and attributions related to these cues. Additionally, it plays a crucial role in fostering moral behaviors (Aquino *et al.*, 2009).

EGCB embodies ethical characteristics such as eco-centricity, environmental friendliness, responsibility and concern for environmental issues. These traits can strengthen customers' identification with the behavior (Tuan, 2018), thereby strengthening their moral identity centrality. According to social cognitive theory, the effectiveness of this enhancement depends on the perceived attributes of the actor (Bandura, 2002). Human employees are generally perceived as autonomous agents capable of genuine creativity and moral motivation (Hur *et al.*, 2018). Therefore, customers observing human-performed EGCB may attribute it to employees' genuine moral motivation, fostering a sense of shared values and reinforcing their moral identity centrality. Conversely, AI robot employees are often seen as programmed entities lacking intrinsic moral or creative intent (Constantinescu and Crisp, 2022; Guan *et al.*, 2024). Customers may perceive their EGCB as a programmed output rather than a volitional act. This diminished personal relevance can reduce the cognitive impact of EGCB on moral identity centrality (Bandura, 1986). Therefore, EGCB performed by humans (vs. AI robots) is expected to induce higher level of moral identity centrality among customers.

Studies have demonstrated that moral identity centrality is crucial for facilitating individual moral actions (Aquino *et al.*, 2009). Customer pro-environmental behavior, recognized as a moral action, aligns with social cognitive theory, which posits that behavior reflects internalized values shaped by observed models (Bandura, 2002). Accordingly, we anticipate that moral identity centrality may increase customers' inclination to engage in environmental practices. First, customers often exhibit behaviors that align with their moral identity. Those with a more central moral identity tend to act in accordance with the virtues they value and seek to positively impact others or society (Wang and Hackett, 2020). Second, they are more likely to expand the boundaries of their in-groups. They incorporate broader social groups and

address their general needs and interests, leading to engagement in ethical behavior for the benefit of all humanity. In conclusion, we propose the mediating effect of moral identity centrality:

- H2. Moral identity centrality mediates the impact of actor type (humans vs. AI robots) of EGCB on customer pro-environmental behavioral intention.

### *2.5 The differential effects of EGCB performed by highly anthropomorphic vs. less anthropomorphic AI robots*

As suggested by social cognitive theory, specific characteristics of external environmental factors can influence how they shape individuals' cognitive regulatory responses (Bandura, 1986). Considering the varying effects of highly anthropomorphic and less anthropomorphic AI robot employees on customer attitudes and behaviors (Blut *et al.*, 2021; Ku, 2024), we propose that EGCB carried out by these two types of AI robots may evoke differing levels of customers' moral identity centrality and, subsequently, their pro-environmental behavioral intentions.

Highly anthropomorphic AI robots are characterized by features such as human-like appearance, expressive gestures and empathetic communication. The service behaviors exhibited by these robots lead customers to form attitudes and evaluations similar to those they have toward human employees (Arikan *et al.*, 2023), resulting in a different impact compared to less anthropomorphic AI robots (Giroux *et al.*, 2022; Li *et al.*, 2023). Due to their greater likelihood of being perceived as intentional agents capable of moral action (Gray and Wegner, 2012), when highly anthropomorphic AI robots engage in EGCB, customers may interpret these actions as deliberate and morally motivated. This interpretation fosters a stronger connection to the observed behavior. In contrast, less anthropomorphic AI robots, which tend to appear more mechanical or utilitarian, may be viewed merely as tools executing programmed tasks, thus reducing the moral salience of their actions. This differential perception suggests that high levels of anthropomorphism enhance the moral signaling effect of EGCB, making it more likely for customers to internalize these cues into their moral identity. Additionally, highly anthropomorphic AI robots are perceived to possess greater agency and social connection abilities compared to their less anthropomorphic counterparts (Garvey *et al.*, 2023). This enhanced perception enables them to establish social relationships and emotional bonds with customers (Yam *et al.*, 2021). Consequently, customers are more inclined to identify morally with the ethical traits displayed by EGCB from highly anthropomorphic AI robots than from less anthropomorphic ones.

Individuals strive to align their behaviors with their self-concept. When customers' moral identity centrality is activated and reinforced by the EGCB executed by highly anthropomorphic AI robots, they are likely to adopt pro-environmental intentions to maintain consistency with this identity. This effect is likely to be weaker in the presence of EGCB demonstrated by less anthropomorphic AI robots, as the moral connection and subsequent activation of identity are diminished.

- H3. Customers are likely to develop a stronger moral identity centrality and subsequently show greater pro-environmental behavioral intentions when they encounter EGCB performed by highly anthropomorphic AI robots compared to that performed by less anthropomorphic ones.

## **3. Methods and results**

### *3.1 Study 1: the effect of actor type of EGCB on customer pro-environmental behavior intentions*

- (1) Methods

Study 1 employed a single-factor (actor type: human vs. AI robot) between-subjects design to examine the impact of EGCB actor type on customer pro-environmental behavioral intention. Based on existing literature, we developed two scenarios, using both images and text descriptions, to depict EGCB by humans and AI robots (Luu, 2021). To ensure academic rigor, we invited six marketing scholars and PhD students to review the materials, leveraging their expertise in marketing theory and research for a critical evaluation. Additionally, ten frontline hospitality employees reviewed the materials to provide practical insights, ensuring the scenarios' relevance and applicability in real-world settings. After incorporating feedback, we revised the materials and validated them through a pre-test, confirming successful manipulation.

Data was conducted via Credamo, a platform widely used in behavioral research (e.g. Chen *et al.*, 2025). Participants were randomly assigned to one of the two conditions and asked to view an illustrated hotel lobby scene (Appendix 1) with either a human ("Xiaohong") or an AI robot ("Xiaozhi") as the EGCB actor. They answered two seven-point Likert scale questions: identifying the actor using the recycling device (Q1) and evaluating whether this act exemplified EGCB (Q2), followed by a four-item pro-environmental behavior intention scale (Cronbach's  $\alpha = 0.80$ ; Qiu *et al.*, 2022) and socio-demographic information.

G\*Power analysis (effect size = 0.25, alpha = 0.05 and power = 0.80) determined a minimum sample size of 128. We recruited 185 participants, selecting those with a Credamo credit score  $\geq 90$ . After excluding invalid responses via attention checks and consistency filters, 181 valid responses remained (29.3% male vs. 70.7% female). The age distribution was as follows: 27.6% were 18–25 years old, 23.2% were 25–30 years old, 39.3% were 31–40 years old, 4.4% were 41–50 years old and 5.5% were 50 years old or above. Regarding education, 2.2% had a high school degree or less, 11.6% had a junior college degree, 76.8% had a bachelor's degree and 9.4% had a master's degree or higher.

## (2) Results

*Manipulation check.* First, all participants in the human employee condition correctly identified the actor as a human and those in the AI robot condition accurately identified the actor as an AI robot, indicating successful manipulation of the actor type. Second, the results of the one-sample *t*-test (compared to 4) indicated that participants in both conditions perceive the scenarios as EGCB ( $M_{\text{human employee}} = 6.34$ ,  $SD_{\text{human employee}} = 0.73$ ,  $n = 91$ ,  $t(90) = 30.44$ ,  $p < 0.001$ ;  $M_{\text{AI robot employee}} = 6.23$ ,  $SD_{\text{AI robot employee}} = 0.81$ ,  $n = 90$ ,  $t(89) = 26.22$ ,  $p < 0.001$ ). In addition, no significant difference in perceived EGCB was observed between the two groups [ $t(179) = -0.94$ ,  $p = 0.351$ ]. Therefore, the manipulation of EGCB in this study was effective.

*Hypothesis testing.* A one-way ANOVA analysis was carried out with pro-environmental behavioral intention as the dependent variable and the actor type of EGCB as the independent variable. Results showed that the pro-environmental behavioral intention of participants in the human employee condition ( $M_{\text{human employee}} = 6.08$ ,  $SD_{\text{human employee}} = 0.54$ ) was significantly higher than that in the AI robot employee condition ( $M_{\text{AI robot employee}} = 5.40$ ,  $SD_{\text{AI robot employee}} = 0.70$ ,  $F(1, 179) = 53.01$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.228$ ), supporting Hypothesis 1.

### 3.2 Study 2: the mediating role of moral identity centrality

#### (1) Methods

Study 2 aimed to reconfirm Hypothesis 1 and test Hypothesis 2, using materials similar to Study 1 but with the context changed to restaurant ordering. Participants were randomly assigned to a human or AI robot condition, with the only difference being the actor using the recycling device: "Xiaohong" (human) or "Xiaozhi" (AI robot). They answered two questions to confirm the scenario's depiction of EGCB, using the same answer choices as in Study 1.

Next, they rated their pro-environmental behavioral intention (Cronbach's  $\alpha = 0.79$ ) and moral identity centrality (Cronbach's  $\alpha = 0.81$ ) on a seven-point Likert scale. Moral identity centrality was assessed using a five-item scale by Aquino *et al.* (2009). Finally, they provided socio-demographic information.

From 173 Credamo participants, 167 valid responses remained after excluding six for quality issues (29.3% male). The age distribution was as follows: 28.2% were 18–25 years old, 26.9% were 25–30 years old, 35.3% were 31–40 years old, 4.8% were 41–50 years old and 4.8% were 50 years old or above. Regarding education, 0.6% had a high school degree or less, 10.8% had a junior college degree, 70.0% had a bachelor's degree and 18.6% had a master's degree or higher.

## (2) Results

*Manipulation check.* Firstly, all participants correctly answered the actor type in both the human and AI robot conditions. Secondly, a one-sample *t*-test (compared to 4) revealed that participants in the human employee condition effectively perceived the manipulation of EGCB ( $M_{\text{human employee}} = 6.24$ ,  $SD_{\text{human employee}} = 0.89$ ,  $n = 83$ ,  $t(82) = 22.90$ ,  $p < 0.001$ ). The same was true for the AI robot employee condition ( $M_{\text{AI robot employee}} = 6.07$ ,  $SD_{\text{AI robot employee}} = 0.80$ ,  $n = 84$ ,  $t(83) = 23.63$ ,  $p < 0.001$ ). Furthermore, there was no significant difference in the perceived EGCB between the two groups [ $t(165) = -1.29$ ,  $p = 0.198$ ]. Therefore, the manipulation in Study 2 was successful.

*Hypothesis testing.* A one-way ANOVA analysis was performed to re-verify the main effect of actor type of EGCB on customer pro-environmental behavior intention. Results indicated that compared to those in the AI robot employee condition ( $M_{\text{AI robot employee}} = 5.57$ ,  $SD_{\text{AI robot employee}} = 0.67$ ), participants in the human employee condition had higher pro-environmental behavior intention ( $M_{\text{human employee}} = 5.98$ ,  $SD_{\text{human employee}} = 0.45$ ,  $F(1, 165) = 20.95$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.113$ ), supporting [Hypothesis 1](#).

Subsequently, a mediation analysis was performed using the bootstrap method with 5,000 resamples, with actor type of EGCB (0 = human employee, 1 = AI robot employee) as the independent variable, pro-environmental behavior intention as the dependent variable and moral identity centrality as the mediator. The analysis controlled for socio-demographic variables. The results showed that actor type of EGCB negatively affected moral identity centrality ( $b = -0.32$ ,  $p < 0.001$ ), indicating that participants exposed to EGCB performed by human employees exhibited higher moral identity centrality than those exposed to EGCB performed by AI robot employees. Furthermore, moral identity centrality was positively correlated with pro-environmental behavioral intention ( $b = 0.36$ ,  $p < 0.001$ ). The indirect effect of actor type of EGCB on pro-environmental behavior intention, mediated by moral identity centrality, was negative and significant (*indirect effect* =  $-0.12$ , 95% CI [ $-0.21$ ,  $-0.04$ ]). This finding supported [Hypothesis 2](#).

### 3.3 Study 3: the differential effects of EGCB performed by highly anthropomorphic vs. less anthropomorphic AI robots

#### (1) Methods

Study 3 aimed to test [Hypothesis 3](#). The experimental materials used in this study were similar to that in the AI robot employee condition of Study 1, but the context was changed to coffee shop ordering. Additionally, the images depicting the recycling process were updated. Specifically, for the low anthropomorphic condition, the material was identical to that of the AI robot employee condition in Study 1, while the image of the AI robot the highly anthropomorphic condition was updated to reflect a more human-like appearance ([Appendix 2](#)).

Participants were randomly assigned to either condition and answered two manipulation check questions on a seven-point Likert scale: "Q1: In the presented scenario, how similar is

the AI robot Xiaozhi to a human being?” and “Q2: In the presented scenario, the act of the coffee shop employee using the recycling device to develop creative gadgets exemplifies employee green creative behavior.” They then reported pro-environmental behavioral intention (Cronbach’s  $\alpha = 0.79$ ) and moral identity centrality (Cronbach’s  $\alpha = 0.82$ ) using prior scales, followed by sociodemographic information.

From 200 Credamo participants, 195 valid responses remained after excluding five for quality issues (30.8% male). The age distribution was as follows: 27.2% were 18–25 years old, 22.1% were 25–30 years old, 33.3% were 31–40 years old, 11.8% were 41–50 years old and 5.6% were 50 years old or above. Regarding education, 7.2% had a high school degree or less, 10.2% had a junior college degree, 67.2% had a bachelor’s degree and 15.4% had a master’s degree or higher.

## (2) Results

**Manipulation check.** A one-sample *t*-test analysis (compared to 4) revealed that the perceived degree of anthropomorphism in the highly anthropomorphic condition ( $M_{\text{highly anthropomorphic}} = 5.65$ ,  $SD_{\text{highly anthropomorphic}} = 0.93$ ,  $n = 98$ ,  $t(97) = 17.56$ ,  $p < 0.001$ ) was significantly higher than that in the low anthropomorphic condition ( $M_{\text{low anthropomorphic}} = 3.05$ ,  $SD_{\text{low anthropomorphic}} = 1.11$ ,  $n = 97$ ,  $t(96) = -8.40$ ,  $p < 0.001$ ). In addition, significant difference in perceived degree of anthropomorphism was observed between the two groups ( $t(193) = 17.71$ ,  $p < 0.001$ ). Therefore, the manipulation of AI robot employees’ degree of anthropomorphism was successful.

In addition, the results of the one-sample *t*-test (compared to four) indicated that participants in both conditions perceived the employees’ recycling action as EGCB ( $M_{\text{highly anthropomorphic}} = 6.24$ ,  $SD_{\text{highly anthropomorphic}} = 0.77$ ,  $n = 98$ ,  $t(97) = 28.71$ ,  $p < 0.001$ ;  $M_{\text{low anthropomorphic}} = 6.09$ ,  $SD_{\text{low anthropomorphic}} = 0.96$ ,  $n = 97$ ,  $t(96) = 21.51$ ,  $p < 0.001$ ). Furthermore, there was no significant difference in perceived EGCB between the two groups [ $t(193) = 1.22$ ,  $p = 0.224$ ]. Hence, the manipulation of EGCB in Study 3 was effective.

**Hypothesis testing.** We performed a mediation analysis using the bootstrap method with 5,000 resamples. In this analysis, the degree of anthropomorphism of AI robot employees (0 for low anthropomorphism, 1 for high anthropomorphism) was the independent variable, pro-environmental behavioral intention was the dependent variable and moral identity centrality was the mediator. Socio-demographic variables were included as control variables. The results showed that participants exposed to highly anthropomorphic AI robots exhibited higher level of moral identity centrality compared to those exposed to less anthropomorphic ones ( $b = 0.30$ ,  $p < 0.01$ ). Moral identity centrality was positively correlated with customer pro-environmental behavioral intention ( $b = 0.47$ ,  $p < 0.001$ ). Compared to that exhibited by less anthropomorphic ones, EGCB performed by highly anthropomorphic AI robots elicited significantly higher customer pro-environmental behavioral intention, mediated by moral identity centrality (*indirect effect* = 0.14, 95% CI [0.05, 0.25]). This result supported [Hypothesis 3](#).

## 4. Conclusions

### 4.1 General discussion

Using social cognitive theory, we investigated how different actors of EGCB (humans vs. AI robots) affect customer pro-environmental behavioral intention. Study 1 revealed that EGCB performed by humans triggers higher customer pro-environmental behavioral intentions than AI robots, likely due to customers’ greater empathy toward human behaviors ([Li et al., 2023](#)). This aligns with previous research showing that human and AI robot employees performing the same tasks elicit different behavioral responses from customers ([Wang et al., 2023](#)).

Study 2 revealed that moral identity centrality mediates this effect. Specifically, EGCB by humans, compared to AI robots, enhances customers’ moral identity centrality, leading to stronger pro-environmental intentions. This result aligns with [Giroux et al.’s \(2022\)](#) research,

which indicates that customers show lower moral intentions when interacting with AI compared to human employees in service delivery. Our findings also support previous arguments that individuals' moral identity centrality fosters their moral behavior (Aquino *et al.*, 2009).

Study 3 unraveled the differentiated impacts of EGCB performed by highly anthropomorphic vs. less anthropomorphic AI robots. Specifically, compared to less anthropomorphic ones, EGCB performed by highly anthropomorphic AI robot employees triggers greater moral identity centrality in customers, leading to stronger pro-environmental behavioral intentions. A possible explanation is that the more anthropomorphic the AI robot employees are, the more likely customers are to evaluate and interact with them as if they were human (Blut *et al.*, 2021). This is consistent with studies showing anthropomorphic traits reduce perceived differences between human and AI robot employees (Garvey *et al.*, 2023; Giroux *et al.*, 2022; Li *et al.*, 2023).

#### 4.2 Theoretical contributions

First, this study significantly advances EGCB literature by investigating its impact on customer pro-environmental behavioral intention. While previous research has predominantly concentrated on factors promoting EGCB, such as green human resource management (Farooq *et al.*, 2022) and customer pressure (Cho and Yoo, 2021), its outcomes remain underexplored. By comparing EGCB performed by humans versus AI robots, this research expands the theoretical scope of EGCB outcomes to encompass external stakeholders, particularly customer responses. These insights also deepen our understanding of EGCB in the context of the increasing prevalence of AI robots in the service industry.

Second, this work enriches the research on the antecedents of customer pro-environmental behavioral intention by identifying EGCB as a key precursor. While employee behaviors' influence on customers is well-documented (Beatson *et al.*, 2008), their role in fostering pro-environmental intentions has received less attention. Our findings indicate that EGCB performed by humans stimulates stronger pro-environmental behavior intention compared to that performed by AI robots. This addresses the call for deeper investigation into the distinct influences of AI robots and human employees on customer behavior in an era increasingly characterized by the presence of AI-powered service robots (Li *et al.*, 2023; Wien and Peluso, 2021).

Third, drawing on social cognitive theory, we identify moral identity centrality as a mediator in the relationship between EGCB actor type and customer pro-environmental behavioral intention. This incorporation of moral identity centrality as a key cognitive factor extends the framework of social cognitive theory, addressing the recommendations made by Aquino *et al.* (2009). Our such effort also contributes to social cognitive theory by applying it within hybrid human-AI environments, thereby broadening its relevance and applicability. In addition, we enhance the literature on moral identity centrality by positioning EGCB as an antecedent and customer pro-environmental behavior intention as a consequential outcome.

Finally, our findings indicate that highly anthropomorphic AI robots performing EGCB foster greater moral identity centrality and pro-environmental behavioral intention than less anthropomorphic ones. This underscores the importance of human-like design features in shaping customer social cognitive processes (Li *et al.*, 2023; Wien and Peluso, 2021), contributing to social cognitive theory and human-AI interaction research while opening avenues for studying AI design in sustainable service contexts.

#### 4.3 Managerial implications

First, given that human employees outperform AI robots in performing EGCB to promote customer pro-environmental behavior intention, companies should prioritize fostering EGCB among human employees. To achieve this, organizations can establish a structured idea generation program with prompt evaluation and feedback mechanisms to recognize and

implement valuable green initiatives. Additionally, organizations should actively support promising ideas with resources and clear implementation plans. Furthermore, managers must provide explicit EGCB guidelines and regular training to equip employees with essential skills. Additionally, implementing reward systems – such as bonuses, promotions or recognition programs – can motivate employees to engage in EGCB. For instance, inviting customers to assess the creativity of employees' green behaviors and offering bonuses or commissions based on their feedback can further incentivize impactful EGCB.

Second, the adoption of AI robots is increasingly common in the service industry, with these robots progressively taking over tasks traditionally performed by human employees (Schepers *et al.*, 2022). Therefore, companies must carefully consider how to deploy AI robot employees effectively and efficiently (Li *et al.*, 2023). Our findings indicate that highly anthropomorphic AI robots performing EGCB more effectively stimulate customers' moral identity centrality and pro-environmental behavioral intentions compared to less anthropomorphic counterparts. To optimize impact, companies should design AI robots with human-like appearances, incorporating realistic facial expressions and body language to foster empathetic connections. Equipping robots with advanced conversational skills for natural, emotionally responsive dialogue further enhances their human-like presence. Additionally, aligning robot personalities with brand values ensures consistent, engaging customer interactions, strengthening the impact of EGCB initiatives.

Third, this study suggests that customers' moral identity centrality mediates the relationship between EGCB actor type (humans vs. AI robots) and customer pro-environmental behavioral intention. Customers with higher moral identity centrality show stronger pro-environmental behavioral intentions. Prior research has indicated that ethically relevant activities can enhance customers' moral identity centrality (Reed *et al.*, 2007). Consequently, companies can design eco-friendly initiatives to boost customer involvement, such as "blind box of leftovers" programs selling near-expiry items at discounts, "old things exchange" bazaars for trading used goods or "bicycle power generation" devices for customers to charge electronics by pedaling, promoting sustainability and engagement.

## 5. Limitations and future research

First, this study employs a scenario experimental approach to test the research model. Considering the complexity and uncertainty present in real-life situations, future research should incorporate field experiments to validate these findings. In addition, future research should employ alternative data collection platforms such as Sojump, to further validate the findings and mitigate potential platform-specific biases. Second, in examining the consequences of EGCB, we focused on customer pro-environmental behavioral intention. Future research should explore other types of behaviors, both those of customers and employees themselves. Third, our study primarily distinguishes high- and low-anthropomorphic AI robots based on their human-like versus non-human-like appearance. Future research should explore the integration of advanced AI features, such as voice recognition and autonomous decision-making, to provide a more holistic distinction between high- and low-anthropomorphic AI robots. Finally, in our manipulation check for highly versus less anthropomorphic AI robot, we employed a single-item measure. Future research could utilize a multi-item anthropomorphism scale to provide a more nuanced assessment.

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Hongxia Lin: Conceptualization; Writing – original draft; Writing – review and editing; Funding acquisition.

Qing Zhang: Writing – original draft.

Jian Tian: Conceptualization; Writing – original draft; Writing – review and editing; Project administration.

Jiyu Li: Data analysis.

Na Liu: Conceptualization; Survey.

### Ethics declarations

*Ethical approval*: The procedure performed in this study involving human participants was in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

### Data availability

The data that supports the findings of this study is available from the corresponding author upon reasonable request.

### Submission declaration

This manuscript is not previously published or being considered by another journal.

## Appendix 1

### Human employee condition

Please imagine the following scenario:

You are checking in at a hotel, and a frontline employee named Xiaoli directs your attention to the right side (as shown in Figure A1). Xiaoli explains, “My colleague Xiaohong is using the recycling device to develop creative gadgets like keychains, earrings, and cell phone stand. The items are made from disposable materials such as plastic bottles used by customers. The process involves crushing, cleaning, hot melt compression and injection molding. The resulting creative gadgets (as shown in Figure A2) are provided to customers for free as souvenirs.” Xiaoli then shows you a brochure featuring pictures of various creative gadgets and ask you to choose one. She promises that it will be made and given to you when you leave.



**Figure A2.** Examples of creative gadgets. Source(s): Authors' own work

Figure A1. Human employee Xiaohong engaging in green creative behavior. Note: Figure A1 is not publicly available due to copyright issues but can be provided upon request AI robot employee condition.

Please imagine the following scenario:

You are checking in at a hotel, and a frontline employee named Xiaoli directs your attention to the right side (as shown in [Figure A3](#)). Xiaoli explains, “My AI robot colleague Xiaozhi is using the recycling device to develop creative gadgets like keychains, earrings, and cell phone stand. The items are made from disposable materials such as plastic bottles used by customers. The process involves crushing, cleaning, hot melt compression and injection molding. The resulting creative gadgets (as shown in [Figure A4](#)) are provided to customers for free as souvenirs.” Xiaoli then shows you a brochure featuring pictures of various creative gadgets and ask you to choose one. She promises that it will be made and given to you when you leave.



Figure A3. AI robot Xiaozhi engaging in green creative behavior. Source(s): Authors' own work



Figure A4. Examples of creative gadgets. Source(s): Authors' own work

**Appendix 2**

The pictures used in the material of the low anthropomorphic AI robot employee condition.  
The pictures used in the material of the high anthropomorphic AI robot employee condition.



**Figure A5.** The low anthropomorphic AI robot engaging in green creative behavior. Source(s): Authors' own work



**Figure A6.** Examples of creative gadgets. Source(s): Authors' own work



**Figure A7.** The high anthropomorphic AI robot engaging in green creative behavior. Source(s): Authors' own work



**Figure A8.** Examples of creative gadgets. Source(s): Authors' own work

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