Prabandhan Darpan - Journal of Management Studies, *Volume 1 (Issue 2: May - August, 2025): Pages 1-10* *ISSN:3107-5983 (Online)*
Published on: September 29, 2025.

Prabandhan Darpan - Journal of Management Studies

Contents available at: *https://www.swamivivekanandauniversity.ac.in/jms/*

Unveiling Green Purchase Intention of Customers: Identifying the Influence of Autonomous Artificial Intelligence based Green Product, Static Green Products, and Privacy Concern

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Abstract

Everyone is considering digital process as an environmentally sustainable process for performing any activity. However, people are greatly concerned about how their data is being utilized. The general purpose of this study was to check the attitude of customers towards purchasing Artificial Intelligence (AI)-based green products while by presenting privacy concern as moderator. Companies are launching several AI based green products, such as automated room cleaning robots, application-based e-scooters, to improve environmental health. However, there is lack of exploration into the impact of AI-based green products on purchase intention, especially considering privacy concerns as a potential mediator. This necessitated the current study. Drawing upon signalling theory this study utilized both secondary and primary data. Primary data was collected from 237 respondents and based on convenience sampling method. The survey questionnaire, an ordinal scale, was developed based on the previous studies. Unlike static green product benefit, perceived autonomous AI-green product benefits significantly influence customers' willingness to engage in green purchasing behaviour and even privacy concern fails change this significant relationship between variables. The autonomous capabilities of AI in green products that can enhance consumer interest and drive purchase intention. Marketers must focus on communicating about green products by showing the environment sustainability because if customers are unaware then it will fail to develop favourable customer behaviour, as static features do not have a similar impact. This will also help the companies to mitigate the negative influence of privacy concern.

Keywords: *Artificial Intelligence, Green Products, Environmental Benefits, Green Purchase Intention, Perceived Benefits.*

1. Introduction

The limited resources available on Earth presently pose a significant challenge in meeting human needs, resulting in an imbalanced situation that demands a thoughtful and sustainable response (Acharya, 2021). Addressing this challenge requires the development of principles that not only cater to human needs but also uphold the quality of environmental health (Acharya, 2021). In response to this, innovative AI-based solutions have emerged, aiming to revolutionize traditional practices and effectively address critical social problems (Nishant et al., 2020). Scholars have emphasized that the true objective of AI lies in enhancing environmental sustainability (Nishant et al., 2020). The role of AI in shaping a sustainable future has become a focal point of research, recognized as a key area for investigation (Rezapouraghdam et al., 2021). Studies have explored AI's impact on environmental sustainability across various industries (Bao & Xie, 2022; Murugan et al., 2022), Various sectors are witnessing the integration of artificial intelligence (AI) to drive sustainable practices. This includes the implementation of AI in sustainable food production

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and delivery systems (Camar´ena, 2020; Marvin et al., 2022), optimizing energy usage for sustainability (Ahmad et al., 2021; Saheb et al., 2022), the advent of sustainable smart manufacturing (Y. Liu et al., 2020; Tucker, 2021), and the promotion of sustainable green marketing, encompassing green purchasing and AI-based decision aids (Bjørlo et al., 2021; Frank, 2021). Additionally, AI is playing a role in advancing sustainable transportation (Budak & Sarvari, 2021; Zhao et al., 2020). These diverse applications underscore the multifaceted impact of AI in fostering sustainability across various domains. Studies on AI have consistently demonstrated its potential to enhance the environmental sustainability of products across various industries. While numerous companies are incorporating AI to improve the environmental footprint of their offerings, there is a noticeable gap in the existing literature within the business domain. To date, there is a dearth of articles exploring the impact of AI-based green products on green purchase intention, especially considering privacy concerns as a potential mediator. Building on signaling theory, this study seeks to examine the green purchase intentions of customers regarding AI-based green products, with a particular focus on privacy concerns acting as a moderator.

2. Literature Review

The mechanisms connecting environmental sustainability and purchase intent, in a market, customers after evaluating different kinds of available products, they seek to buy a product which promises highest perceived value. Firms always try to maximize this perceived value by improving their product's benefits, both monetary and non-monetary (Babin and Harris, 2017). Unlike benefit like good quality related attributes, which focuses only on a single individual, the environmental sustainability of an offering provides benefit to both nature and society (Ottman, 2011). However, environmental sustainability had long been considered insignificant in measuring customer behavior. Gradual development of environmental concern has been changing this thought, for some scenarios, it may vary from actual environmental sustainability (Sen et al., 2006), on attitudes of customers and their intentions toward green products (Choi and Ng, 2011; Koller et al., 2011; Martínez and Del Bosque, 2013; Nyilasy et al., 2014).

To better understand these kinds of effect, in this study, scholars have utilized signaling theory. Signaling theory is focused on the usage of sustainable activities to signal desirable or undesirable features of a product or company (Herbas Torrico et al., 2018; Connelly et al., 2011; Spence, 2002). The major reason behind focusing on signaling theory is due to its focus on AI-based technology, which customers are receiving and experiencing positively (Hoyer et al. 2020). Firstly, a product emphasizing environmental sustainability signals that the company is morally superior. Consequently, customers develop a favorable attitude toward it (Koller et al., 2011; Martínez and Del Bosque, 2013). Secondly, environmental sustainability enhances trustworthiness among customers as it can be observed by them before making a purchase (Martínez and Del Bosque, 2013). Based on this trustworthiness the unobservable features, such as, how their data is being processed, can be translated into favorable attitude and behavior of customers towards the company (Herbas Torrico et al., 2018; Martínez and Del Bosque, 2013). Depending on this assumption, this study has adopted signaling theory (Connelly et al., 2011; Spence, 2002) for developing research premises.

In this research, overall environmental sustainability was divided into two parts. First, Perceived Static environmental Benefit (PSB) are generated from the design, production, and distribution processes of a product. The impacts from these activities cannot be measured beforehand. For instance, energy efficiency during product use, recyclability, and eco-friendly disposal methods contribute to the dynamic environmental impact on the effectiveness of these aspects depends on user choices and habits, reflecting a more interactive and ongoing influence on sustainability. Actually, this kind of benefit relates with the traditional approach of environmental sustainability and its impact is already known to customers (Choi and Ng, 2011; Koller et al., 2011; Martínez and Del Bosque, 2013; Nyilasy et al., 2014). Second, Perceived Autonomous environmental Benefit (PAB), it utilizes AI-enhanced products to predict environmental impacts, learn and find solution. Unlike static benefits, its benefit arises from utilisation and interaction with the environment. For instance, depending on the air quality of a room AI enabled air purifier acts. Alternatively, fitbits or smart-watches can analyse user's eating habit, movement and send notifications accordingly that can reduce environmental footprint.

3. Hypothesis

Based on signalling theory (Connelly et al., 2011; Spence, 2002), purchase intention and perceived environmental sustainability are positively related because such signals reflect the moral foundations of the company and help build

trustworthiness (Herbas Torrico et al., 2018). Over time, these signals enhance customers' perceptions of product quality (Koller et al., 2011; Martínez & Del Bosque, 2013), strengthen their association with the company (Martínez & Del Bosque, 2013), and increase their desire to use the product as a way of expressing their core values to society at large (Koller et al., 2011). Consequently, these factors collectively improve consumers' intention to purchase the product (Choi & Ng, 2011; Herbas Torrico et al., 2018; Koller et al., 2011; Martínez & Del Bosque, 2013; Nyilasy et al., 2014).

In developing this type of purchase intention, customer attitude towards the environment plays a significant role. For instance, Panda et al. (2020) found that customers develop their green buying motives based on their environmental attitudes. Similarly, Tsen et al. (2006) observed that customers with favourable environmental attitudes are willing to pay more for green products. When a product demonstrates environmental sustainability, customer behaviour is positively influenced (Huang et al., 2014; Chekima et al., 2016). Scholars such as Michaelidou et al. (2010), Fauzan and Azhar (2019), and Amoako et al. (2020) have also shown that environmental concern fosters green purchase intention.

In many cases, customers prefer to purchase environmentally friendly products (Lee, 2009; Mostafa, 2007), and their purchase intention is shaped by signals indicating sustainable practices (Li & Cai, 2012; Hanayasha, 2018; Sharma & Klein, 2020). Perceived environmental value refers to buyers' perceptions of a product's environmental impact (Ashton et al., 2010; Hänninen & Karjaluoto, 2017; Song et al., 2019). According to Chen and Chang (2012), perceived environmental value is a critical factor in determining green purchase intention (Koller et al., 2011). It reflects the willingness of customers to purchase products that provide environmental benefits (Al-Gasawneh & Al-Adamat, 2020; Suki & Suki, 2019; Ahmed & Zhang, 2020).

These discussions have presented the concept of environmental sustainability in a conventional sense, aligning with the static environmental benefits as per this study. It is plausible that a similar framework could be applied to autonomous environmental benefits associated with an AI-enhanced product. It can be possible that autonomous environmental benefits are more influential because the users have control over the autonomous behavior of AI-based product. As a result, its actions can reflect a stronger social signal about user's environment concern. For instance, if an AI-powered health app on a smartphone sends regular notifications encouraging users to adopt healthier eating habits, it may influence users to reduce consumption of unhealthy foods, contributing to sustainable development in both human well-being and the environment.

H1^{a}: Customer attitude towards Perceived Static (non AI-enabled) environmental Benefit (PSB) play a significant role in improving green purchase intention.

H1^{b}: Customer attitude towards Perceived Autonomous (AI-enabled) environmental Benefit (PAB) play a significant role in improving green purchase intention.

4. Moderating Role of Privacy Concern

Privacy concern and its consequential behavior has long been studied by variety of disciplines (Acquisti et al., 2015; Baruh and Popescu, 2017; Martin and Murphy, 2019). In case on AI-based technology, privacy concern is major hindrance that prevent customers to carryout favorable attitude (Cheng et al. 2022) it showed a significant negative impact on usage behavior (Vilmakumar et al., 2021). Angst and Agarwal (2009) and Buchanan et al. (2007) have also highlighted same finding. In addition, it was concluded that when customers have privacy concern they stop using those systems which requires their personal data. (Oseni et al. 2021) and this perception acts as major determinant of customer behavior (Lowry et al., 2012; Shah et al., 2014). There is always inverse relationship with privacy concern and customer behavior (Sun et al., 2015; Baruh and Popescu, 2017; Pomfret et al., 2020). However, the moderating role of privacy concern on green purchase intention is yet not disclosed. Another study concluded that customers behavior resulted out of privacy concern is greatly depends upon their attitude towards technology (Vilmakumar et al., 2021).

H2: Privacy concerns of customers playing a moderating role between Customer attitude towards perceived static (non AI-enabled) environmental benefits, Customer attitude towards perceived autonomous (AI-enabled) environmental benefits and green purchase intention.

The developed research premises or hypotheses, based on previous available studies, were applied to form the research model (Fig. 1). The model was empirically tested based on data collected through survey.

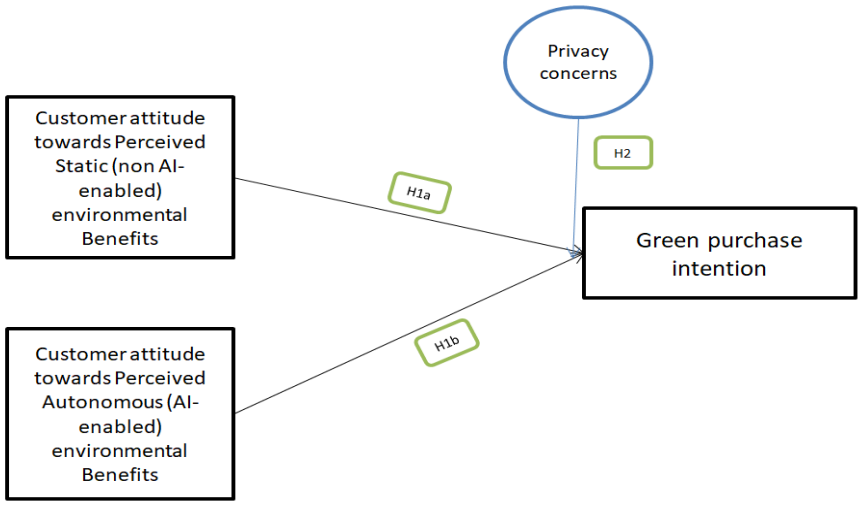

Figure 1: Proposed Research Model

5. Method of the Study

This study adopted a descriptive cross-sectional research design to examine the influence of customer attitudes towards perceived static (non–AI-enabled) and autonomous (AI-enabled) environmental benefits on green purchase intention, and to assess the moderating role of privacy concerns. Both primary and secondary data sources were utilised to ensure a comprehensive understanding of the research problem. Secondary data were gathered from academic journals, policy documents, and published reports relevant to artificial intelligence, green products, and consumer behaviour.

For primary data collection, a sample of 237 respondents was selected from the Kolkata region using a non-probability sampling technique. Data were collected through structured e-questionnaires, which employed an ordinal scale to measure the constructs of interest. The measurement scales were adapted from established studies to ensure reliability and validity (Mehta & Chahal, 2021; Chaubey et al., 2011; Costa et al., 2021; Adhitiya, 2019). The questionnaire consisted of sections covering demographic details, perceived static and autonomous environmental benefits, privacy concerns, and green purchase intention.

The research questions focused on understanding (a) the role of perceived environmental benefits (static and autonomous) in shaping green purchase intentions, and (b) whether privacy concern moderates these relationships. Correspondingly, the objectives were to analyse these relationships and to examine the moderating effect of privacy concerns. After data collection, the proposed research model was subjected to Confirmatory Factor Analysis (CFA) to validate the constructs and assess model fit. Subsequently, multiple regression analysis was conducted using IBM SPSS 25 and AMOS 23 to test the hypotheses and explore the relationships among variables. This systematic approach ensured methodological rigour and provided empirical evidence to address the research objectives effectively.

6. Data Analysis

Initially, a pilot survey was conducted to ensure the reliability of the data collection instrument. The obtained value confirms the scale's reliability, in line with the guidelines provided by Hair et al. (1998).

Table 4: Reliability Statistics

Cronbach's Alpha	N of Items
0.801	15

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.839
Bartlett's Test of Sphericity	Approx. Chi-Square	2417.339
	df	105
	Sig.	.000

To ensure the identification of items contributing to each existing construct, even in the context of green purchase intention of AI-products, an Exploratory Factor Analysis (EFA) was conducted. The EFA utilized Principle Component Analysis (PCA) with Varimax rotation. As shown in Tables 3-4, the collected data were deemed effective and acceptable for further factor exploration (Pallant, 2020). This analysis extracted 4 factors (Table 6), explaining 70.477 percent of the total variance. During the EFA, based on expert recommendations, factor loadings below .60 were suppressed. The extracted components were further explored using Confirmatory Factor Analysis (CFA) in AMOS 20.

Table 3: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.264	35.094	35.094	5.264	35.094	35.094	3.815	25.433	25.433
2	3.782	25.21	60.305	3.782	25.21	60.305	3.378	22.521	47.955
3	1.52	10.132	70.437	1.52	10.132	70.437	3.372	22.482	70.477

Table 4: Rotated Component Matrix[a]

	Component		
	1	2	3
PSB1		.701	
PSB2		.823	
PSB3		.884	
PSB4		.818	
PSB5		.676	
PAB1			.727
PAB2			.818
PAB3			.865
PAB4			.785
PAB5			.709
GP1	.839		
GP2	.835		
GP3	.909		
GP4	.907		
GP5	.881		
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 5 iterations.			
PSB-Perceived Static Benefit, and PAB- Perceived Automated Benefit			

The Confirmatory Factor Analysis (CFA) model was tested by loading all items onto their respective factors identified through EFA. Assessing model fit, convergent validity, and discriminant validity is essential before conducting Structural Equation Modelling (SEM). As shown in Table 5, all fit indices met the recommended thresholds (Hair et al., 1998). Convergent and discriminant validity were confirmed using Average Variance Extracted (AVE) and the square root of AVE (Table 6). In line with Hair et al. (2006) and Fornell and Larcker (1981), all statistical values were significant, supporting the adequacy of the model for SEM.

Table 5: Model Fit Measures

Model Fit indices	**GFI**	**CFI**	**SRMR**	**Pclose**	**RMSEA**	**CMIN/DF**
Values	0.917	0.957	0.051	0.08	0.049	2.740
Source: *Primary Data (using Gaskin and Lim 2006 Statistical tool package add-on for SPSS AMOS)*						

Table 6: Validity Checking							
	CR	**AVE**	**MSV**	**MaxR(H)**	**PSB**	**PAB**	**GP**
PSB	0.875	0.586	0.277	0.893	**0.765**		
PAB	0.862	0.614	0.277	0.898	0.526	**0.783**	
GP	0.918	0.738	0.010	0.940	0.007	-0.098	**0.859**

Table 7: Collinearity Statistics		
	Tolerance	VIF
PSB	0.261	3.538
PAB	0.318	3.141
GP	0.292	3.427

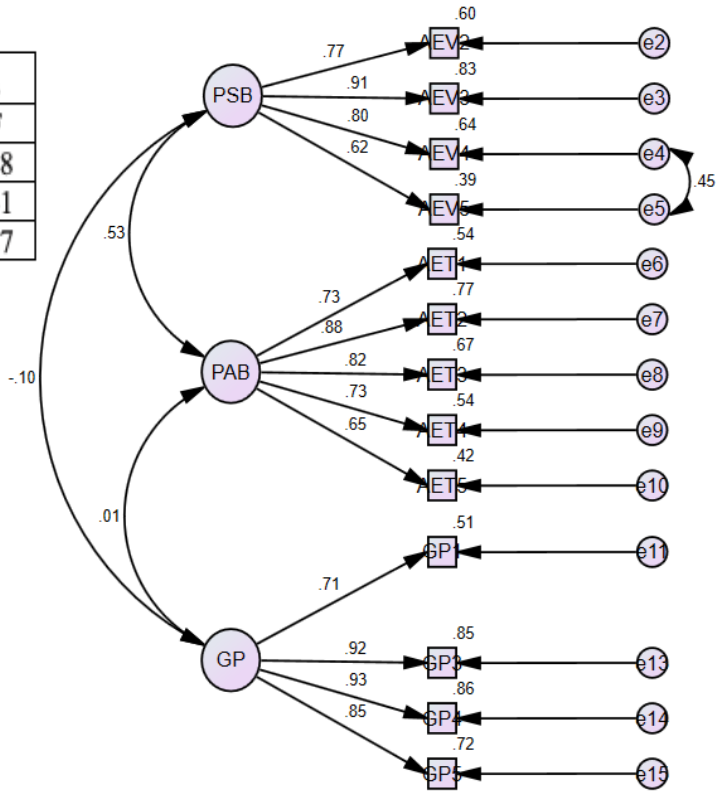

Figure 2: Modified model after checking validity and reliability

Variance Inflation Factor (VIF) Test

As per Hair et al. (1998), VIF measures the independence of regression coefficients' variance. VIF values ranging from 2.6 to 3.53 and tolerance values between 0.26 and 0.378 (Table 7) indicate that multicollinearity is not an issue in this study, aligning with acceptable thresholds.

Table 8: Regression Model for Testing of H1a and H1b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.959[a]	0.919	0.918	1.29973	0.919	580.500	4	204	0.000
a. Predictors: (Constant), PSB, PAB										
Model		Unstandardized Coefficients		Std. Coefficients	t	Sig.				
		B	Std. Error	Beta						
1	(Constant)	0.070	0.274		0.256	0.798				
	PSB	0.151	0.047	0.144	18.123	0.061				
	PAB	0.851	0.044	0.742	6.832	0.000				

The table displays results from a multiple regression analysis on independent variables— PSB (Perceived Static Benefit), PAB (Perceived Autonomous Benefit)—impacting the green purchase intention. The model, with an R-square of 0.919, is significant at a 95% confidence level. Notably, PAB has a significant influence on GP with std. B (0.742).

Table 9 regression model for moderator testing (H2)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.711[a]	0.506	0.505	12.76106	0.506	420.834	1	411	0
2	.769[b]	0.592	0.587	11.65902	0.086	21.342	2	407	0
a. Predictors: (Constant), GP									
b. Predictors: (Constant), PSB, PAB									

Table 9.1 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	18.385	2.068		8.8910	0
	PSB	01.464	0.071	0.711	20.514	**0**
2	(Constant)	10.124	2.276		4.4480	**0**
	PSB	0.3010	0.155	0.146	1.9370	**0.255**
	PAB	0.2080	0.160	0.115	1.3010	**0.043**

The table presents results from a moderating test, perceived concern, through a multiple regression analysis on independent variables—PSB (Perceived Static Benefit), PAB (Perceived Autonomous Benefit)—affecting green purchase intention. The model, with an R-square of 0.506 and 0.592 is significant at a 95% confidence level. Notably, this empirical model with privacy concern as a moderator reducing the statistical significance of the models but PAB is still having a significant relation with GP at std. B (0.115)

7. Conclusion

Study highlights the significant role of perceived benefits of autonomous AI products in shaping green purchase intention. Attitudes towards autonomous AI-product benefits positively influence consumers' willingness to engage in green purchasing, whereas attitudes towards static, non-AI product benefits do not exert a significant effect. The findings suggest that the dynamic and autonomous features of AI are more influential in promoting green purchase intention. Privacy concerns, examined as a moderating factor, were found to have no significant effect on this relationship, indicating that, in the context of environmental sustainability, such concerns do not substantially influence consumers' purchase intentions. From a theoretical perspective, the study contributes to signalling theory by demonstrating the differentiated impact of AI features on green purchase intention. Managerially, businesses can enhance consumer interest and drive adoption by emphasising the autonomous capabilities of AI in green products, while static features may have limited impact. The study has several limitations. Its findings are context-specific, limiting generalisability across markets and cultures, and replication in diverse contexts is recommended. Methodologically, reliance on prior literature may not fully capture AI-enabled green product dynamics, and other variables influencing green purchase intention were not considered. Additionally, the cross-sectional design restricts insights into how consumer perceptions and intentions evolve over time. Future research could address these limitations through longitudinal studies, experimental or qualitative approaches, and inclusion of additional variables to develop a more comprehensive understanding of consumer behaviour toward AI-based green products. These efforts will provide valuable guidance for researchers and practitioners in advancing sustainable consumption through AI innovations.

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