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THE INFLUENCE OF GREEN INNOVATION ON MILLENNIALS' ONLINE GREEN PURCHASE BEHAVIOR IN CHINA: THE MEDIATING ROLES OF WILLINGNESS TO PAY AND POSITIVE EMOTION

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Abstract

Objectives: This study aimed to examine the impact of green innovation on millennials' online green purchase behavior and explain the mediating mechanisms of willingness to pay and positive emotion underlying this effect. The research objective is to assess the influence of green innovation on millennials' green purchase behavior, and to explain the mediating role of willingness to pay and positive emotion between green innovation and online green purchase behavior. **Participants:** 341 millennials aged 28-40 with online green purchase experience in Guangdong Province, China participated in the study. Data was collected through an online survey questionnaire. **Study Method:** A cross-sectional quantitative study design was adopted. Participants completed a survey assessing green innovation, willingness to pay, positive emotion and online green purchase behavior. Data was analyzed using PLS-SEM to test the conceptual framework. **Findings:** Results showed green innovation positively predicted online green purchase behavior, willingness to pay and positive emotion. Additionally, willingness to pay and positive emotion positively affected online green purchase behavior. Further analyses confirmed the mediating roles of willingness to pay and positive emotion. **Conclusions:** The findings empirically validate green innovation's potential to motivate online green buying both directly and indirectly by triggering emotional affinity and willingness to pay premium for sustainable products. Practical and theoretical implications are discussed.

Keywords: Green Innovation, Willingness to Pay, Positive Emotion, Online Green Purchase Behavior.

1. INTRODUCTION

China's digital economy has grown rapidly in the past 10 years. By the end of 2022, China's digital economy has reached RMB 50.2 trillion, ranking second in the world and accounting for 41.5% of China's GDP. Online retailing continues to grow and has become an important driving force for consumption (National Bureau of Statistics, 2023). Environmental issues are closely related to consumer behavior. The concept of sustainable consumption emphasizing environmental protection and social responsibility has gained significant public attention (Quoquab & Mohammad, 2020). Particularly, *online platforms* provide great potential to promote green consumption among young demographics. Recent studies have shown that *online* consumers have realized that their purchase of eco-friendly products can help lessen negative environmental effects (Sh. Ahmad et al., 2022; Hussain et al., 2020). In China, over 70% of consumers claim that they are willing to pay more for sustainable products, which gives a great opportunity for online green brands and companies (British Chamber of Commerce in

The Seybold Report
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China, 2021). E-commerce Companies and online platforms like Alibaba and JD have applied various green innovations. They encourage green online brands to promote eco-friendly products. However, research shows that there are over 80% of Chinese online consumers claimed to support sustainable consumption, only less than 20% of this group of consumers actually have the purchase behavior (Dong et al., 2020). Hence, to bridge the intention-behavior gap, it is imperative to investigate the factors influencing online green purchase behavior.

Scholars have researched extensively on factors influencing online green purchase intention, such factors covers from corporate green innovation to perceived consumer effectiveness (Chang, 2019; Li et al., 2018; Xie et al., 2019). However, there remains a dearth of research explaining actual green buying behavior, beyond mere intention (Sammer & Wüstenhagen, 2006). Moreover, the mechanisms underlying green innovation's influence on *online* green purchases have yet to be clearly explicated (Oltra & Saint Jean, 2009). Therefore, this study establishes a framework examining how corporate green innovation shapes *online* buying behavior via two mediators-willingness to pay and positive emotion. The novelty of this research is to investigate the relationship between firm's green innovation and consumers' *online* green purchase behavior, offering a more holistic theoretical model encompassing both rational utility factor like willingness to pay and affective factors like positive emotion to interpret online green buying decisions. This study aims to close the gap between consumers green attitude and behavior by a holistic framework with quantitative study in increasing *online* consumer's green purchase behavior in China. Thus, the research objective is to assess the influence of green innovation on millennials' green purchase behavior, and to explain the mediating role of willingness to pay and positive emotion between green innovation and millennials' online green purchase behavior. The research questions thus proposed as follows:

Research question 1: How is the level of green innovation influencing millennials' online green purchase behavior?

Research question 2: What is the mediating role of willingness to pay and positive emotion between green innovation and millennials' online green purchase behavior?

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Individuals' green purchase behavior can significantly reduce the negative effect of consumption on the environment (Kumar, 2022). Yadav and Pathak (2017) used the theory of planned behavior to examine determinants of green purchase decisions. Their findings revealed that environmental knowledge and perceived effectiveness of green purchases positively influenced consumers' intention to buy green products.

By highlighting psychological factors impacting green consumer choices, this study contributes key insights on promoting sustainable consumption. Additionally, Rahmi (2017) applied green brand image concepts to investigate predictors of green purchase intention and behavior. The results demonstrated green advertising, brand image, and environmental knowledge as antecedents explaining consumers' willingness to pay premium prices for eco-friendly creative industry goods.

The Seybold Report
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Moreover, Geng et al. (2017) conducted a meta-analysis with over 80 studies. The research shows evidence on the relationship between green supply chain management and performance. Their findings proved that business benefits such as market share expand and cost savings could be achieved by implementing green organizational strategies.

2.1 Online Green Purchase Behavior

Online green purchase behavior refers to consumers adoption of green products while shopping online. In some scholars research, this concept covers consumers decision-making process while shopping green products online. There are five stages including green need recognition, information search, alternatives evaluation, sustainable purchase decision, and post-purchase assessment (Mican & Sitar-Taut, 2020; Quoquab & Mohammad, 2020).

When green consumers are shopping online, they care about the environmental issues, searching for the green brands and eco-friendly products. By purchasing green products, they help reduce resource waste and support environmental protection goals.

The green purchase behavior in this study is based on the consumer decision making model originally proposed by Engel, Blackwell and Miniard (1986). This model describes consumers' decision process as consisting of five key stages - need recognition, information search, evaluation of alternatives, purchase decision and post-purchase behavior.

While this model initially applied for traditional product purchases, it has been widely adopted in research on consumer decision-making across contexts, including green product purchase (Sreen et al., 2018).

As the model shows, purchase behavior comprises a complex process with multiple phases - from problem recognition to purchase outcomes. Various internal and external variables interact across these stages. In case of online green purchase behavior, factors like environmental knowledge, green innovation, willingness to pay and emotions determine consumers' choice and purchase preference.

2.2 Green Innovation

Scholars have defined green innovation in various ways. Fussler and James (1996) defined it as the development of new products and processes that increase customer and public value while reducing environmental harm. Kemp and Pearson (2007) described green innovation as organizational innovations in products, processes, management or business models that reduce environmental risks and improve resource efficiency.

In this study, green innovation is defined as the innovative process where a green business implements product, marketing, process innovations that meet consumer needs, meanwhile reducing ecological impacts across the full product lifecycle.

This involves developing innovative green products, applying eco-friendly technologies and conveying ecological marketing strategies to promote sustainability (Schiederig et al., 2012). Some studies highlight that corporate green innovation positively motivates consumers' online sustainable purchase behavior. For instance, Ar's (2012) findings showed green product and

The Seybold Report
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process improvements enhanced firms' capacity to satisfy customer environmental demands, indirectly stimulating green buying intentions. Similarly, Li et al. (2018) demonstrated technology and management green innovations increased preference of environmentally conscious purchases. Hence the hypothesis is proposed as followed:

H1: Green innovation positively influences online green purchase behavior.

2.3 Willingness to pay

Willingness to pay refers to the extra amount of money that consumers are willing and able to pay for a product or service (Vecchio & Annunziata, 2015). This concept indicates the preferences for a good or service (Yadav et al., 2019).

In this research, willingness to pay is defined as the extra amount of money consumers are willing to pay for green products or services. The theoretical support of willingness to pay is the theory of utility maximization (Marshall & Guillebaud, 1961). It proposes that consumers calculate their purchases with the purpose of getting maximum satisfaction with limited budget.

Willingness to pay represents the price that maximize consumer utility for green products. The environmental benefits and emotional values from green products will increase consumer utility, thus consumers are more willing to pay premiums.

Whether consumers are willing to pay extra price for the green products affects the companies adoption of green innovation (Chen & Chang, 2013). Studies prove that green innovation in product designs, packaging or marketing activities stimulates consumers' willingness to pay premiums for innovative and eco-friendly products (Barbarossa & De Pelsmacker, 2016; Iweala et al., 2019). Hence the hypothesis is proposed as followed:

H2: Green innovation positively influences willingness to pay for green products

Consumers willingness to pay premium price for green products means they are ready to take greater cost to get sustainable products (Jung et al., 2021; Yadav et al., 2019). Research shows higher willingness to pay for items with eco-labels or green brands increase the sales of green products, especially in online occasions (Barbarossa & De Pelsmacker, 2016; Sammer & Wüstenhagen, 2006). Hence the hypothesis is proposed as followed:

H4: Willingness to pay for green products positively influences online green purchase behavior

Green innovation impacts purchase intentions and increase sales of eco-friendly goods through affecting the consumers willingness to pay (Chen & Chang, 2013). This implies WTP mediates green innovation effects on online green purchasing.

Some studies confirm willingness to pay premiums transmit positive impacts of green product or process innovation onto green purchase behavior (Barbarossa & De Pelsmacker, 2016; Zhang et al., 2023). Hence the hypothesis is proposed as followed:

H6: Willingness to pay for green products mediates the relationship between green innovation and online green purchase behavior

The Seybold Report
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2.4 Positive Emotion

Positive emotions refer to pleasant psychological states characterized by positive affect, life satisfaction, and well-being (Fredrickson, 1998; Wadlinger & Isaacowitz, 2006). Researchers define positive emotions as subjective experiences promoting behavioral engagement and goal achievement (Williams & DeSteno, 2008). In environmental psychology, positive emotions like moral satisfaction help form pro-environmental attitudes and behaviors which is critical for sustainability (Fredrickson, 1998). This research applies the cognition-affect-behavior model analyzing how consumers' positive emotions toward green products influence online purchase intentions (Quoquab & Mohammad, 2020). The cognition-affect-behavior model postulates that environmental behavior is determined by an individual's cognitive factors, affective variables and conative drivers (Quoquab & Mohammad, 2020). Cognitive aspects cover environmental knowledge, values and beliefs that shape attitudes. Affective factors include emotional affinity and attachments with nature. Conative drivers refer to intentions, willingness and plans to act pro-environmentally. This study applies the cognition-affect-behavior framework analyzing the cognitive, emotional and motivational factors influencing green purchase.

Positive emotion includes three key dimensions - warm glow, green trust and emotional affinity to nature. Warm glow means the emotional satisfaction derived from green purchases viewed as moral deeds (Andreoni, 1990). Consumers obtain this positive affect through feeling that they contribute to environmental protection by buying eco-friendly products. Green trust refers to the confidence and trust that consumers place in environmental claims and performance of sustainable goods (Y.-S. Chen, 2010). Higher green trust engenders positive attitudes, reducing worries about product quality. Emotional affinity toward nature describes individuals' affectionate bonds with the natural world (Kals et al., 1999). Stronger emotional connections with nature make people more likely to consider environmental impacts in purchase decisions.

Innovations that allow consumers to experience sustainability benefits can also increase their trust in the green claims and eco-friendly properties of innovative products. Research by Barbarossa et al. (2017) showed perceived eco-innovativeness of electric cars heightened positive emotions by reinforcing consumers' green self-identity. Hartmann and Apaolaza's (2012) study also determined eco-innovations like green energy devices increased positive emotions via enhancing consumers' confidence in environmental performance. Therefore, green innovations that provide observable sustainability improvements or allow realization of green goals can stimulate favorable emotions. Hence the hypothesis is proposed as followed:

H3: Green innovation positively influences positive emotion toward green products

Empirical evidence demonstrates the positive emotions of warm glow and green trust directly and significantly increase consumers' intentions and willingness to purchase environmentally sustainable products. For instance, Wang et al. (2022) determined appeal-induced discrete positive emotions expanded choices of green over conventional items. De Sio et al.'s (2022) research also showed green trust stemming from verifiable sustainability claims expanded online buying. Dong et al. (2020) provided corroborating evidence of mediation between nature

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affinity and web-based green purchases. Hence the hypothesis is proposed as followed:

H5: Positive emotion toward green products positively influences online green purchase behavior

Positive emotions represent mediating mechanisms in the chain linking green innovation introduction to market success. Barbarossa et al.'s (2017) study determined green product perceptions by eco-innovations accelerates online car buying through emotional self-appraisals and green satisfaction. Chen and Chang (2012) proved green trust and value perception mediate green innovation influences on online green retail purchases. These findings logically indicate full mediation between green innovation evoked positive emotions as mediator, and consumer adoption via online transactions. Hence the hypothesis is proposed as followed:

H7: Positive emotion toward green products mediates the relationship between green innovation and online green purchase behavior

2.5 Conceptual Framework

This study intends to use a quantitative method, to investigate how firm's green innovation influence consumer's online green purchase behavior through the mediating variables of willingness to pay and positive emotion. By establishing a structural equation model, the study aims to assess the influence of green innovation on millennials' green purchase behavior in Guangdong Province in China. The relationship between constructs and the proposed hypothesis based on the above discussion is represented in Figure 1.

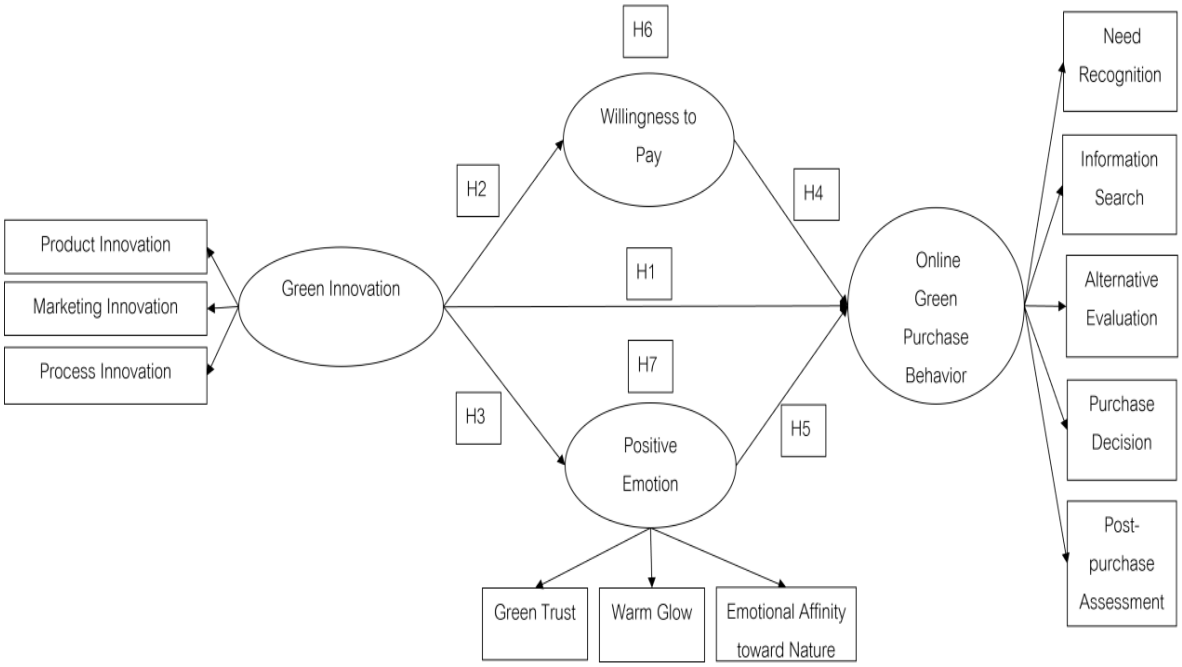

Figure 1: Conceptual Framework

The Seybold Report
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3.METHOD

To examine the millennials' online green purchase behavior, a cross-sectional research has been employed with quantitative study. It is a type of observation design that describe the general situation for the targeting population at one point of time (Lavrakas, 2008).

3.1. Research instrument and data

A multiple-item questionnaire was used as a survey instrument in this quantitative study. Individuals aged 28-40 with online green purchase behavior in the past 12 months living in Guangdong Province were the target population of data collection. Millennials were chosen as research subjects due to their dominance among eco-conscious Chinese online consumers. Guangdong Province was selected given its pioneering role in green transformation under national sustainable development initiatives. Over 80% of Guangdong urban residents shop online (British Chamber of Commerce in China, 2021), facilitating recruitment through e-commerce sites. PLS-SEM was utilized for data analysis. Compared to covariance-based SEM, PLS-SEM is more suitable for exploratory research focused on predicting key target constructs and testing new hypothesized relationships (Hair et al., 2011; Sarstedt et al., 2014). Given this study's objectives of examining and predicting how green innovation, willingness to pay and positive emotions influence millennials' online green purchases, PLS-SEM was selected.

The total number of the green product consumer in Guangdong Province is difficult to estimate, so the population of the sample is unknown number. Therefore, the author uses the formula of population by Hair et al. (2011).

According to the minimum sample size principle of Hair et al. (2011), PLS-SEM minimum sample size should be equal to the larger of the following: (1) ten times the largest number of formative indicators used to measure one construct or (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model. To ensure more reliable result of this research, the sample size of 350 people will be sought taking into account the practical and feasible options for research.

The multi-section survey questionnaire was administered to 350 millennials aged 28-40 in Guangdong Province, China using a leading survey platform, Wenjuanxing. Customized sampling criteria ensured all respondents represented the target research population on key characteristics of age, location and eco-brand purchase experience.

Capturing data from a single green brand's consumers controlled firm-level variability. 9 likely invalid responses were removed that exhibited acquiescence bias. The final analytical sample of 341 millennials meets minimum requirements for PLS-SEM models. This filtered dataset enabled robust quantitative evaluation of the theorized framework linking green innovation, willingness to pay and positive emotions to millennials' online green purchasing behavior.

In Table 3.1 the demographic profile of respondents shows a slight majority were female (53.1%), with the most common age group being 31-35 years (49.6%). Over 60% held a bachelor's or associate's degree, and the largest industry representation came from public service (31.4%), followed by finance (28.7%). In terms of income distribution, the biggest

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segment earned RMB 5,001-10,000 monthly (46.6%), and all 341 participants had online green purchase experience in the past year.

Table 3.1: Demographic profile

Demographic Items		Frequency	Percent %	Cumulative Percent %
GENDER	Male	160	46.9	46.9
	Female	181	53.1	100.0
AGE	28-30	101	29.6	29.6
	31-35	169	49.6	79.2
	36-40	71	20.8	100.0
EDUCATION	High School or Lower	102	29.9	29.9
	Bachelor's Degree or Associate's Degree	211	61.9	91.8
	Master's Degree or Higher	28	8.2	100.0
INDUSTRY	Manufacturing	62	18.2	18.2
	Retail	74	21.7	39.9
	Finance	98	28.7	68.6
	Public Service	107	31.4	100.0
INCOME	<RMB3,000	31	9.1	9.1
	RMB3,001-5,000	102	29.9	39.0
	RMB 5,001-10,000	159	46.6	85.6
	>RMB10,000	49	14.4	100.0
PURHCASER	Yes	341	100.0	100.0
	No	0	0.0	0.0

3.2. Measures

Scales validated from the literature have been deployed in this study, and the description is detailed under Table 3.2. The green innovation variable consists of 3 dimensions - marketing innovation, product innovation and process innovation. The measures for these dimensions are adapted from various researchers including Chen (2008), Chen et al. (2006, 2021), Ar (2012), Awan et al. (2021), and others.

The willingness to pay measures are adapted from researchers such as Lestari & Nita (2021), Ghali (2020), Yadav & Pathak (2017), and Tang & Lam (2017). The items assess consumers' willingness to pay premium prices for green products.

The positive emotion variable includes 3 dimensions - warm glow, green trust and emotional affinity toward nature. The warm glow measures are adapted from Birgit (2019), Iweala et al. (2019), Hartmann et al. (2017) and others. The emotional affinity measures are adapted from Müller et al. (2009), Dong et al. (2020), and Taufique (2022).

The online green purchase behavior variable consists of 5 dimensions - need recognition, information search, alternative evaluation, purchase decision and post-purchase assessment. The measures for these scales are adapted from researchers like Garcia-Salirrosas & Rondon-Eusebio (2022), Chen et al. (2020), Hosseinikhah Choshaly (2019), Rausch & Kopplin (2021), Narsis (2023) and others.

The Seybold Report
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Table 3.2: Measurement

Variable	Dimensions	Items	Researchers/Year
Green Innovation	Marketing Innovation (MI)	MI01/MI02/MI03/ MI04/MI05	Sari & Indriani, 2022; L. Chen et al., 2021; Anning-Dorson, 2017; Hussain et al., 2020; R. Lee et al., 2019; Nieves & Diaz-Meneses, 2016
	Product Innovation (PdI)	PdI01/PdI02/PdI03/ PdI04/PdI05	Y.-S. Chen, 2008; Y.-S. Chen et al., 2006; J. Chen & Liu, 2020; Begum et al., 2022; Ar, 2012; Chiou et al., 2011; Awan et al., 2021
	Process Innovation (PcI)	PcI01/PcI02/PcI03/ PcI04/PcI05	Awan et al., 2021; L. Chen et al., 2021
Willingness to Pay (WTP)		WTP01/WTP02/WTP03/WTP04/WTP05/WTP06/WTP07/WTP08/WTP09/WTP10	Lestari & Nita, 2021; Ghali, 2020; Yadav & Pathak, 2017; Tang & Lam, 2017
Positive Emotion	Warm Glow (WG)	WG01/WG02/WG03/WG04/WG05	Birgit, 2019; Iweala et al., 2019; Hartmann et al., 2017; Hartmann & Apaolaza-Ibáñez, 2012
	Green Trust (GT)	GT01/GT02/GT03/ GT04/GT05	Nekmahmud et al., 2022; Sultana et al., 2022; Sh. Ahmad et al., 2022; Amin & Tarun, 2021; Y. Chen & Chang, 2012
	Emotional Affinity toward Nature (EAN)	EAN01/EAN02/EAN03/EAN04/EAN05	Müller et al., 2009; Dong et al., 2020; Van Tonder et al., 2020; Taufique, 2022
Online Green Purchase Behavior (Online GPB)	Need Recognition (NR)	NR01/NR02/NR03/ NR04/NR05	García-Salirrosas & Rondon-Eusebio, 2022; Zameer & Yasmeen, 2022
	Information Search (IS)	IS01/IS02/IS03/IS04/IS05	C. Haridasan et al., 2021
	Alternative Evaluation (AE)	AE01/AE02/AE03/ AE04/AE05	Y.-S. Chen et al., 2020; Hosseinikhah Choshaly, 2019
	Purchase Decision (PD)	PD01/PD02/PD03/ PD04/PD05	Rausch & Kopplin, 2021; Narsis, 2023; Qureshi et al., 2023; K. Lee, 2010
	Post-purchase Assessment (PA)	PA01/PA02/PA03/ PA04/PA05	Birgit, 2019; Suhartanto et al., 2021

4. DATA ANALYSIS AND RESULT

The data analysis is carried by SmartPLS 4.0 using PLS-SEM for hypothesis testing with measurement model assessment and structural model assessment. Predictive capabilities were also demonstrated using PLSpredict procedures.

The Seybold Report
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4.1. Assessment of the measurement model

Internal consistency reliability and Convergent validity

According to Hair et al. (2017), the acceptable threshold for Cronbach's alpha and composite reliability is 0.70. As seen in Table 4.1, the Cronbach's alpha and composite reliability (both rho_a and rho_c) values for all the variables exceed 0.70, indicating adequate internal consistency reliability.

Convergent validity is assessed using AVE. An AVE value of 0.50 or higher indicates adequate convergent validity (Hair et al., 2017). As per Table 4.1, the AVE values for all the variables are greater than 0.50. Specifically, green innovation has an AVE of 0.638, online green purchase behavior has an AVE of 0.625, positive emotion has an AVE of 0.651 and willingness to pay has an AVE of 0.629. Thus, there is evidence of adequate convergent validity for all the variables.

Table 4.1: Reliability and Convergent Validity

Variable	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Green Innovation	0.959	0.96	0.964	0.638
Online GPB	0.975	0.976	0.977	0.625
Positive Emotion	0.962	0.962	0.965	0.651
WTP	0.934	0.937	0.944	0.629

Discriminant Validity - Fornell-Larcker Criterion

According to Fornell and Larcker (1981), discriminant validity is established if the square root of the average variance extracted (AVE) of each variable is greater than the correlations between that variable and all other variables. As seen in Table 4.2, the square root of AVE (diagonal values) are all greater than the corresponding correlations between the variables. The square root of AVE for green innovation is 0.799. The square root of AVE for online GPB is 0.791. The square root of AVE for positive emotion is 0.807. The square root of AVE for WTP is 0.793. All are greater than their highest correlation with any other variable.

Table 4.2: Discriminant Validity - Fornell-Larcker Criterion

Variable	Green Innovation	Online GPB	Positive Emotion	WTP
Green Innovation	0.799			
Online GPB	0.451	0.791		
Positive Emotion	0.429	0.389	0.807	
WTP	0.389	0.371	0.410	0.793

4.2. Assessment of structural model

Multicollinearity

According to Kock (2015), multicollinearity should be examined in any path model containing two or more independent variables influencing the same dependent variable. A common cutoff threshold is a VIF value of 5. That is, VIFs exceeding 5 indicate a potential collinearity issue (Hair et al. 2017).

The Seybold Report
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In the result, the highest VIF value is 1.342 for online GPB. All other VIF values are below 1.4. Since no VIF value exceeds the threshold of 5, it can be concluded that there are no critical issues with multicollinearity in the model (Kock, 2015). As in Table 4.3, the result of construct VIF is also satisfactory.

This suggests the variables are sufficiently independent from each other, allowing their individual effects on willingness to pay and online GPB to be adequately estimated in the model.

Table 4.3: Construct VIF

	Online GPB	Positive Emotion	WTP
Green Innovation	1.316	1.000	1.000
Online GPB			
Positive Emotion	1.342		
WTP	1.291		

Evaluation of Direct Effects

To evaluate the significance of the direct effects, the bootstrapping method was applied (Hair et al., 2017). Effects with t-values above 1.96 are considered significant at $p < 0.05$. As seen in Table 4.4, all hypothesized direct relationships have t-values above 1.96, demonstrating significance at $p < 0.05$.

Specifically, green innovation has a positive direct effect on online GPB ($\beta = 0.451$, $t = 10.469$, $p < 0.001$), a positive direct effect on positive emotion ($\beta = 0.430$, $t = 10.203$, $p < 0.001$), and a positive direct effect on WTP ($\beta = 0.391$, $t = 8.772$, $p < 0.001$).

Additionally, positive emotion ($\beta = 0.187$, $t = 3.417$, $p = 0.001$) and WTP ($\beta = 0.177$, $t = 3.305$, $p = 0.001$) positively influence online GPB. Thus, H1, H2, H3 H4 and H5 are supported.

Table 4.4: Hypothesis Test - Direct Effects

Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Results
H1: Green Innovation -> Online GPB	0.451	0.454	0.043	10.469	0.000	Supported
H2: Green Innovation -> WTP	0.391	0.394	0.045	8.772	0.000	Supported
H3: Green Innovation -> Positive Emotion	0.430	0.434	0.042	10.203	0.000	Supported
H4: WTP -> Online GPB	0.177	0.177	0.054	3.305	0.001	Supported
H5: Positive Emotion -> Online GPB	0.187	0.188	0.055	3.417	0.001	Supported

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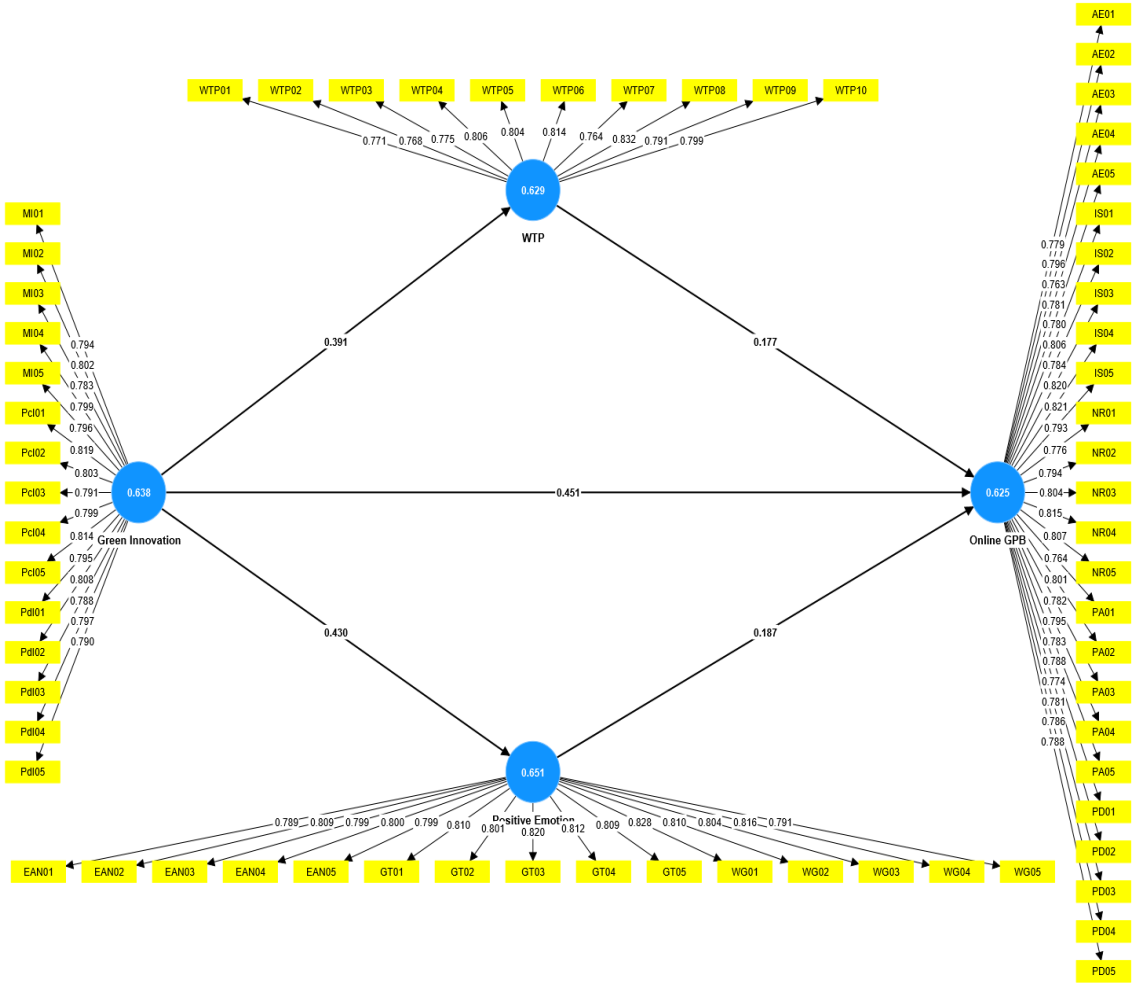

Figure 2: Hypothesis Testing

Evaluation of Mediating Effects

To assess the significance of the indirect effects, a bootstrapping procedure with 5,000 subsamples was applied. Mediation is established if the indirect effect is significant and the direct effect between the independent and dependent variables becomes insignificant or demonstrates substantially reduced effects after the inclusion of mediators (Hair et al., 2017).

As shown in Table 4.5, the indirect effects of green innovation on online GPB through positive emotion ($\beta = 0.081$, $t = 3.150$, $p = 0.002$) and through WTP ($\beta = 0.069$, $t = 3.093$, $p = 0.002$) are significant. This provides support for partial mediation effects via H6 and H7.

The Seybold Report
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Table 4.5: Hypothesis Test - Mediating Effects

Hypothesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Results
H6: Green Innovation -> WTP -> Online GPB	0.069	0.070	0.022	3.093	0.002	Supported
H7: Green Innovation -> Positive Emotion -> Online GPB	0.081	0.082	0.026	3.150	0.002	Supported

R^2 measures the proportion of variance in the dependent variable that can be explained by the independent variables (Hair et al., 2017). Values range from 0 to 1, with higher values indicating more explanatory power. The adjusted R^2 accounts for the number of independent variables and sample size to provide a more conservative estimate. As shown in Table 4.6, the R^2 values for Online GPB, Positive Emotion, and WTP are 0.275, 0.185, and 0.153 respectively. This indicates that 27.5% of the variance in Online GPB is explained by the independent variables. While relatively low, these values are adequate for an exploratory social science study (Hair et al., 2011).

Table 4.6: R^2

	R-square	R-square adjusted
Online GPB	0.275	0.268
Positive Emotion	0.185	0.183
WTP	0.153	0.150

Effect Size

F^2 evaluates whether an independent variable has a substantive impact on a dependent variable (Henseler et al., 2015). Values of 0.02, 0.15, and 0.35 signify small, medium, and large effects respectively. As shown in Table 4.7, Green Innovation has small-medium F^2 effects on Online GPB, Positive Emotion, and WTP. This confirms that Green Innovation has a substantive impact on these variables in the model.

Table 4.7: Effect Size - F^2

	Online GPB	Positive Emotion	WTP
Green Innovation	0.095	0.227	0.180
Online GPB			
Positive Emotion	0.036		
WTP	0.034		

Predictive Relevance - Q^2

Q^2 indicates how well the data collected empirically can be reconstructed with the help of the model and parameter estimates (Hair et al., 2019). Values larger than zero suggest the model has predictive relevance.

As shown in Table 4.8, Q^2 values for all endogenous constructs are considerably larger than zero, ranging from 0.537 to 0.596. This provides support for the model's predictive relevance regarding the dependent variables.

The Seybold Report
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Table 4.8: Predictive Relevance - Q^2

	SSO	（SSE）	Q^2 (=1-SSE/SSO)
Green Innovation	5115	2137.805	0.582
Online GPB	8525	3505.971	0.589
Positive Emotion	5115	2063.973	0.596
WTP	3410	1579.764	0.537

5. DISCUSSION

Summary of Main Findings

This study developed and tested a conceptual framework analyzing how green innovation influences millennials' online green purchase behavior, with willingness to pay and positive emotion as mediating roles. The results provide strong empirical support for the hypothesized relationships. Green innovation demonstrated significant positive direct effects on online purchase behavior (β=0.451, $p<0.001$), willingness to pay (β=0.391, $p<0.001$), and positive emotion (β=0.430, $p<0.001$).

Additionally, willingness to pay (β=0.177, $p=0.001$) and positive emotion (β=0.187, $p=0.001$) positively predicted online buying. Further analysis confirmed the mediating roles of willingness to pay and positive emotion. Green innovation had indirect effects on purchase behavior through willingness to pay (β=0.069, $p=0.002$) and positive emotion (β=0.081, $p=0.002$). Thus, H1-H7 were fully supported.

The results highlight green innovation's potential, both directly and indirectly, to promote millennials' adoption of sustainable online retail.

Theoretical and Practical Contributions

This research enriches understanding of which way organizations can leverage green innovation to shape consumer decisions and drive online eco-buying. The findings demonstrate green innovation's multiple impacts - it directly enables adoption while also triggering emotional and rational processes that provide added impetus for purchases. Moreover, this study fills a gap by examining green innovation's effects on actual buying behavior. Much research has focused on behavioral intentions rather than realized market transactions (Sammer & Wüstenhagen, 2006).

The results provide novel quantitative insights on converting green feelings into online retail sales. For practice, the research guides e-commerce firms on bundling hardware innovations with emotional messaging and tactical pricing to most effectively capture environmentally conscious market segments. It provides a roadmap for startups on directing innovative capabilities toward the most impactful levers in virtual green commerce.

Limitations and Future Research

This study has several limitations that provide avenues for future research. First, the sample consisted solely of millennials in one Chinese province. Additional samples covering wider demographics and regions would improve generalizability.

The Seybold Report
ISSN 1533-9211
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Second, self-reported data may incorporate bias. Incorporating actual sales data could increase validity. Third, cross-sectional analysis offers only a snapshot. Longitudinal tracking of innovation and consumer metrics could provide richer dynamic insights.

Building on this research, promising directions include examining moderating effects of demographic factors like gender or income on relationships in the framework. Additionally, comparing innovation's emotional and rational drivers across cultures would provide useful practical insights. Finally, developing enhanced models incorporating additional variables like social influence could further advance understanding of complex decision-making pathways shaping online eco-consumption.

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