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The Moderating Effect of Green Advertising on the Relationship between Gamification and Sustainable Consumption Behavior: A Case Study of the Ant Forest Social Media App

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Abstract: The end of the twentieth century saw increased research on sustainability issues, particularly consumer consumption patterns and their environmental impact. As consumers become more aware of the need to shift consumption habits toward green initiatives, a broader set of methods encouraging sustainable living should be sought. Due to the popularity of gamification in apps and other technology-related solutions, little research has been conducted to investigate gamification and advertising as a strategy to promote sustainable consumption. Using convenience sampling, this study surveyed 305 Ant Forest app users to investigate the relationship between gamification, perceived enjoyment, and sustainable consumption while observing green advertising as a moderating effect. The findings show that green advertising does not moderate gamification experience or perceived enjoyment but does moderate perceived enjoyment and sustainable consumption. Given that the study samples were university students, it is surprising to learn that gamification and green advertising have no relationship, thus denying the gamification experience to encourage sustainable behavior among China's youth. As a result, marketers pursuing green initiatives should keep this impactful result in mind when implementing gamified features in user-experience apps. Gaming is seen uniquely for pleasure and enjoyment, not for creating behavioral change and awareness.

Keywords: green advertising; gamification; sustainable consumption behavior; ANT Forest; China's youth; social media

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1. Introduction

The environmental risks posed by climate change can be mitigated by reducing carbon emissions, which is an important goal of the Paris Agreement [1]. To achieve this goal, it is essential that stakeholders drive technology and regulation to pursue sustainable production and bring sustainable goods and services to the market while also encouraging behavioral changes that benefit the environment [2]. Although consumers recognize and have shown a willingness to protect the environment, green consumption behaviors still encounter obstacles. There is a significant "green gap" between consumers' attitudes and intentions and their actual consumption behaviors [3]. To bridge this gap, green advertising can be effective in specific population segments and promote sustainable consumption in cross-cultural contexts [4]. However, existing sustainability research has paid little attention to advertising strategies that can help bridge the green gap [5]. In addition, gamified advertising featuring interactivity and game-like functions is gradually gaining attention from marketing researchers [6]. The complexity of advertising games as a growing non-traditional type of media also means the research is still in its infancy [7].

In today's dynamic and disruptive digital marketplace, gamification and social user management enabled by technological advancements are influencing marketing strategies [8]. Adding brand messages to the digital game has become an increasingly common

advertising strategy for well-known brands [7]. With the popularization of the sharing economy, big data, and artificial intelligence, sustainable development production and services are changing and are becoming more focused on promoting the sustainable consumption behavior of the masses [9,10]. Research has shown that green advertisements can effectively convey green information to consumers and affect their perception of green products [11]. Therefore, an interactive gamification experience can increase consumer engagement and motivation under the influence of green advertising [12].

According to previous studies, gamified green advertising is suitable for the following scenarios: (1) the gamified explanation has an impact on customers in terms of environmental knowledge, attitudes, and behaviors [13]; (2) the contextual cues of advertising games have impacts on consumers' brand memory and brand attitude [14]; (3) the mood swings brought about by gamified advertising interaction can enhance the effective emotional experience for consumers [15].

In recent research, youth refers explicitly to young people born between 1995 and 2012 as a group of digital natives who are well aware of the technological revolution [16]. China's youth are self-expressive, confident, adventurous, and take pride in their values [17]. They have the strongest consumption motivation [18], they understand sustainable living, and they prioritize purchasing green products more than other generations [19]. The youth population in China is approximately 280 million and is considered the most influential group in sustainable consumption [18]. The youth have shown great interest in social media and mobile games, and their interaction is the basis for driving young consumers' additional consumption motivation [20]. Combined with social media strategies, gamification strategies can satisfy the basic needs of autonomy, competence, and relevance to stimulate intrinsic motivation in users [21].

The global digital game industry's rapid growth provides substantial corporate marketing opportunities. The potential and effectiveness of in-game advertising have also attracted greater attention from the academic community [22]. The huge potential of the gaming market and the gradual weakness of traditional advertising have produced a gap in research that identifies the most effective strategies for integrating advertising in digital games [23].

The survey results in this study reveal that most game users agree that adding interactive advertisements to virtual games is necessary to help players fulfil every fantasy requirement. Young peoples' attitudes toward play revolve around how brands can help them pursue their dreams [24]. Repeated in-game exposure to ads can strengthen user recall and recognition, attitude toward a brand, and willingness to purchase a brand, suggesting that in-game advertising may be more effective than previously thought [25].

Gamification is the process of enhancing service by providing motivation to evoke the user's game experience and generate further action [26]. Gamification has become a new trend in marketing because it can create unique consumer interactions [27]. Games and gamified tasks can increase user enjoyment and engagement [28], allowing the application of gamification in various contexts, such as social media and related consumption behavior. To achieve this goal, gamified design elements can establish sustainable values in consumers to promote more active communication [29]. Incentives and rewards in gamification generate positive meaning and promote changes in user behavior [30]. Therefore, gamification in marketing focuses on providing consumers with a game experience to engage them in various activities related to a product or brand [31]. Gamification encourages consumer participation by turning dull daily behaviors into exciting experiences, ultimately increasing consumer participation and brand loyalty [32].

Ant Forest, a popular social media app in China with over 550 million users, combines environmental-themed online games with offline low-carbon behaviors [33]. As the world's most extensive online public environmental application [34], Ant Forest allows users to establish a stable social network and enjoy social interaction and stimulates their loyalty to the game to maintain a huge user base [33]. Ant Forest records users' green consumption behaviors, such as using public transportation, purchasing environmentally

friendly products, and making online payments and records and converts these low-carbon behaviors into game rewards [35]. Users can also interact with friends in the virtual game world, compete or cooperate to complete online tree-planting tasks, and exchange these virtual trees for real trees to be planted in desert areas [35].

In the specific use process, the concept of environmental protection promoted by Ant Forest has played an important role in promoting the satisfaction of users in using the mobile application [36]. There is enhanced continuous usage of the mobile application by users under the green promotion of Ant Forest, which interacts with gamification participation motivation and green consumption behavior [37]. In addition, both Ant Forest's social media and gamification functions constitute a persuasion system that leads to eventual behavioral change by influencing users' sustainable intentions [38].

Enterprises can use crowd-creation projects such as Ant Forest to establish online brand communities, realize the value of co-creation and corporate social responsibility in a virtual form, and guide consumers to participate in sustainable consumption [39]. Such an approach can increase consumers' enthusiasm to participate in sustainable consumption and reduce the cost of green advertising [39]. As a social gaming feature in China's largest mobile payment app (Alipay), Ant Forest is a green initiative with tangible environmental benefits. Its role improves user satisfaction with the parent company and strengthens the brand's image as a global leader in sustainable finance [40]. More specifically, Ant Forest launched the green products produced by the public welfare forests planted by users in the game and promoted the practical value and low price of these products in green advertisements, thus improving the lives of local growers [41]. As an internet public welfare platform, Ant Forest has the characteristics of openness and interactivity commonly found in social media [42]. Studying its operating model can help stimulate consumers' green values, co-creation values, social relations, and sense of personal achievement, which ultimately promotes consumers' willingness to participate in internet public welfare [42].

2. Theoretical Foundation

This study utilizes the theory of planned behavior (TPB) as its theoretical foundation. The TPB is widely applied in the study of explaining and predicting human behavior based on information and communication technology [43–46]. The original TPB theory states that attitudes, subjective norms, and perceived behavioral control influence intentions, which ultimately leads to actual behavior [47]. Since the TPB can predict the intentions and behaviors of a wide range of customers [48,49], scholars have applied the TPB to predict users' purchase behaviors [50,51]. In order to further explain the intentions of educated young consumers to buy green products, more variables have been added to the TPB model to explore sustainable consumption [52].

Ant Forest influences users' sustainable intentions through persuasion, achievement, and entertainment, ultimately leading to user behavior changes [38]. Research on gamified advertising in mobile applications has also applied the TPB to verify that young consumers are affected by gamified advertising, increasing their intention to make purchases through mobile applications [6]. On the one hand, as an entertaining game, Ant Forest helps farmers plant public welfare forests and publicizes the value of planting fruits as green products. On the other hand, it also creates international publicity for technology and financial companies investing in sustainable practices [41]. This study proposes the following framework based on the research described above (see Figure 1). The hypotheses are developed based on the study's theoretical framework, as follows.

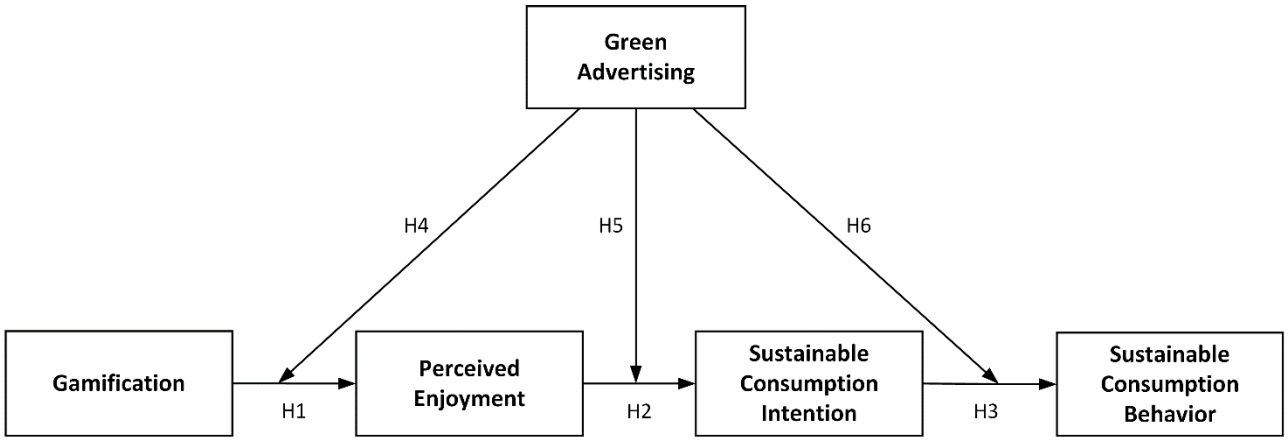

Figure 1. Theoretical framework of the study.

3. Hypotheses Development

Research on e-commerce gamification has shown a favorable impact on social interactions and the perceived enjoyment of Indian female consumers [53]. Crowdsourcing, crowdfunding, or the sharing economy have spawned increasingly more gamified systems in which gamified competition among teams leads to higher perceived enjoyment [54]. In e-banking gamified software, the ease of use of gamification has a positive impact on the enjoyment experienced by users [55]. Therefore, the first hypothesis proposed:

Hypothesis 1 (H1). *Gamification will have a positive effect on perceived enjoyment.*

The presence of accommodation services websites can enhance purchase intentions by increasing customers' perceived trust, enjoyment, and sociability [56]. The perceived utility and hedonic value obtained from artificial intelligence technology experiences can promote consumers' purchase intentions, with a perceived hedonic value superior to a perceived utility value [57]. In the research on live consumption, there is a positive relationship between perceived enjoyment and consumers' live consumption intentions [58]. Therefore, the second hypothesis proposed:

Hypothesis 2 (H2). *Perceived enjoyment will have a positive effect on sustainable consumption intention.*

The attitudes, subjective norms, perceived behavioral control, and altruistic values in the TPB all significantly impact sustainable consumption intentions, and intentions positively impact sustainable consumption behaviors [59]. For example, consumers' intentions to use online car-hailing services have been proven to impact online car-hailing behaviors [60] positively. The same conclusion has been drawn regarding the consumption of green aquatic products [61]. Therefore, the third hypothesis proposed:

Hypothesis 3 (H3). *Sustainable consumption intention will have a positive effect on sustainable consumption behavior.*

As gamification has a greater influence on the decision-making of online consumers, researchers have focused on how in-game advertising affects the user game experience, which has been proven to affect players' attitudes towards games [27]. Adult users give high ratings to brands advertised in games because these ads improve their cognitive skills and ultimately provide users with the best experience by providing a high level of challenge during gameplay [62]. Consumers' brand attitudes as an advertising strategy affect the relationship between the perceived ease of use and perceived enjoyment of gamification in e-commerce [63]. Therefore, the fourth hypothesis proposed:

Hypothesis 4 (H4). *Green advertising will significantly moderate the relationship between gamification and perceived enjoyment*.

Research by Hussain and Rehman [64] pointed out that the interactivity of in-game advertising positively impacts consumers' purchase intentions, and the consistency of games and products strengthens these effects. In addition, the information and feedback presented by in-game advertisements play an important role in explaining players' motivations and influencing their memory and attitudes [65]. Adding anthropomorphic images in green advertising can not only increase the persuasive effect with enjoyment but also promote the marketing of green products [66]. Therefore, the fifth hypothesis proposed:

Hypothesis 5 (H5). *Green advertising will significantly moderate the relationship between perceived enjoyment and sustainable consumption intention*.

Green advertising has been proven to directly or indirectly stimulate consumers' sustainable consumption intentions and behaviors [67]. Green advertising attitudes can strongly predict behavioral intentions, and young people are more likely to form a positive view of green advertising, which may not bring sales immediately but has a positive impact on future sales [68]. In addition, green advertising was shown to have a significant positive moderating relationship among self-image, environmental concern, social impact, and sustainable consumption behavior [69]. Therefore, the sixth hypothesis proposed:

Hypothesis 6 (H6). *Green advertising will significantly moderate the relationship between sustainable consumption intention and sustainable consumption behavior*.

4. Methodology

4.1. Survey Design

In similar research, the sampling of China's youth populations is often concentrated on university campuses. University students and young faculty members cover the primary age groups of China's youth. Moreover, China's youth generally have higher education levels above high school and are proficient in modern communication technology, which coincides with the targeted sample [70–73]. Therefore, the data for this research were obtained from university campuses in China, including undergraduates, postgraduates, young researchers, and faculty members. Because it is a study focused on China's youth, the age range was 18–27 years. The data were collected via an online questionnaire in November 2022 to reduce the risk of contracting the coronavirus (COVID-19) [74]. The convenience and speed of online surveys allow researchers to obtain data easily [75]. Online questionnaires were distributed and collected through Wenjuanxing, China's most commonly used online survey platform [76]. Because the respondents were all Chinese, the questionnaire was translated into Chinese [76]. In addition, the translated questionnaire was reviewed by language experts in translatology. Considering the huge number of Ant Forest users, this research used convenience sampling. Convenience sampling of specific populations can yield an acceptable sample when involving a large population [77]. To obtain a more comprehensive sample, the online questionnaire was also disseminated to student and teacher groups via social media [78].

4.2. Measurements

Based on the theoretical framework, the questionnaire was designed to measure the relationship between the variables. The questionnaire contained six sections, including demographic information such as age, gender, education, occupation, and income, and information regarding the respondents' use of Ant Forest. The remaining five sections corresponded to the five variables in the framework and were derived from existing research. The specific items and sources can be found in Table 1. All the instruments were reviewed and finalized by three communication professors and marketing professionals

to ensure the appropriateness and effectiveness of the content. Before disseminating the survey, 50 students participated in a pilot study. Cronbach's alpha values of all the pilot results were higher than 0.70, verifying the internal consistency of the instruments.

Table 1. Summary of the Construct Items and Sources.

Construct	Code	Questionnaire Items	Source
Green Advertising (GA)	GA1	Green advertising is essential to recognize environmentally friendly products in Ant Forest.	Mkik et al., 2017 [79]
	GA2	Green advertising reinforces the environmental commitment of the brand/product in Ant Forest.	
	GA3	Green advertising reinforces the ecological image of the brand in Ant Forest.	
	GA4	Green advertising attracts the attention of consumers in Ant Forest.	
	GA5	Green advertising is effective at changing consumer behavior in Ant Forest.	
Gamification (GAM)	GAM1	Ant Forest can be used very well on the Alipay platform.	Grangeia et al., 2019 [21]
	GAM2	I felt more motivated to practice sustainable behaviors after using Ant Forest.	
	GAM3	I felt motivated to reflect on previous sustainability behaviors after using Ant Forest.	
	GAM4	The levels of Ant Forest motivated me to practice sustainable behaviors even more.	
	GAM5	Ant Forest turned my sustainable behaviors funnier.	
	GAM6	Ant Forest has played a good navigation role for the Alipay platform.	
	GAM7	After using Ant Forest, I had more interest in sustainable behaviors than I was not interested in before.	
	GAM8	Ant Forest helped me develop my daily sustainability behaviors.	
	GAM9	The medals received in Ant Forest were one more reason to motivate me to practice sustainability behaviors.	
	GAM10	I became happy and proud of my friends for acquiring their medals.	
Perceived Enjoyment (PE)	PE1	I have fun interacting with Ant Forest.	Rouibah et al., 2016 [80]
	PE2	Using Ant Forest provides me with a lot of enjoyment.	
	PE3	I enjoy using Ant Forest.	
Sustainable Consumption Intention (SCI)	SCI1	I plan to buy green products (organic foods or energy-saving products) through Alipay next month.	Chi, 2021 [81]
	SCI2	I am willing to consider switching to other brands for ecological reasons.	
	SCI3	I am willing to spend more money to buy healthy products through Alipay.	
	SCI4	I will consider buying green products through Alipay because they are less polluting.	
Sustainable Consumption Behavior (SCB)	SCB1	I perform daily activities to care for and preserve the environment.	Awais et al., 2020 [82]
	SCB2	I would like to make changes in my lifestyle in search of more responsible consumption.	
	SCB3	I am satisfied with my responsible consumption behaviors.	
	SCB4	I purchase and use environmentally friendly products.	
	SCB5	I often pay extra money to purchase an environmentally friendly product.	

In this study, 512 questionnaires were collected through non-probability sampling. Through the screening questions at the beginning of the questionnaire, the researchers of this study finally identified 305 participants who had actually used Ant Forest and received gamification rewards and regarded their questionnaires as valid questionnaires to meet the purpose of this study. The survey was conducted mainly on university campuses, so the vast majority of participants were students, young researchers, and faculty members. The students and young teachers at the universities were judged to meet the age requirements for China's youth and sufficient information technology skills to ensure they had enough knowledge of mobile applications and the ability to provide precise feedback through online questionnaires [70]. The purpose of the research and the rights of the participants were explained at the beginning of the questionnaire. Basic information regarding the respondents, except their names, was collected to adhere to research ethics [83]. The participants provided private information voluntarily and were informed they could stop responding to the questionnaire at any time, thus further adhering to the research ethics [84]. A five-point Likert scale was used to measure the research variables, ranging from 1 (strongly disagree) to 5 (strongly agree). Smart-PLS software and the Statistical Package for the Social Sciences (SPSS) were used to analyze the data.

Table 2 shows the demographic profiles of the respondents. Most of the respondents were college students (n = 246), accounting for 80.66% of the total sample. The respondents covered most of China's youth (from 18 to 25 years old), and most were female (62.3%). All the participants indicated they use Ant Forest. The respondents who had never used Ant Forest were asked to withdraw from the survey before responding to the questionnaire to ensure that the appropriate sample was obtained. From the statistical data, most of the users are in a light-weight state because 65.9% of the users only use Ant Forest once every few days, and 79.67% of the users have not completed the achievement of planting real trees. A total of 72.46% of the users learned about Ant Forest through the information recommendation inside the Alipay platform. It can be seen that Alipay's green advertisements still mainly function within the platform.

Table 2. Respondents' Demographic Profiles.

		Total N = 305	
		Frequency	**%**
Age	18	34	11.15
	19	104	34.10
	20	86	28.20
	21	11	3.61
	22	26	8.52
	23	13	4.26
	24	16	5.25
	25	15	4.92
Gender	Male	115	37.70
	Female	190	62.30
Education	Undergraduate	229	75.08
	Postgraduate	76	24.92
Occupation	Public official	3	0.98
	Professional technician	21	6.89
	Researcher	28	9.18
	Freelancers	7	2.30
	Student	246	80.66
Monthly income	Below CNY 4000	159	52.13
	CNY 4000–6000	23	7.54
	CNY 6001–10,000	28	9.18
	CNY 10,001–16,000	7	2.30
	Do not want to say	88	28.85
Duration of using Ant Forest	Less than one month	91	29.84
	One month–Five months	75	24.59
	Six months–One year	34	11.15
	Greater than one year	105	34.43
Frequency of using Ant Forest	Every few days	201	65.90
	Once a day	81	26.56
	Several times a day	23	7.54
Achievements while using Ant Forest	Collected "green energy" but never completed a planting	243	79.67
	Completed a planting	53	17.38
	Complete multiple plantings	9	2.95
The way to learn about Ant Forest	Recommended by Alipay	221	72.46
	Publicity from friend	37	12.13
	Advertising	15	4.92
	Others	32	10.49

5. Results

5.1. Measurement Model

This study used a variance-based structural equation model to evaluate the measurement and structural models, and Smart-PLS (4.0) software was used as an evaluation tool. The descriptive statistics of all 27 construct items are shown in Table 3. The construct reliability of the measurement model was tested via Cronbach's alpha and composite reliability (CR) (see Table 4) to reflect convergent and discriminant validity. The factor loadings and average variance extracted (AVE) are also shown in Table 4 to reflect the convergence effect of the structure. All the factor loadings exceeded 0.7, and the AVEs exceeded 0.6, which means that all the items have high reliability [85]. Cronbach's alpha was between 0.834 and 0.944, and the composite reliability (CR) was between 0.837 and 0.948, which supports the internal consistency of all the subscales and the instrument's construct and discriminant validity [86].

Table 3. Descriptive Statistics of the Construct Items.

Item	Mean	Scale Min.	Scale Max.	Standard Dev.	*p*-Value
GA1	4.003	2	5	0.847	0.000
GA2	4.134	2	5	0.796	0.000
GA3	4.118	2	5	0.763	0.000
GA4	4.046	2	5	0.800	0.000
GA5	3.866	2	5	0.926	0.000
GAM1	4.013	1	5	0.941	0.000
GAM2	3.748	1	5	0.961	0.000
GAM3	3.777	1	5	0.990	0.000
GAM4	3.820	1	5	0.915	0.000
GAM5	3.902	1	5	0.918	0.000
GAM6	3.846	1	5	0.868	0.000
GAM7	3.810	2	5	0.885	0.000
GAM8	3.895	2	5	0.877	0.000
GAM9	3.938	2	5	0.853	0.000
GAM10	3.964	1	5	0.862	0.000
PE1	4.030	2	5	0.847	0.000
PE2	4.000	2	5	0.802	0.000
PE3	3.980	2	5	0.864	0.000
SCI1	3.626	2	5	0.915	0.000
SCI2	3.738	1	5	0.953	0.000
SCI3	3.875	1	5	0.936	0.000
SCI4	3.885	2	5	0.904	0.000
SCB1	4.016	1	5	0.903	0.000
SCB2	3.892	2	5	0.825	0.000
SCB3	3.856	2	5	0.908	0.000
SCB4	3.898	2	5	0.833	0.000
SCB5	3.748	2	5	0.875	0.000

The discriminant validity can be assessed using the Fornell–Larcker criterion and the heterotrait-monotrait ratio (HTMT) [87]. The heterotrait-monotrait ratio (HTMT) is considered superior to the Fornell–Larcker criterion regarding the degree of discrimination between reaction structures [88]. The HTMT values of all the scales in this study were lower than 0.9 (see Table 5), which is consistent with the criteria for establishing discriminant validity [88].

5.2. Structural Model

This study evaluates a structural model that examines the relationship between the variables in the theoretical framework. The bootstrapping resampling was set to 5000 re-samples and was 95% bias-corrected in the data analysis in order to speed up (BCa) the study of the significance of the structural path coefficients and coefficients of determination (R^2). Table 6 presents the results of all six hypotheses in the structural

model. All the direct effects (H1, H2, H3) showed significant positive effects with p-values less than 0.001 and betas of 0.424 (H1), 0.645 (H2), and 0.482 (H3), respectively. Green advertising showed no significant moderating effect between perceived enjoyment and sustainable consumption intention (H5) ($\beta = 0.022$, $p > 0.05$). Green advertising had a significant positive effect on the moderating effect between gamification and perceived enjoyment (H4) ($\beta = 0.063$, $p < 0.05$), while green advertising had a significant negative effect on the moderating effect between sustainable consumption intention and sustainable consumption behavior (H6) ($\beta = -0.100$, $p < 0.05$).

Table 4. The Measurement Model Assessment Results.

Construct	Item	Loading	Cronbach's Alpha	CR	AVE
Green Advertising	GA1	0.911	0.944	0.948	0.818
	GA2	0.917			
	GA3	0.925			
	GA4	0.910			
	GA5	0.856			
Gamification	GAM1	0.805	0.941	0.942	0.653
	GAM2	0.785			
	GAM3	0.825			
	GAM4	0.814			
	GAM5	0.810			
	GAM6	0.823			
	GAM7	0.807			
	GAM8	0.800			
	GAM9	0.804			
	GAM10	0.807			
Perceived Enjoyment	PE1	0.941	0.941	0.941	0.895
	PE2	0.952			
	PE3	0.945			
Sustainable Consumption Intention	SCI1	0.853	0.837	0.839	0.671
	SCI2	0.800			
	SCI3	0.789			
	SCI4	0.834			
Sustainable Consumption Behavior	SCB1	0.804	0.834	0.837	0.602
	SCB2	0.755			
	SCB3	0.792			
	SCB4	0.818			
	SCB5	0.707			

Note: AVE = average variance extracted, CR = composite reliability.

Table 5. Discriminant Validity (HTMT Criterion).

		1	2	3	4	5	6	7	8
1.	Green Advertising								
2.	Gamification	0.889							
3.	Perceived Enjoyment	0.863	0.859						
4.	Sustainable Consumption Intention	0.771	0.862	0.877					
5.	Sustainable Consumption Behavior	0.805	0.868	0.830	0.894				
6.	Green Advertising × Gamification	0.151	0.148	0.077	0.135	0.234			
7.	Green Advertising × Perceived Enjoyment	0.130	0.090	0.048	0.117	0.152	0.823		
8.	Green Advertising × Sustainable Consumption Intention	0.137	0.122	0.035	0.101	0.189	0.710	0.765	

In addition to the structural model analysis, the effect sizes (f^2) were also assessed. The p-values confirmed the significance between the paths but failed to indicate the effect size. Therefore, to verify the effect's size, the f^2 value and p-value should be shown in the report [89]. The effect sizes (f^2) should be weighted as small (0.02), medium (0.15), and large (0.35) [90]. The effect sizes of H1-H3 were all above medium, while the effect sizes of

all the moderating effects (H4, H5, H6) were small (see Table 6). In addition, the R^2 values of the variables in the model were between 61.6% and 72.3%. All the path coefficients and R^2 in the structural model are shown in Figure 2.

Table 6. Hypotheses Testing Results.

	Hypothesis/Relationship	Std. Beta	Std. Dev.	t-Value	*p*-Value	Decision	f^2
H1	Gamification -> Perceived Enjoyment	0.424	0.068	6.227	0.000	Accept	0.191
H2	Perceived Enjoyment -> Sustainable Consumption Intention	0.645	0.085	7.570	0.000	Accept	0.335
H3	Sustainable Consumption Intention -> Sustainable Consumption Behavior	0.482	0.051	9.524	0.000	Accept	0.343
H4	Green Advertising × Gamification -> Perceived Enjoyment	0.063	0.028	2.224	0.026	Accept	0.011
H5	Green Advertising × Perceived Enjoyment -> Sustainable Consumption Intention	0.022	0.042	0.527	0.598	Reject	0.001
H6	Green Advertising × Sustainable Consumption Intention -> Sustainable Consumption Behavior	−0.100	0.044	2.273	0.023	Accept	0.021

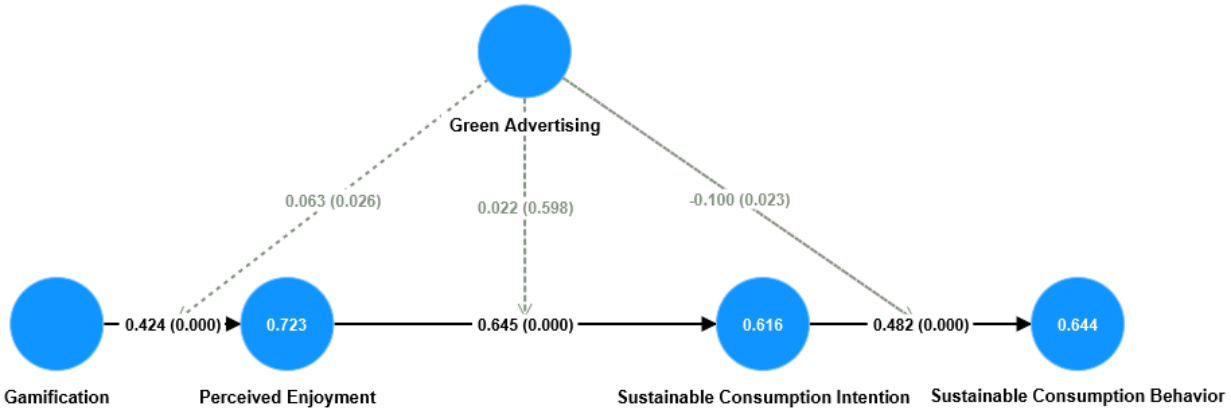

Figure 2. Structural Model (Path coefficients and R^2).

6. Discussion

The rapid growth of Ant Forest users demonstrates that gamification meets the needs of young users [38]. Due to their preference for gamification, young users enjoy using Ant Forest for an extended period of time. The data analyses revealed that 70.16% of China's youth respondents in this study's sample had used Ant Forest for more than six months, and 34.10% of the respondents frequently played (at least once per day). Long-term and stable participation makes it possible for gamified applications to influence users' sustainable behaviors. It can be seen from the structural model that gamification, perceived enjoyment, sustainable consumption intention, and sustainable consumption behavior all show significant positive relationships, and the effects are greater than the medium range ($0.15 < f^2 < 0.35$). According to the results, gamification in Ant Forest, supported by the TPB extended model, influences the sustainable consumption intentions and behaviors of China's youth respondents in the current study. This is similar to the results obtained by Chen's [91] research regarding the mechanism of gamification affecting user behavior.

In order to encourage users to practice sustainable behaviors, promote the company's environmental protection concept, and seek economic returns, green advertising elements are constantly added to Ant Forest [41]. Green advertising moderates the impact of gamification on perceived enjoyment, which encourages China's youth to invest more energy in participating in the interactive experience in Ant Forest. Adding advertising to games can provide users with challenges that improve their cognitive skills, providing them with the best gaming experience [62]. In turn, these experiences lead users to perceive more enjoyment.

However, green advertising did not play a moderating role in transforming perceived enjoyment into sustainable consumption intention. This is in contrast to previous re-

search [92], which suggested that advertisements can enhance interactions with consumers and increase consumers' perceived enjoyment by designing simple and vivid interfaces [92]. These modifications could be implemented in Ant Forest in the future.

Green advertising plays a negative moderating role in the impact of sustainable consumption intention on sustainable consumption behavior. In the case of Ant Forest, green advertising hindered behavior formation. This may be due to excessive digital advertising disrupting the flow of the users' interactions, making it difficult for users to focus on achieving their behavioral goals. As Arora [93] explained, online digital advertising can become so intrusive that it disrupts users' workflow and invades their privacy. This can annoy users and make them less likely to use the online platform. The high proportion of China's youth users (79.67%) in the current study's sample who failed to complete the tree planting in Ant Forest also suggests advertising interference.

In the case of Ant Forest, the moderating effect (f^2) of green advertising was small (whether positive or negative), which means that China's youth users in this study did not fully adapt to green advertising in the game. This result may be related to the consumption habits of China's youth. Previous research has shown that China's youth have the lowest level of unnecessary sustainable consumption behaviors compared to other generations [94].

7. Conclusions

7.1. Theoretical Significance

This study proposes a model of how green advertising affects gamification and sustainable consumption behavior based on an extended TPB model. The theoretical significance of the model is demonstrated through a survey of 305 respondents. The results show that green advertising has a significant positive impact on the gamification experience of Ant Forest users. However, the effect of the impact could be more substantial and needs to be studied further. Incorporating green advertising into mobile applications has received extensive academic support [8,95–97]; however, the mechanism of green advertising deserves more research.

7.2. Practical Significance

Ant Forest was developed as an online environmental protection application to encourage sustainable behavior in the general public. Currently, the number of such applications is relatively small, so research is limited [33]. In China, Ant Forest pioneered the introduction of gamified interactive forms to promote sustainable consumption behaviors. The mobile application has attracted many users and led to more than 50 million trees being planted [98]. This study also further proved that gamification ultimately affects sustainable consumption behaviors through perceived enjoyment and sustainable consumption intentions. The developers of social media applications should fully consider the effect of this mechanism and strengthen the function of gamification in social media applications to obtain further environmental protection benefits. In addition, adding more green advertisements should produce better publicity effects and economic benefits. Such a model deserves to be studied and promoted further.

According to the survey results of the moderating effects, social media application development companies can consider reasonably playing the role of green advertising in future products so that they can further satisfy users' perceived enjoyment with gamification while optimizing the user experience [27]. At the same time, marketing experts should also pay attention to the negative moderating effect of green advertising on the relationship between consumption intention and behavior to avoid excessive marketing that may lead to green skepticism among users [99].

7.3. Limitations and Future Directions

First, this study's sample lacks diversity, as most respondents are young students receiving higher education in urban areas. This reflects the current user base of Ant Forest, which is more open to the concept of gamification and sustainable development. However, these findings may not be generalizable to other populations, such as the middle-

aged, elderly, and general populations [38]. Secondly, this study only introduced green advertising as a marketing variable for analysis and did not comprehensively consider the impact of other variables, such as word of mouth and brand image, which can be investigated in future research. The data show that although 79.67% of China's youth respondents in this study use Ant Forest to obtain game rewards, they have not yet engaged in planting trees. Users participate in gamification more for entertainment and have fewer opportunities to perform sustainable behaviors. Therefore, how strengthening the influence of in-game green advertisements to encourage users to practice sustainable consumption behaviors is a direction worthy of further research. In addition, 72.46% of China's youth joined Ant Forest because of the recommendation mechanism of the parent company Alipay's internal system rather than the promotion effect of green advertisements in Ant Forest. Therefore, how to promote Ant Forest through its in-game green advertisements can also be considered a valuable research direction.

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