Encouraging Individuals to Go Green by Gamification: An Empirical Study

Completed Research Paper

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Abstract

The quality of the environment is the main concern of the current world. For the improvement of environmental quality, individuals are suggested to perform pro-environmental behaviors. Gamifying information systems to encourage their users to do so is an emerging phenomenon showing its potential for environmental conservation. Contributing to the environment in interesting ways is the main idea of gamification which helps the system attract users. However, maintaining active user engagement within such a gamified system is difficult. To understand the mechanism of users' continuous intention to use gamified information system for environmental protection, this research based on the theories of goal framing and gamification affordance to explain what factors influence user' continuance to use intention and what roles the gamification design takes in the user interaction with the system. This study contributes to knowledge of research and practice regarding gamified information systems for environmental protection.

Keywords: Pro-environmental behaviors, gamified information systems, gamification affordance, goal framing theory

Introduction

The deterioration of the world-around environments is increasingly serious with the evidence of resource depletion, global warming, deforestation, and so on (Cooper and Molla 2017). The researchers have already realized that not only the organizational activities, but also individual behaviors have the significant influence on the quality of environment and sustainability (Loock et al. 2013; Ünal et al. 2018). Therefore, motivating and attracting individuals to perform pro-environmental behavior (PEB) is also a fundamental way for environmental conservation (Bhushan et al. 2018; Steg et al. 2014). The PEB refers to any individual behavior which is beneficial to the enhancement of the environmental quality (Steg et al. 2014). In the current digital era, as the information systems (IS) take an important role in many fields, the immense environmental challenges facing society today have also necessitated the effort toward exploring IS enabled solutions to environmental issues (Tim et al. 2018). In this circumstance, what an IS can afford to facilitate individuals to perform their PEBs should also be one of the potential orientations for the IS contributing to environmental conservation.

Ant Forest is such an IS dedicating to encouraging their users to perform PEBs. Ant Forest released by the Alibaba (a famous e-business company in China) in 2016 is, for now, the most successful and largest online platform of individual carbon account for encouraging individuals to perform PEBs (Yan 2017). The significant feature of this online platform is the gamification design. Gamification, the use of game elements in the non-game contexts (Seaborn and Fels 2015), is one of the most popular IS design strategies which trigger individual motivation to perform relevant behaviors with the use of the IS (Hamari et al. 2018). Various game elements, such as leaderboard, points, and game-based interaction, are used in the Ant Forest to attract individuals using this online platform to perform PEBs (e.g., walking rather than driving, taking the public transportation, and paying the utility online (without cash)). After the registration on the Ant forest, performed PEBs of the individuals can be converted into “energy points” accordingly in their Ant Forest account. Furthermore, these “energy points” can then be used by the individuals to apply for planting the real trees funded by various charities which have cooperation with Alibaba. So far, Ant Forest has lured over 220 million users in China to perform PEBs (Javed 2018). Furthermore, 10.25 million trees have been planted in China because of the users’ contributions on the Ant Forest, which equates to a 1.22 million ton reduction in emission of carbon dioxide (Yin 2017).

The current success of Ant Forest implies that gamification is the effective design strategy for IS to motivate users to performance PEBs. Despite the effectiveness of gamification design, previous studies also constantly have found that it is difficult to maintain active user engagement in a gamified IS due to the short-term effects of game elements (Suh et al. 2017). In the context of environmental conservation, the individuals’ continuous performance of PEBs is more meaningful and critical to the sustainable development of the environment. Hence, it is crucial to understand the mechanisms explaining why users would continue to use the gamified IS which is designed for environmental conservation. Whereas most studies related to IS for environmental protection (this research steam is called green IS) are conducted at the organizational level (Loock et al. 2013; Tim et al. 2018), green IS research at the individual level is relatively limited. Moreover, compared with considerable gamification studies in the contexts of learning and working (e.g., Santhanam et al. 2016; Suh and Wagner 2017), gamification research related to environmental conservation is also lacking. Without a sufficient understanding of how a gamified IS developed for environmental conservation encourages users continuously to use, the campaign of gamifying IS for environmental conservation will fail to achieve sustainable development and ultimate success.

To bridge the research gap, two related research questions are proposed: (1) what user perceptions, when engaging with gamified IS designed for environmental conservation, influence users’ continuance to use intention? (2) How does gamification design influence these user perceptions? Based on the theories of goal framing and gamification affordance, this study develops a research model to answer both key research questions. The findings of this research contribute to the richer knowledge of individual green IS research. Furthermore, the study also helps researchers understand the influence of gamification on the individuals’ decision-making in the context of using gamified IS to perform PEBs. For the IS practitioners, this study also provides the guideline for the IS designers to consider appropriate game mechanisms and elements which can enhance user continuous intention to the engagement with gamified IS developed for environmental conservation.

Theoretical Background

Goal Framing Theory

The goal framing theory (Lindenberg 2006) was proposed to help researchers systematically understand how the multiple goals influence PEBs to be acted. The central tenet of the goal framing theory is that goals guide the individual’s intention and their behaviors with respect to the environment in a specific situation. This theory claims that the goals govern or “frame” what people attend to, how people evaluate various aspects of the situation, and what alternatives are being considered in the certain scenario (Lindenberg and Steg 2007; Steg et al. 2014).

Three specific types of goal related to the PEB motivations are identified by the goal framing theory. They are the normative goal “to act appropriately”, the hedonic goal “to feel better right now” and the gain goal “to guard and improve one’s resources” (Lindenberg and Steg 2007). The following subsections illustrate three specific requirements of users derived from these three goals when users perform PEBs with the use of the gamified IS.

Green Effectiveness Derived from Normative Goal

The normative goal makes people especially sensitive to what they think they ought to do, such as contributing to a clean environment or showing exemplary behaviors (Steg et al. 2014). Furthermore, people in the normative goal frame usually consider the effectiveness of the PEBs (Poortinga et al. 2003). Therefore, one of the most significant requirements or needs for the applications proposed by this sort of users is green effectiveness. Green effectiveness is defined as the accuracy and completeness with which users achieve their goals of environmental conservation with the help of IS (Hamilton and Chervany 1981; Teo et al. 2003).

Enjoyment Derived from Hedonic Goal

The hedonic goal leads to individuals focusing on the ways to seek after the desirable affective response (say, improving their feelings) (Steg et al. 2014). Relevant studies show that people are more likely to perform PEBs when they believe to derive enjoyment and satisfaction from acting pro-environmentally (De Groot and Steg 2010). This indicates that users with the hedonic goal usually consider the enjoyable level provided by the systems. Enjoyment refers to the extent to which the interaction with the systems is perceived as pleasurable and enjoyable (Guo and Poole 2009; van der Heijden 2013). The enjoyment as a desirable affective response is also important for users’ satisfaction during the systems interaction (Agrebi and Jallais 2015; Djamasbi et al. 2010).

Social Gain Derived from Gain Goal

People with the gain goal would be very sensitive to the changes in their personal resources, such as money and social status (Steg et al., 2014). The criterion for goal realization is the improvement of one’s resources (Lindenberg and Steg 2007). Because of the advance of technologies for social networking, plenty of research has uncovered the power of social interaction on users’ online behaviors (e.g., Shao and Pan 2019). Therefore, based on the content of gain goal, the social gain could be the significant and achievable requirement of users when performing PEBs with the help of IS. The social gain refers to the performance outcome in gaining the social relationship and reputation when using the IS (Chiu et al. 2006; Salehan et al. 2017).

Affordance Theory and Gamification Affordance

Affordance provides an analytical connection between technological features and user’s experience (van Vugt et al. 2006). Affordance theory argues that materiality (say, technical abilities) of an application is only a part of the relationship between users and technological artifacts (Leonardi 2011). This indicates that the ultimate usability of an application is depended on what a technology can afford as well as whether these affordances fit the goals of users and allow them to perform relevant actions (Suh et al. 2017).

A gamification affordance refers to the affordance appearing in the gamified IS (Suh et al. 2017; Suh and Wagner 2017). The gamification affordance emerges from the interaction between users and the game elements (e.g., trophies, badges, and leaderboards) in the gamified IS. After the exploratory literature review, we identify four specific gamification affordances from existing relevant studies. The affordance of the autonomy support (Chen and Jang 2010) refers to an affordance that enables users to make self-decisions in the gamified IS. The affordance of visibility of achievement (Suh and Wagner 2017) refers to an affordance that enables users to visualize their achievement through levels, leaderboards, and badges. The affordance of the competition (Santhanam et al. 2016) refers to an affordance that enables users to compare their performances with those of others. The affordance of interactivity (Nikou and Economides 2017) refers to an affordance that enables users to communicate with others.

Hypotheses Development

In this section, eleven hypotheses are generated to explore the relationship among four gamification affordances (i.e., autonomy support, visibility of achievement, competition and interactivity), users' perceptions (on green effectiveness, enjoyment and social gain) when using the gamified IS to perform PEBs and their continuance to use intention. The research model is shown in Figure 1.

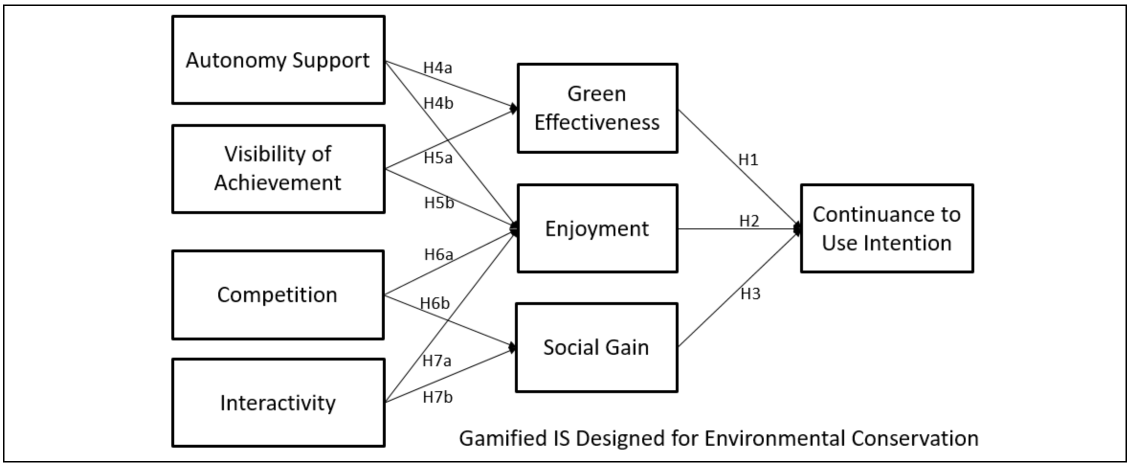


Figure 1. Research Model

Factors Influencing Users' Intention to Continuously Use Gamified IS to Perform PEBs

If an individual focus on the fulfillment of the normative goal, namely in normative goal framing, this individual will more concern about what actions s/he can take to protect the environment (Poortinga et al. 2003; Steg and Vlek 2009). Moreover, the people in this circumstance will also consider what behavior would be effective and appropriate (Lindenberg 2005). Therefore, when engaging with a gamified IS, the users with the normative goal will also consider what they can do with the help of the systems to protect the environment effectively. In this case, green effectiveness of the systems is the important expectation of users because of the influence of the normative goal frame. Thus, this paper argues that if the users perceive high green effectiveness when using the gamified IS to perform PEBs, the users will increase their continuance to use intention to this systems because of the effective help of the systems, which is able to attain their normative goal to protect the environment. Hence, from the perspective of normative goal, Hypothesis 1 is formulated as follows:

H1: Users' perception of green effectiveness is positively associated with their continuance to use intention.

Users in the hedonic goal focus (i.e., hedonic goal framing) will center on the ways to improve their feelings (Steg et al. 2014). In many contexts of using IS, such as physical training (McGloin and Embacher 2018) or workplace (Suh et al. 2018), people are willing to engage with the systems if they feel the desirable affective experience from the interaction with the systems. This is also true in this research context as people are more likely to perform PEBs when they believe to derive enjoyment and satisfaction from acting pro-environmentally (De Groot and Steg 2010). Therefore, this paper argues that people will continuously engage with gamified systems to perform PEBs if they can perceive heightened enjoyment from the interaction with the gamified systems. Hence, from the perspective of hedonic goal, Hypothesis 2 is formulated as follows:

H2: Users' perception of enjoyment is positively associated with their continuance to use intention.

People in the gain goal frame will be sensitive to the change of their resources (Steg et al. 2014), including the economic part and social part (Lindenberg and Steg 2007). That is, high social gain can also fulfill their gain goal. Furthermore, people with gain goal often make reasoned choices and choose alternatives with the highest social and economic benefits (Steg and Vlek 2009). Following this logic of cost-effective, if the users perceive the high social gain when using the gamified IS to perform PEBs, the reasonable choice for users who are in the gain goal frame is to continuously use this gamified system. Therefore, this study proposes that users' perception of the high social gain will influence their intention to continuously use the gamified IS for better PEBs performance. Hence, from the perspective of gain goal, Hypothesis 3 is formulated as follows:

H3: Users' perception of social gain is positively associated with their continuance to use intention.

Roles of Gamification Affordances in Users Performing PEBs via Gamified IS

Previous research confirmed that the freedom for goal setting as a useful autonomy support design afforded by the systems helps the individual users save the consumption of electric energy more effectively (Loock et al. 2013). Furthermore, autonomy support also offers users the possibility to achieve the PEBs in the way they like, which also increases their self-motivation (Ryan and Deci 2000). To safeguard the users' perceived affordance of autonomy support, a gamified system usually provides the choices for the goal setting (say, the multiple selections of challenges), the strategy making and/or the profile setting (van Roy and Zaman 2018). Therefore, we argue that the autonomy support of the gamified IS usually means the high possibility for the user to achieve their PEBs more flexibly and also increase their intrinsic motivation to do so, which further increases users' confidence that this system is able to facilitate users to achieve their goal of environmental conservation effectively. Furthermore, the autonomy support is more likely to help users sense the fulfillment of their autonomy need, which also increases their well-being and enjoyment (Weinstein and Ryan 2010). Hence, Hypothesis 4a/4b are formulated as follows:

H4a: Autonomy support is positively associated with users' perceived green effectiveness.

H4b: Autonomy support is positively associated with users' perceived enjoyment.

The previous literature proves that the visualization of achievement or performance as the feedback positively influences users' behaviors in energy conservation (Loock et al. 2013). Furthermore, the visibility of achievement also increases users' intrinsic motivation to join the activities continuously (Huang and Yeh 2017). To help users perceive the high affordance of visibility of achievement, the gamified IS usually display users' achievement by using game elements of levels, leaderboards, badges and trophies. Visibility of achievement provides the positive reinforcement for the targeted behaviors (Suh and Wagner 2017), which also enhances users' confidence in the abilities of the gamified IS to help them achieve the goal of environmental conservation effectively. Furthermore, visibility of achievement also results in the high perception of enjoyment because the social comparison enabled by showing off the achievement causes an increase in hedonic value (Hamari 2017). Hence, Hypothesis 5a/5b are formulated as follows:

H5a: Visibility of achievement is positively associated with users' perceived green effectiveness.

H5b: Visibility of achievement is positively associated with users' perceived enjoyment.

The leaderboard is the main game element in gamification providing users with opportunities to compete with others (Suh and Wagner 2017). They, therefore, play a critical role in inducing competition by displaying the results and celebrating the winners (Thiebes et al. 2014). In this context, the competition affordance means that users can compare their PEB performance with others within the gamified IS, which leads to positive psychological experience (e.g., immersion and flow experience) related to the enjoyment (Liu et al. 2013). Furthermore, the competition affordance also provides the opportunity for users to interact with others in the gamified IS. Plus, the social interaction is an important way for users to obtain their social resources (Ali-Hassan et al. 2015). Thus, we argue that competition will also increase users' perception of social gain in the gamified IS. Hence, Hypothesis 6a/6b are formulated as follows:

H6a: Competition is positively associated with users' perceived enjoyment.

H6b: Competition is positively associated with users' perceived social gain.

The interactivity is an affordance which helps users fulfill the basic psychological need of relatedness. The fulfillment of this need leads to positive mental states of users, such as well-being (Weinstein and Ryan 2010). Furthermore, the interactivity of the gamified IS also enables users to sense the social support through the interaction with others (Liu et al. 2017), which also increases their enjoyment (Rogers 2017). The previous literature also finds that users prefer to use the social interaction elements to communicate others within the gamified IS (Liu et al. 2017). Moreover, research also finds that users are more willing to make friends with others who are engaging in identical games (Longman et al. 2009). Therefore, the interactivity affordance is also critical for users' satisfaction in social gain when they are engaging with the gamified IS for contributing to the environment. Hence, Hypothesis 7a/7b are formulated as follows:

H7a: Interactivity is positively associated with users' perceived enjoyment.

H7b: Interactivity is positively associated with users' perceived social gain.

Research Methodology

A survey was conducted to test the proposed research model. Whenever possible, we used previously validated measures in our data collection. For the constructs of gamification affordance: Measurements for autonomy support were adapted from the Vallerand et al. (1997), Sørebø et al. (2009) and Nikou and Economides (2017); we adapted instruments of Suh and Wagner (2017) and Suh et al. (2017) to measure visibility of achievement and competition; measurements of interactivity were adapted from Blasco-Arcas et al. (2013) and Nikou and Economides (2017). Measurements for green effectiveness were self-developed based on the concept of effectiveness proposed by Teo et al. (2003); Items of Agarwal and Karahanna (2000) were used (with necessary adaption) to measure enjoyment; Items of social gain were from Salehan et al. (2017) with necessary adaptation to this research. The dependent variable (i.e., continuance to use intention) was measured with the use of adapted items from Suh et al. (2017). All items were measured via a seven-point Likert scale ranging from strongly disagree 1 to strongly agree 7.

Table 1. Demographic Information (N=307)

Variables	Indicators	Frequency	%	Variables	Indicators	Frequency	%
Gender	Male	153	49.8	Income	2000 Yuan & below	4	1.30
	Female	154	50.2		2001~4000 Yuan	28	9.12
Age	16~20	12	3.91		4001~6000 Yuan	80	26.06
	21~25	87	28.34		6001~8000 Yuan	165	53.75
	26~30	102	33.22		8001~10000 Yuan	30	9.77
	31~35	53	17.26		10000 Yuan & above	0	0
	36~40	34	11.07	Volunteer Frequency	None	24	7.82
	41~45	9	2.93		1~3 times per year	87	28.34
	46~50	7	2.28		4~6 times per year	33	10.75
	51~55	3	0.98		7~9 times per year	19	6.19
Education	Middle school & below	4	1.30		1 time per month	41	13.36
	High school	28	9.12		2~3 times per month	43	14.00
	College	80	26.06		1time per week	39	12.7
	Bachelor	165	53.75		2~3 times per week	21	6.84
	Master & above	30	9.77	BMI Index	<18.5	34	11.07
Ant Forest Using History	Less than 3 months	35	11.40		18.5~22.9	162	52.77
	3~6 months	50	16.29		23~24.9	55	17.92
	6~9 months	38	12.38		25~29.9	24	7.82
	9~12 months	44	14.33		30~39.9	15	4.89
	1 year & above	140	45.60		>=40	17	5.54

Following the procedures of Moore and Benbasat (1991), we conducted the card-sorting exercises to test the reliability and validity of items used for measuring constructs. Two judges finally achieved a 95.00% of correct hit ratio and 88.65% of Kappa rate, indicating a satisfactory level of items' quality. We collected survey data on the platform of Baidu MTC which is an online survey platform in China. As the Ant Forest is the most popular and influential gamified IS developed for environmental conservation, the users of Ant Forest were, thereby, invited to complete a questionnaire on the Baidu MTC platform. The incentive (an electronic coupon provided by Baidu MTC) is issued to the users who successfully finished the questionnaire. Finally, 307 valid responses were collected, representing a 93.59% response rate. The demographics are summarized in Table 1. The variables shown in Table 1 are also used as control variables in the research model.

Results

We firstly used SPSS 22.0 and SmartPLS 2.0 to test the validity and reliability of the constructs. The research model was then examined by partial least squares (PLS) analysis.

Measurement Validation

We first assessed the reliability and validity of measurements. As shown in Table 2, factor loading scores on their expected factors are all above 0.7 (Hulland 1999). Furthermore, factor loading scores are also much higher on their expected factors than on other factors. These indicate the acceptable discriminant and convergent validity of the indicators (Barclay and Higgins 1995; Hulland 1999).

Table 2. Confirmatory Factor Analysis

	1	2	3	4	5	6	7	8
AS1	**0.7484**	0.3591	0.2805	0.2977	0.4078	0.3878	0.2008	0.3314
AS2	**0.8004**	0.4118	0.2346	0.2878	0.4502	0.4522	0.1617	0.4429
AS3	**0.8306**	0.4896	0.2997	0.4205	0.4539	0.4659	0.2756	0.4128
AS4	**0.7852**	0.3649	0.3039	0.4183	0.3525	0.4758	0.3362	0.3922
VA1	0.4193	**0.8508**	0.2944	0.3273	0.4755	0.3845	0.1310	0.3435
VA2	0.4461	**0.8822**	0.3086	0.3626	0.5336	0.4266	0.1803	0.3405
VA3	0.4807	**0.8863**	0.3194	0.3548	0.5962	0.511	0.1710	0.4328
Competition1	0.2256	0.2524	**0.8043**	0.3325	0.2083	0.2708	0.3811	0.2211
Competition2	0.3527	0.3956	**0.7597**	0.3479	0.3314	0.3853	0.2275	0.2749
Competition3	0.2578	0.1993	**0.7872**	0.3520	0.2616	0.3386	0.3934	0.3294
Interactivity1	0.4213	0.4296	0.3763	**0.8615**	0.4535	0.5446	0.4126	0.3591
Interactivity2	0.4133	0.3888	0.3880	**0.8547**	0.4307	0.5162	0.4261	0.4209
Interactivity3	0.3158	0.2118	0.3511	**0.8210**	0.3236	0.526	0.5740	0.3231
GE1	0.3927	0.4184	0.2740	0.3593	**0.7682**	0.4965	0.2609	0.3768
GE2	0.4506	0.5120	0.2105	0.4176	**0.8364**	0.5479	0.2367	0.4338
GE3	0.4418	0.5699	0.3436	0.3758	**0.8367**	0.4964	0.2068	0.4568
Enjoyment1	0.4888	0.4193	0.3188	0.5497	0.5374	**0.8712**	0.4082	0.5097
Enjoyment2	0.4801	0.4239	0.3672	0.5400	0.5096	**0.8744**	0.4898	0.5192
Enjoyment3	0.4957	0.4815	0.4084	0.5383	0.5907	**0.8544**	0.4068	0.5243
SG1	0.2699	0.1963	0.3809	0.5741	0.2655	0.4945	**0.9190**	0.3162
SG2	0.2726	0.1637	0.3941	0.4997	0.2262	0.4355	**0.9026**	0.2516
SG3	0.2816	0.1311	0.3835	0.4212	0.2767	0.4067	**0.8545**	0.2625
CI1	0.4905	0.3994	0.2638	0.3820	0.4864	0.5403	0.2279	**0.8651**
CI2	0.2843	0.2440	0.2914	0.3247	0.3496	0.3823	0.3208	**0.7175**
CI3	0.4334	0.3956	0.3238	0.3585	0.4340	0.5320	0.2423	**0.8722**

Note: AS means Autonomy Support, VA means Visibility of Achievement, GE means Green Effectiveness, SG means Social Gain, CI means Continuance to Use Intention

Another criterion for evaluating convergent validity is that the average variance extracted (AVE) for each construct should be equal to 0.5 or greater (Fornell and Larcker 1981). Table 3 displays that all the AVE values range from 0.615 to 0.797. Furthermore, the square roots of AVE on the diagonal are all above 0.78, which are greater than all other cross-correlations. This shows that all constructs capture more construct-related variance than error variance. Taken together, these results demonstrate adequate convergent and discriminant validity for all items (Fornell and Bookstein 1982).

Further, construct reliability was assessed by identifying the composite reliability scores, all of which are above 0.85 (see Table 3), suggesting acceptable internal consistency. To ensure that multi-collinearity did not pose a problem, collinearity diagnostics for constructs were also conducted. The analysis results (see Table 3) show that the scores of variance inflation factors (VIF) (ranging from 1.428 to 2.653) are all well within the recommended area (Hair et al. 1995).

Table 3. Reliability, Correlation Matrix, AVE, and VIF

	Constructs	CR	AVE	VIF	1	2	3	4	5	6	7	8
1	AS	0.870	0.627	1.737	**0.792**							
2	VA	0.906	0.763	1.822	0.509	**0.873**						
3	Competition	0.830	0.615	1.428	0.352	0.351	**0.784**					
4	Interactivity	0.883	0.716	2.013	0.451	0.398	0.438	**0.846**				
5	GE	0.855	0.663	2.144	0.523	0.609	0.338	0.471	**0.814**			
6	Enjoyment	0.901	0.751	2.653	0.563	0.502	0.417	0.626	0.628	**0.867**		
7	SG	0.921	0.797	1.670	0.311	0.181	0.434	0.557	0.289	0.498	**0.892**	
8	CI	0.861	0.675	1.692	0.486	0.416	0.355	0.432	0.514	0.588	0.321	**0.821**

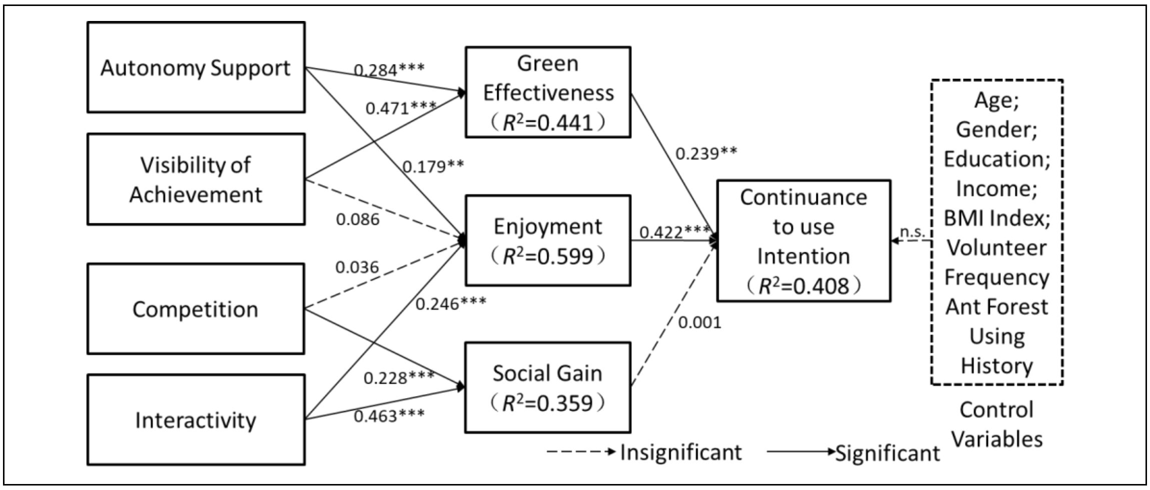
Note: CR is composite reliability; Diagonal elements in bold font are the square root of the AVE from their indicators; Off-diagonal elements are correlations between constructs; AS means Autonomy Support, VA means Visibility of Achievement, GE means Green Effectiveness, SG means Social Gain, CI means Continuance to Use Intention

In addition, three tests were applied to check the severity of common method bias (CMB). Firstly, Harman's one-factor analysis was used to check if the variance of the data was a result of using a common source. The results indicate that the merged factor accounted for only 36.53% of the variance. Plus, the correlation matrix (see Table 3) shows that the highest inter-construct correlations are below 0.628, whereas common method bias is usually evidenced by extremely high correlations (r>0.90) (Bagozzi et al. 1991). Furthermore, we also applied the PLS approach (Liang et al. 2007) to examine the threat of CMB. The average variance of the indicators explained by the constructs was 0.699 and the average variance explained by the method factor was only 0.002. To sum up, these three tests jointly provided strong evidence that CMB is not a significant threat.

Structural Model

The structural model was examined by using SmartPLS 2.0. Results in Figure 2 indicate that the research model is supported by the data, except for H3, H5b and H6a.

The green effectiveness (B=0.239, p<0.01) and enjoyment (B=0.422, p<0.001) positively affect continuance to use intention, thus supporting H1 and H2. The green effectiveness is significantly influenced by autonomy support (B=0.284, p<0.001) and visibility of achievement (B=0.471, p<0.001), verifying H4a and H5a. As hypothesized (i.e., H4b and H7a), both autonomy support (B=0.179, p<0.01) and interactivity (B=0.246, p<0.001) have significantly positive effects on enjoyment. In addition, competition (B=0.228, p<0.001) and interactivity (B=0.463, p<0.001) significantly influence social gain, which supports H6b and H7b. The variances explained (R-square) of green effectiveness, enjoyment, social gain and continuance to use intention are 44.1%, 59.9%, 35.9% and 40.8%, respectively. All control variables are not significant.



Note: ***p<0.001, **p<0.01, n.s. means insignificant

Figure 2. PLS Results of Structural Model

Limitations

The current study has several limitations that offer future research opportunities for further improvements. Firstly, the generalizability of findings is limited. Because the research is based on one specific research object, namely Ant Forest (a most popular gamified IS designed for environmental conservation in China), the generalization of conclusions needs more findings from other objects to support. Furthermore, the research method used in this study is simplex (only a survey was conducted in this study). The mix-method approach is supposed to be adopted in future research. In addition, the sample size is small, and data are all collected by self-report respond. The sample size should be expanded, and data collected from various sources are needed in the further investigation.

Discussion and Implications

Based on the theories of goal framing, we found that users' perceived green effectiveness and enjoyment are the significant predictors for the users' continuance to use intention. Furthermore, drawn on the notion of gamification affordance, we also identified four gamification affordances which have significant impacts on users' perceptions in the context of using gamified IS to perform PEBs. These findings have implications from the theoretical perspective and practical perspective.

Theoretically speaking, this research extends the understanding of users' change of intention in the context of gamified IS developed for environmental conservation. Based on the goal framing theory, this paper confirmed that users' perceived green effectiveness and enjoyment are the important factors influencing users' continuance to use intention to the gamified IS designed for environmental protection. These results imply that in the context of gamified IS for environmental conservation, the users using the systems to contribute to the environment is not only for the enjoyable feeling (i.e., hedonic goal). This research found that the perception of green effectiveness also affects users' continuance to use intention, which means that the normative goal is also an influential factor in the context of gamified IS. Therefore, these results jointly support that the not only hedonic purpose should be considered in the gamification design (Liu et al. 2017), especially in the context of environmental conservation. However, the social gain perception which is related to the gain goal fails to show the significant influence on users' continuance to use intention. This implies that the effect of gain goal on user intention in the context using gamified IS to perform PEBs is still not clear, but this also indicates further research opportunities on individual PEBs in the context of gamified IS.

Moreover, this study further clarified the influences of specific gamification affordances on users' different perceptions when using the gamified IS for PEB performance. One interesting finding we observed is that not all gamification affordances trigger the enjoyable experience. In this research, we found that competition and visibility of achievement did not significantly influence users' perception of enjoyment. Whereas, previous research finds that competition and visibility of achievement significantly influence enjoyment of user in the context of compulsory IS use, such as skill training (Santhanam et al. 2016) and the workplace (Suh and Wagner 2017). Our explanation on these findings is that the context difference results in the diverse results. In this research context, performing PEBs is a type of altruistic and voluntary behaviors (Steg et al. 2014) which are fundamentally different from the obedient behaviors usually researched by previous studies. Therefore, the findings of this research indicate that the context of environmental conservation as a unique scenario may change the effect of some gamification affordances with respect to users' enjoyable experience. Furthermore, we also found that the influence of gamification affordances is not only on the enjoyment. In this research, we found that certain gamification affordances also influence users' perception of green effectiveness (impacted by autonomy support and visibility of achievement) and social gain (influenced by competition and interactivity). Similar findings also can be found in other gamification studies. For instance, Suh et al. (2017) find that gamification affordances trigger users' both types of experience, namely flow and aesthetics, in the workplace. These findings imply the multiple roles of gamification in user-system interaction regarding its influence on user experience.

For IS developers' point of view, this research help the IS designers gamify the IS to encourage individuals to perform PEBs. The IS designers are supposed to consider the contextual difference of environmental conservation, in contrast with other contexts (e.g., learning and workplace), when applying specific game elements to gamify the systems. Furthermore, the IS developers also are suggested to consider more other user requirements and experience rather than only the hedonic enjoyment when gamifying systems.

Conclusion

This research focuses on an emerging phenomenon that individuals perform PEBs with the use of gamified IS. To help the final success of the campaign of gamifying IS to attract more individuals performing PEBs, this research aims to understand the mechanism determining users' continuance to use intention to the gamified IS for environmental conservation and the roles of gamification design in user engagement in this system. Results of this research contribute to the knowledge of research and practice regarding gamified IS developed for supporting individual PEBs.

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