

Study on the Promotional Effect of Ant Forest on Pro-environmental Behavior

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Abstract

Environmental protection has become a contentious topic in society as a result of the current worldwide environmental degradation. The entire community should be involved in environmental conservation as a social concern. Therefore, the only way to fundamentally stop the environment from getting worse is to encourage individuals to engage in pro-environmental behavior. The rapid development of the Internet has significantly altered how people live their daily lives. The advancement of information technology has not only brought convenience and enjoyment, but it has also given the people a new method to get involved in environmental protection, and "Ant Forest" is an effective endeavor. Ant Forest is a green application created to motivate users to gather "green energy" through an online gaming system, and ultimately the system would plant actual trees for users in the real world. The public's awareness of environmental protection is raised, and environmental habits are formed as a result of this innovative method to protecting the environment. Research on this new system and its effects on users' environmental behavior is lacking, nevertheless. This research develops a theoretical framework based on values theory and persuasion system theory to examine how Ant Forest affects users' pro-environmental behavioral intention.

Keywords

Pro-environmental behavioral intention; Value Theory; Principles of persuasion design.

1. INTRODUCTION

The state of the world's ecology has steadily declined in recent years. The fifth assessment report of the United Nations Intergovernmental Panel on Climate Change (IPCC) predicts that by the end of this century, global surface temperatures will have increased by an average of 0.3°C to 4.8°C. The paper also notes that airborne concentrations of carbon dioxide, methane, and nitrous oxide have reached their highest points in 800,000 years. Global environmental and climate change now pose a severe threat to human life and long-term socioeconomic progress.

Massive greenhouse gas emissions, excessive water consumption, excessive land use, deforestation, etc. are all results of human activity. Environmental issues like ecological degradation and global climate change have been caused by these actions. Therefore, a key strategy for addressing environmental issues is to encourage people to adopt pro-environmental behavior. Research on the elements influencing individual pro-environmental behavior must be done in order to motivate the people to take aware environmental acts and support environmental protection.

Environmental education programs and various environmental taxes are just a couple of the initiatives that governments and affiliated organizations have actively implemented to encourage more people to participate in environmental activities. The concept of "online environmental protection" emerged as a result of the rapid advancement of information technology and the dissolution of time and geographical limitations. Online environmental protection is the practice of increasing environmental awareness and action through the use of social media, digital technology, and the Internet in order to advance sustainable development objectives. There are already a lot of online environmental initiatives, like Panda Guardian, which Weibo and the China Green Foundation jointly launched.

Alipay created the online game Ant Forest with the intention of inspiring people to conduct low-carbon environmental action. With more than 550 million users, Ant Forest has grown to be the most widely used environmental mobile application in China. The success of Ant Forest can be attributed to three key factors. First off, Ant Forest is an online game that makes players feel happy and successful. Secondly, Ant Forest combined the content of online and offline. Users can plant virtual trees online that will eventually grow into actual trees, but in order to promote the online game, they must also engage in offline environmental preservation initiatives. Consistent environmental activism by Ant Forest aids in increasing users' knowledge of environmental problems. Additionally, Ant Forest is a social application that enables users to create and manage social networks throughout the game as well as engage in online social activities to fulfill social demands.

Ant Forest is a customized green information system that includes an environmental application for individual users. A green information system is one that effectively promotes environmental protection and increases eco-efficiency. According to research on green information systems, users' perceptions of environmental sustainability and their capacity to 'voluntarily' change their behavior are influenced by persuasive systems. The Ant Forest system design is also compatible with the philosophy of persuasive system design concepts. Therefore, this study investigates how users are affected by the persuasive system design of Ant Forest.

Since Ant Forest is a new APP with few comparable goods, the academic community has paid it little attention; therefore, it is important to explain how Ant Forest functions. Therefore, the following research questions are presented. Is there a relationship between Ant Forest's users' value and the system's functional features? What ideals do Ant Forest users cherish in particular? The answers to the aforementioned queries will help individuals adopt pro-environmental behaviors and advance environmental APP development. We have merged persuasion systems theory and value theory to construct a thorough research model that tries to demonstrate the connections between persuasive design principles, self-enhancing ideals, and pro-environmental behavioral intention in order to respond to these concerns.

2. RESEARCH BACKGROUND

2.1. Ant Forest

Alipay created the Ant Forest app to nudge users toward being low-carbon and environmentally friendly. Through the applet option on the Alipay site, users can immediately access Ant Forest. The 'gaming' function of Ant Forest is its key feature, allowing users to play games by gathering and utilizing 'green energy'. There are two ways for users to access green energy. In order to transform each user's low-carbon activity into a certain amount of green energy, the Ant Forest system can first define conversion criteria based on scientific carbon reduction and recycling algorithms. By connecting users' online gaming experiences with their outside environmental behavior, Ant Forest makes it simpler and more enjoyable for users to engage in low-carbon behavior on a daily basis. Users can also 'steal' energy from their peers. The social networking capabilities of Ant Forest are reflected in this design. Each user in Ant

Forest has a unique list of friends depending on their social network, and by visiting their friends' pages, they can "steal green energy" from their friends. A leaderboard shows users' and their friends' current levels of "green energy" in real time. The 'Co-Planting' feature of Ant Forest, which includes 'Family Trees', 'Love Trees', and 'Classmate Forests', recently allowed users to plant trees with friends. Through cooperative play, co-planting can improve interpersonal bonds and increase user stickiness by luring users to Ant Forest more regularly.

Users will be able to raise trees from seed to maturity by gathering "green energy," and once they are mature, a real tree can be planted in the user's honor through PayPal in the desert. In the interim, 2.74 million acres of desertified land have been renovated, and 200 million actual trees have been planted in desertified places.

2.2. Value Theory

As a result, value can be utilized to predict attitudes and behavioral intentions since it plays a significant role in explaining particular beliefs and behaviors [1-2]. Value is described by Schwartz as 'desirable transitional goals of varying importance that can serve as guiding principles for the life of a person or other social entity'.

The cornerstone of value study is Schwartz's value theory, and on the basis of this theory, academics have concentrated their studies on the factors that influence values and the connection between values and behavior. According to research on the factors that influence values, five personality traits and values are closely associated. According to Parks-Leduc et al. [3], affect-based personality traits had a lower correlation with personal values than cognitive-based personality traits did. Other impacts on values were taken into account in several research. For instance, Rokeach [4] stated that differences and similarities across people, organizations, nations, and cultures have an impact on personal values.

Another set of academics is more interested in how a person's values affect their behavior. Values and behavior are typically closely connected in a circular framework, according to Bardi and Schwartz [5]. Investigations have also been made into the connection between values and behavior. According to Sortheix and Lonqvist [6], an individual's values indirectly influence their level of life satisfaction through the influence of their social environment. To the extent that an individual's values are in line with those of the group, their values are effective in enhancing their well-being.

Values can be categorized as self-enhancement and self-transcendence values, according to Schwartz's value theory. While self-transcendence values place more emphasis on the interests of others, self-enhancement values place more emphasis on one's own interests and feelings. This distinction can be used to explain why people engage in environmental protection activities with varying attitudes and behaviors, and as a result, this dichotomy has been frequently used in research on environmental protection issues.

2.3. Persuasion system design model

Persuasion systems are information systems that enable users to modify their attitudes and behaviors by freely moving in the direction intended by the technology. In addition, a framework for the design and assessment of persuasion-based systems was created. According to the framework, any system for persuasion must adhere to four fundamental design principles: primary task support, support for human-machine conversation, social support, and system reliability. Human-machine dialogue support means that the system gives the user relevant and motivating feedback through text, images, sound, and other forms; primary task support means that the system supports the achievement of the user's primary activities and goals while tracking progress on the task; System reliability refers to the credibility and dependability of the system's design as well as the legitimacy and dependability of the services it offers. Social support refers to the system's use of social influence to inspire the user.

Domestic researchers concentrate more on the in-depth analysis of existing persuasion system models, focusing on the creation and application of persuasion systems as well as further examining the connection between persuasion system creation and user use. Zhang Gan [7] created a product targeted at health-related behaviors and further researched how product users behaved using the PSD model. Wei Hanyu [8] investigated a gamified and social persuasion system and demonstrated how these components may motivate user behavior. Meng Jiao [9] enhanced the theory of persuasive systems design and looked at the design ideas for products that support healthy lifestyles. The role and impact of persuasive systems in the setting of Q&A platforms were examined by Xu Yiming et al. [10] using Zhihu as a research object and the persuasive system design model as a theoretical foundation.

On the other hand, foreign academics have concentrated more on improving or expanding the persuasive system design model in order to pinpoint the elements that affect user behavior. Lehto et al. [11] examined the impact of perceived persuasiveness on users' desire to continue using the system in order to eliminate the social support principle from the list of four principles. To further explore users' intentions to keep using, Lehto and Oinas-Kukkonen [12] restored the social support variable and also added a new variable, perceived achievement. Primary task support and system reliability, according to Drozd et al. [13], can positively influence perceived persuasiveness, and perceived persuasiveness can further influence users' intention to use.

3. RESEARCH MODEL AND PROPOSALS

Intentions can predict behavior, according to numerous studies. Additionally, intentions are a superior predictor of behavior compared to other cognitions including norms and self-efficacy. Environmental research frequently employs behavioral intentions as a proxy for actual behavior since real behavior is frequently influenced by complicated factors that are challenging to assess. An key indicator of an individual's actual pro-environmental behavior is their pro-environmental behavioral intention.

3.1. Value

Values are objectives that can direct a person's or a group of people's lives in various situations. According to value theory, there are two basic categories of values that humans can hold: self-enhancement values and self-transcendence values. Users' experiences in Ant Forest are primarily influenced by their self-enhancement values, which place a stronger emphasis on personal interests than self-transcendence values, which are more concerned with the interests of others. This study will address both gamification and social viewpoints in order to establish the value preconditions for Ant Forest users' behavioral intentions since Ant Forest contains both gaming and social characteristics. The first viewpoint illustrates Ant Forest's gamified nature. Since Ant Forest is essentially an online game, it possesses the usual attributes of online games, which can make players happy and satisfied. Additionally, Ant Forest offers social capabilities that enable users to communicate with and exchange information with their friends while using Ant Forest, aiding in the maintenance of users' social connections.

Self-enhancement values are tightly tied to individual costs and benefits. An app called Ant Forest offers a variety of leisure and amusement options. First off, Ant Forest offers a variety of gaming features, such as game rating, that enable players to experience genuine self-satisfaction and earn practical virtual rewards. Second, users won't find using Ant Forest too challenging, which makes it a pleasurable and pleasant experience. Additionally, Ant Forest offers a forum for user communication and sharing. Ant Forest's social nature is one of its key characteristics and a crucial element in acquiring user support. The social connection between users and the social value derived from the process, as stated in earlier work, are what make Ant Forest special. As a result, utilitarian, hedonic, and social components of the user's experience are

crucial in studies on Ant Forest. In light of this, we suggest that users' assessments of utilitarian value, hedonic value, and social value represent their most important self-enhancement values.

Utilitarian value

Utilitarian value refers to the external advantages that users see as a result of utilizing Ant Forest, such as rewards, perks, and recognition on a virtual and physical level. The user's pleasure with Ant Forest's effectiveness, efficiency, and outcomes determines if utilitarian value is satisfied. Through Alipay, which can be used to grow virtual trees in the game, users of Ant Forest may transform their actual low-carbon behavior into green energy. In unused spaces, Ant Forest will plant actual trees whenever the virtual seedlings reach adulthood. Users of Ant Forest are encouraged to play the game by using virtual game components including leaderboards, points, and badges. Users feel gratified by these game components, which increases their interest in Ant Forest and willingness to play for longer periods of time. Therefore, we conclude that

Proposal 1. User's perceived utilitarian value is positively associated with his/her pro-environmental behaviour intention.

Hedonic value

Hedonic value describes the perceptions of pleasure, enjoyment, and entertainment that users have when using Ant Forest. This suggests that the gaming experience is intrinsically enjoyable and fun. Numerous studies have demonstrated that users primarily use wireless devices or gaming consoles to play computer games online. Hedonic value had an impact on students' behavioral intentions, according to a study on students' adoption of Internet-based learning material. Users can feel relaxed and happy when gathering energy and finishing chores in Ant Forest, which can encourage them to play the game more. Therefore, we propose that

Proposal 2. User's perceived hedonic value is positively associated with his/her pro-environmental behaviour intention.

Social value

Social value is the value that users are able to create and sustain through their use of Ant Forest in their social interactions and connections with friends. Ant Forest's game design places a strong emphasis on how social contact is interactive. Ant Forest encourages players to invite friends to play alongside them, enhancing the game's enjoyment and interactivity through interpersonal contact. Users can play the game with their friends and plant trees, compete with them, and work together to win. This increases social engagement and connection and improves friendships. Secondly, by allowing friends, relatives, and even complete strangers to water the seedlings planted in Ant Forest, users are given the opportunity to experience a certain level of social value. Users are more devoted to Ant Forest and more inclined to keep using it because Ant Forest is an interactive experience that gives them opportunity for social connection and interpersonal contact. Therefore, we believe that

Proposal 3. User's perceived social value is positively associated with his/her pro-environmental behaviour intention.

3.2. Principles of persuasive design

Primary task support

Primary task support is methodically guiding and monitoring users as they begin and complete task objectives. The provision of users with practical and efficient means of completing tasks or goals, so raising their sense of self-efficacy, is a crucial component of primary task support. Ant Forest offers a novel way for users to participate in environmental conservation and support people in achieving their environmental goals by encouraging users to amass "green energy" through offline low-carbon behavior and planting actual trees in the

real world. Ant Forest offers features like energy balls, energy leaderboards, and energy bars that provide users with a precise and practical summary of their progress and recent accomplishments, making them feel satisfied. Users experience a sense of accomplishment and fulfillment as they advance toward their goals thanks to milestone rewards like certificates and medals. Therefore, we believe that

Proposal 4a. The primary task support design of the Ant Forest system is positively associated with users' utilitarian value.

Ant Forest uses gamified environments to achieve the majority of task assistance. For instance, the 'bag' on the Ant Forest home page is divided into four primary categories: backgrounds, skins, charms, and accessories. Users can speed up their energy acquisition by using the available props, and they can also dress up their personal pages with accessible skins and charms to improve their game fun. In addition, Ant Forest is frequently updated with fresh games, including the most recent release, 'Magical Ocean' to accommodate changing customer demands. Ant Forest's gamification design effectively improves customers' gaming experiences, enabling them to unwind and enjoy themselves as they utilize it. Therefore, we assume that

Proposal 4b. The primary task support design of the Ant Forest is positively associated with users' hedonic value.

The nurturing of virtual trees and the gathering of "green energy," both of which are intrinsically related to buddy contact, make up the main elements of Ant Forest. The two major ways to obtain "green energy" are by "stealing" it from friends and participating in individual users' offline low-carbon behavior. In addition to stealing energy, other options include watering friends' trees and sending messages to friends. The energy leaderboard allows users to view their own energy rankings as well as those of their friends. You have the option to jointly plant virtual trees with your friends in addition to planting them independently. Ant Forest clearly has a social component because users may keep up their social network and actively engage with their friends while using it. Therefore, we believe that

Proposal 4c. The primary task support design of the Ant Forest is positively associated with users' social value.

Human-machine dialogue support

In order to motivate the user, the system delivers feedback to them via graphics, text, and sound under the guise of "human-machine dialogue support." Users of Ant Forest will be given a variety of certificates, some of which will include expressions of gratitude in addition to formal endorsements. Users will also have access to recordings of field trips to the trees they've planted, which will help them feel more motivated and satisfied by providing them a more realistic and vivid feeling of their contribution to the ecosystem. Users can earn virtual rewards for finishing green activities by clicking the "reward" button on the Ant Forest site, which encourages participation and gives users a sense of accomplishment. Therefore, we assume that

Proposal 5a. The human-machine dialogue support design of the Ant Forest is positively associated with users' utilitarian value.

Gamification was used into the design of the human-machine dialogue support in Ant Forest as one of its primary elements to increase user engagement. Users can intuitively experience the entertaining pattern design, the virtual tree growth system, the subtle dynamic effects, and the real-time updated user interaction interface on the Ant Forest game page. This meets the requirements of the human-machine dialogue support setting and gives users a higher level of gaming experience, promoting relaxation and enjoyment while playing. Therefore, we propose

Proposal 5b. The human-machine dialogue support design of the Ant Forest is positively associated with users' hedonic value.

The emphasis in Ant Forest is on user engagement. Ant Forest displays the friends who have earned the most energy value as well as the friends who have earned the most energy value. It also refreshes the daily energy value earned from friends and the energy value earned by friends. Daily, weekly, and overall rankings are updated in real-time under "Forest Ranking," enabling users to see exactly where they stand in respect to their peers. The information above, both in text and graphic form, is intended to assist human-machine communication and can significantly improve user-friend engagement. Therefore, we believe that

Proposal 5c. The human-machine dialogue support design of the Ant Forest is positively associated with users' social value.

Social support

Social support denotes the use of social influence to inspire consumers. As a social media, Ant Forest's social influence cannot be understated. According to the Ant Forest system, a user's Ant Forest usage behavior is more likely to be accepted by their social circle, which leads to feelings of accomplishment and self-satisfaction, the more positively their social circle views Ant Forest and the more attention they pay to the number of certificates and energy ranking. According to Li Mengdi's research from 2018, Ant Forest may increase the number of people who actively and freely participate in environmental activities. Participants may also experience feelings of pride and accomplishment as a result of their participation. Therefore, we hypothesize the following

Proposal 6a. The social support design of the Ant Forest is positively associated with users' utilitarian values.

With games like 'stealing' energy, watering amongst friends, energy leaderboards, messaging from friends, and giving energy back, the Ant Forest system is built with a heavy emphasis on social interaction between users, allowing players to have fun and unwind while playing. Perceived social support can have a favorable impact on entertainment motivation. Therefore, the following hypothesis is proposed.

Proposal 6b. The social support design of the Ant Forest is positively associated with users' hedonic value.

A number of games in Ant Forest, such as energy rankings, co-plant, energy "stealing" and sending pop-up messages to pals, all call for the involvement of peers in order to promote social interaction. Users won't completely experience Ant Forest's social interaction features until more of their friends and neighbors start using it. Therefore, we believe that

Proposal 6c. The social support design of the Ant Forest is positively associated with users' social value.

System reliability

It assesses a system's dependability, or if the system's design and the services offered are dependable and trustworthy. The value of the energy sphere can be used to infer the user's life trajectory because the value of "green energy" is determined based on the user's offline low-carbon behavior, which is a serious privacy risk. Ant Forest takes user privacy and system security very seriously since it offers the option to hide the energy ball's value. When utilizing Ant Forest, users shouldn't have to worry about their personal information being compromised. They should feel confident that Ant Forest is safeguarding their data for their advantage. Therefore, we believe that

Proposal 7a. The system reliability design of the Ant Forest is positively associated with users' utilitarian values.

Ant Forest works with a number of national professional organizations and institutions, in addition to safeguarding users' privacy, to ensure that the act of planting trees in the actual world is authentic and reliable, allaying users' anxieties and concerns and fostering trust. Users

can only enjoy an immersive gaming experience and fully appreciate the fun and delight of the game if they have faith in the Ant Forest initiative. Therefore, we believe that

Proposal 7b. The system reliability design of the Ant Forest is positively associated with users' hedonic value.

All interactions between users and their friends are shielded from security flaws that violate privacy in the Ant Forest project. In Ant Forest, users can communicate with their friends in an open and unrestricted manner, facilitating the growth and upkeep of their social network. Therefore, we believe that

Proposal 7c. The system reliability design of the Ant Forest is positively associated with users' social value.

4. RESEARCH CONTRIBUTIONS

4.1. Implications for research

In order to enhance the research context and content of personal environmental protection behavior, this paper first examines the 'online+offline' environmental protection context of Ant Forest. By erasing the spatial and temporal limits of environmental protection and fusing online gaming content with offline environmental protection behavior, Ant Forest represents a significant advancement in the field of environmental protection. This paper has further deepened the understanding of individual environmental protection behavior in the context of the 'online+offline' environment by researching the continuous game intention and environmental protection behavior intention of ant forest users, as well as the factors affecting user behavior. In addition, this paper adds new influencing factors to the traditional "offline" environmental protection research, adding "online" environmental protection-related content, and to some extent enriching the research content in the area of environmental protection.

Secondly, this study adds to and supplements the value theory by examining the impression of personal value motivated by ant forest users while they are using it. Value theory offers categories and definitions for personal values, but the precise ways in which they are articulated in various contexts vary without definitions. By analyzing the values connected to Ant Forest users' gaming experiences and utilizing value perceptions as a sample of many sorts of values, this study seeks to shed light on the relationship between human values and environmental behavior. This study expands on the practical applications of value theory and offers a fresh perspective for comprehending Ant Forest users' pro-environmental behavior.

Last but not least, this thesis employs the design principles of persuasive systems to pinpoint the main affects of Ant Forest on users' environmental behavior. An environmental application called Ant Forest has a persuasive system that adheres to the rules of persuasive design. The essential design components that affect users' personal value judgements and pro-environmental behavioral intentions in Ant Forest are identified in this thesis using persuasive design principles, and their influencing mechanisms are examined. The research on green information systems is enriched by this study, which offers fresh perspectives and pointers for the study and application of environmental applications or online environmental projects.

4.2. Implications for practice

First off, by analyzing Ant Forest users, this study offers beneficial insights for managers and developers of Ant Forest and related environmental applications. First, Ant Forest may further improve the gaming experience and cater to the needs of its players by following the rules of compelling design. At the same time, it can expand on its current framework to offer greater strategies and features. In order to draw in more customers who share its ideals, Ant Forest might also emphasize and promote its environmental philosophy more strongly.

The study also has consequences for governmental bodies and environmental nonprofits. The "online to offline" concept of environmental conservation put out by Ant Forest enables environmental efforts to reach more people and have a bigger impact online. Additionally, the "online to offline" paradigm aids in integrating environmental protection ideas into people's daily lives, hastening the development of a society that values the environment. As a result, governments and environmental groups can use this model as a guide and the Internet and other information technology tools to actively promote environmentally friendly behavior and awareness as well as social awareness and involvement in environmental protection.

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