IMPACT OF GAMIFICATION-DRIVEN MOTIVATIONAL AFFORDANCES IN GREEN LOGISTICS ON REUSABLE PACKAGING BEHAVIOR

Mu-Chen Chen
Department of Transportation and Logistics Management
National Yang Ming Chiao Tung University
4F, No. 118, Section 1, Chung Hsiao W. Road, Taipei 100003, Taiwan
ittchen@nycu.edu.tw

Chia-Lin Hsu[1]
Department of Information Management
Fu Jen Catholic University
No.510, Zhongzheng Rd., Xinzhuang Dist., New Taipei City 242062, Taiwan
157287@mail.fju.edu.tw

Yi-Chen Huang
Department of Transportation and Logistics Management
National Yang Ming Chiao Tung University,
4F, No. 118, Section 1, Chung Hsiao W. Road, Taipei 100003, Taiwan
yichen.mg10@nycu.edu.tw

ABSTRACT

Gamification has become a trend in the field of sustainability. To enhance consumers' intention to use and return reusable packaging, this study develops a gamified technology approach to elaborate on the motivations that drive users' engagement in sustainable behaviors. It investigates the impact of green psychological benefits generated during the gamification technology experience on the behavior of using and returning reusable packaging. A PLS-SEM model is developed to examine the influence of external and internal motivations stimulated by gamification design elements on the green psychological benefits, which drive consumers' behavioral outcomes of using and returning reusable packaging in e-commerce. This study finds that intrinsic and extrinsic motivations have a significant and positive impact on green psychological benefits and, in turn, significantly and positively influence consumers' intentions to use and return reusable packaging. Furthermore, the research confirms that the warm glow effect has a partial mediating effect on the link between intrinsic motivation and intention to use and return reusable packaging. This study contributes to the theory and practice of social sustainability marketing technology by enhancing the understanding of customer motivations and behavioral intentions in e-commerce in the sustainable gamification context.

Keywords: Green gamification technology; Green psychological benefits; Social sustainability marketing technology; Reusable packaging technology

1. Introduction

During the COVID-19 pandemic, many brick-and-mortar stores switched to online sales (Celinska-Janowicz & Dolega, 2024; Kim, 2020), and the usage of e-commerce continued to increase due to the huge increase in online shopping demand (Lu et al., 2020). A Statista (2020) report states that in 2019, global retail e-commerce sales amounted to US$3.53 trillion, and this figure was projected to grow to approximately US$6.54 trillion by 2022. The COVID-19 pandemic not only triggered widespread public anxiety and a surge in panic buying of daily necessities but also significantly boosted the sales of food products and home-based activity items as consumers curtailed their

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[1] Corresponding author.

outdoor activities. This has led to an increase in the environmental cost of carbon emissions from delivery vehicles (Pålsson et al., 2017), while individual shipments generate additional transport packaging (Zimmermann & Bliklen, 2020). According to the World Economic Forum (2024), under a business-as-usual scenario, the number of delivery vehicles operating in urban environments is projected to increase by 61% by 2030. This growth is expected to result in a 60% surge in global carbon emissions from last-mile deliveries, which would represent approximately 54% of emissions within the transport sector and 13% of overall urban emissions. Such an increase presents substantial risks to public health, with projections indicating a 12% rise in healthcare expenditures and a 14% escalation in urban traffic congestion.

Packaging plays a key role in green logistics, which affects environmental sustainability because it generates a significant amount of waste if it is non-reusable (Seo et al., 2016). Online shopping generates a significant amount of additional packaging waste to protect products during distribution, and further causes environmental damage (Kim et al., 2022). The research results of Statista indicated that the greenhouse gas emissions generated by packaging consumables will account for about 45% of the total carbon emissions of e-commerce in 2020 (Coppola, 2022). Regarding packaging use, the choice between single-use and sustainable reusable packaging significantly impacts waste generation (Pålsson et al., 2013). Research has shown that when reusable packaging reaches a certain number of cycles, it helps conserve resources and avoid waste (Zimmermann & Bliklen, 2020). Aggarwal (2024) demonstrates that reusable packaging boxes designed for 20 use cycles significantly outperform their disposable counterparts across multiple environmental impact categories, including a 59% reduction in climate change-related emissions. The study highlights the environmental benefits of reusable systems, revealing marked decreases in various ecological footprints and reinforcing the case for sustainable packaging solutions. The environmental impact and waste of resources caused by packaging consumables, such as packing boxes, packaging cushioning consumables, and sealing tapes, have become global issues. Most of the packaging waste generated by online shopping is cartons, plastic cushioning materials, and tapes, and consumers often choose to discard packaging waste (Chueamuangphan et al., 2020). Thus, companies must change in response to sustainable and green trends (Chhabra et al., 2017). Green packaging, that is, the use of environmentally compatible ecological materials and recycling, can be used to solve the problem of carbon footprint and waste in practice (Sarkis et al., 2010), while sustainable packaging is a key consideration in achieving sustainable development goals (Fonseca et al., 2020) with social and economic implications (de la Caba et al., 2019).

Understanding how to drive and motivate consumers to engage in sustainable behaviors is an important topic in marketing research (White et al., 2019). As the awareness of cultivating sustainable consumption habits continues to grow, scholars are seeking broader approaches to encourage sustainable lifestyles, such as gamification (Douglas & Brauer, 2021). Gamification is the use of game elements and mechanisms in non-game entertainment environments (Huotari & Hamari, 2017), applying the essence of games—fun, gameplay, design, and challenges—to the real world (Palmer et al., 2012). By applying the hedonic nature of games to utilitarian purposes (Koivisto & Hamari, 2019), gamification has unlimited potential to motivate and drive people to take actions that are personally and collectively beneficial. Past empirical studies on gamification have shown that, in most cases, gamification has positive effects on motivation and behavior (Koivisto & Hamari, 2019; Sailer et al., 2013), and there have been many studies on the application of gamification in the field of e-commerce to attract and guide consumer behavior (Aulia et al., 2022; Insley & Nunan, 2014).

To enable e-commerce consumers to develop the habit of using and returning reusable packaging, gamification elements are designed in the packaging reusing model. Through gamification, the motivation to implement sustainable behavior is given to drive consumers and encourage them to take action (Anderson et al., 2013), finally achieving the purpose of influencing user behavior (Robson et al., 2015). Motivation is the psychological process that guides and drives people to produce behavior (Gollwitzer & Bargh, 1996). Individuals may be driven by the desire to gain fame, respect, friendship, and other social and psychological goals (Olson Jr, 1971). Self-determination theory mentions that behavior is mainly influenced by extrinsic motivation or intrinsic motivation (Deci & Ryan, 2013). Self-determination theory is a prominent framework for understanding human motivation and is widely recognized for its effectiveness in identifying the contextual factors that influence individual behavior (Gilal et al., 2019). In gamification, users may be motivated by both extrinsic motivation (e.g., reward) and intrinsic motivation (e.g., sense of achievement and enjoyment) (Hamari & Koivisto, 2015b). Therefore, gamification should emphasize an understanding of the motivation types that drive users to participate in the sustainable behavior of using green reusable packaging, provide users with a variety of game experiences, and connect users with the context of reality so as to achieve the purpose of changing their behavior patterns.

User motivation will affect psychological engagement, which in turn will affect behavioral outcomes (Lyu & Kim-Vick, 2022; Seiffert-Brockmann et al., 2018). Most gamification studies have focused on the effects of gamification design elements on guiding specific behaviors (Che et al., 2023; Hamari et al., 2014; Liu et al., 2024; Venturi et al., 2025), largely ignoring the underlying psychological mechanisms to explain these effects (Deterding,

2014). In other words, the motivation of users in gamification may reveal psychological needs that need to be satisfied (Sailer et al., 2017) and their impact on behavioral outcomes (Che et al., 2023; Mekler et al., 2017). Based on the above discussion, gamification tends to stimulate different motivations to influence the user psychologically to promote the expected results. It is of more academic value to explore the influence of users' motivation on their green psychological benefits, that is, how motivations through gamification guide users' intention to use and return. Therefore, this study explores the motivations generated through gamification and their influence on the green psychological benefits of reusable packaging users.

2. Literature review and hypotheses development

2.1. Green logistics packaging

Logistics packaging is different from consumer packaging. It has functions such as the protection and identification of goods, the organization of contents, and the transmission of information, and has physical attributes that lead to desirable affordance such as convenient storage and practical transportation (Jazairy & Von Haartman, 2020). Commodities wrapped in consumer packaging are grouped and bundled in specific quantities in consideration of the economic benefits and customer needs. Logistics packaging includes cartons, plastic bags, bubble tape, adhesive tape, film, and other structures. If the packaging materials are poorly selected, excessive packaging or repeated packaging may be needed, leading to increased waste, depletion of resources, and harm to the natural environment. There may also be concerns about logistics packaging affecting human health (Agyabeng-Mensah et al., 2020).

Green packaging, also known as sustainable packaging, does not pollute the ecological environment and does not cause harm to human health. It can be reused, decomposed naturally, recycled, and regenerated; it promotes the economy and the environment (Guo et al., 2021). The Sustainable Packaging Coalition defines sustainable packaging as packaging that is sourced responsibly, is effective and safe throughout its life cycle, meets market standards for performance and cost, is manufactured entirely using renewable energy, and is effectively recycled after use. Based on the premise that recycling locally provides valuable resources for future generations (Carlson, 2008), this definition combines environmental and economic considerations. To promote the development of global green packaging, the International Organization for Standardization (ISO) formulated the ISO 14000 international environmental management standard (Johnson, 1997).

Reusable online shopping packaging is reusable packaging (a bag or box) meant to eliminate the environmental burden of one-time online shopping packaging. Reusable packaging can be roughly divided into two categories according to the mode of reuse and the owner of the packaging (Greenwood et al., 2021). Rental packaging may have a deposit or fine mechanism, and consumers must return the reusable packaging to the company after use. The other category is refillable packaging, which will be returned to the consumer after the consumer purchases the product for the first time. In addition to refilling the contents multiple times, consumers can use this type of packaging in other ways. When applied to commercial packaging, consumers can choose to refill by purchasing refill packs (Coelho et al., 2020); when applied to logistics packaging, consumers can return the reusable packaging to enterprises or third-party packaging recycling platforms to clean, disinfect, and reuse. The reusable packaging discussed in this research is the reusable packaging used for e-commerce logistics delivery to wrap the goods ordered by consumers. After taking out the online shopping products, consumers can choose whether to return the reusable packaging.

2.2. Gamification

Gamification aims to provide users with a gaming experience in a non-gaming entertainment context. Through the game thinking process and the use of game mechanics, users can have a sense of engagement and accomplishment (Reeves & Read, 2009). Gaming experience can increase user engagement and motivation (Hamari & Koivisto, 2015a; Koivisto & Hamari, 2019), create value (Mulcahy et al., 2015), and guide users to perform specific behaviors (Huotari & Hamari, 2017). Gamification focuses on the game experience, that is, the pursuit of the satisfaction of inner needs (Huotari & Hamari, 2017), and game design, that is, the game design elements that can guide users to perform the behavior expected by the game designer (Deterding, 2011). Gamification is the use of elements in games that arouse user motivation in non-game contexts to guide user behavior according to the needs of designers (Anderson et al., 2013). Gamification can be seen as designing a way to change user behavior (Mandujano et al., 2021), increase user awareness, and drive users to achieve a desired new behavior or continue the original behavior (Van Boeijen et al., 2020).

Wood and Reiners (2012) divided gamification into reward-based gamification and meaningful gamification according to the type of motivation that gamification designers want to elicit. Reward-type gamification provides extrinsic motivation to attract users to participate in the gamification technology experience, which can achieve immediate and short-term changes in users (Nicholson, 2013). Meaningful gamification instigates intrinsic motivation. Creativity and learning outcomes are both positively affected (Ryan & Deci, 2000), and meaningful gamification can increase user engagement and performance outcomes in specific tasks (Cerasoli et al., 2014). The internal

achievements and perceptions obtained by users from the gamification technology experience are connected with previously held beliefs, which may lead to a change in these beliefs and thus have a long-term impact on the user's behavior or attitude (Liu et al., 2017). Gamification combines these two motivations, applying gamification design elements to provide extrinsic motivation to attract interaction and shape the user's intrinsic motivation (Muntean, 2011).

2.3. Self-determination theory

Self-determination theory (Deci & Ryan, 1985) is a macroscopic human motivation theory that is used to explore the motivation or factors for individuals to engage in specific behaviors. According to the degree of self-determination, the motivation types are extrinsic motivation and intrinsic motivation (Deci & Ryan, 2004). Extrinsic motivation is not a unitary construct but exists along a continuum of autonomous regulation. It can be differentiated into four distinct types: external regulation, introjected regulation, identified regulation, and integrated regulation (Ryan & Deci, 2020; Tsai et al., 2021). External regulation refers to behavior driven solely by the desire to obtain external rewards or avoid punishments. Introjected regulation involves internal pressures, such as guilt or ego involvement, where the behavior is partially internalized but not fully accepted as one's own. Identified regulation occurs when an individual consciously values a behavior and accepts it as personally important, thus engaging in it with a sense of volition. Integrated regulation, the most autonomous form of extrinsic motivation, reflects a full internalization of the behavior's value, such that it aligns with one's core values and needs; however, the behavior is still performed to attain separable outcomes. Extrinsic motivation refers to the drive to perform an activity based on the expectation of obtaining separable outcomes, such as earning rewards and gaining recognition (Ryan & Deci, 2019; Tsai et al., 2021). More precisely, extrinsic motivation in the form of external regulation refers to behavior that is driven by external demands or contingencies, such as the pursuit of monetary rewards or the avoidance of punishment (Ryan & Deci, 2000a). Intrinsic motivation refers to the internal psychological drivers that compel individuals to engage in behaviors or activities they find inherently enjoyable, satisfying, or meaningful (Ryan & Deci, 2000; Ryan & Deci, 2020; Shahid et al., 2024). A core principle of self-determination theory suggests that autonomy (i.e., the need for autonomy, reflecting a sense of control over one's own actions), competence (i.e., the psychological need for self-efficacy and a sense of mastery), and relatedness (i.e., the need for relatedness, reflecting the desire to feel connected to and accepted by others) constitute three fundamental psychological needs essential for intrinsic motivation (Ryan & Deci, 2017; Tsai et al., 2021). Environments that support individuals' psychological needs for autonomy, competence, and relatedness are conducive to fostering high-quality motivation and sustained engagement. When these needs are fulfilled, individuals tend to exhibit greater psychological resilience and functional effectiveness. Conversely, when these needs are thwarted, individuals are more likely to experience adverse outcomes such as loneliness, helplessness, and a diminished sense of self-efficacy (Chiu et al., 2024). In sum, both intrinsic and extrinsic motivations play pivotal roles in shaping user behavior (Cassia & Magno, 2024). Effectively balancing these motivational drivers in product or system design can enhance the quality and sustainability of user engagement over time.

2.3.1. Extrinsic motivation

2.3.1.1. Virtual rewards

Virtual rewards are rewards or intangible incentives that users receive after performing desired behaviors, functioning as a quid pro quo to provide users with positive behavioral reinforcement based on the performance or implementation of desired behaviors (Richter et al., 2015). The most common element of gamification applied in consumer contexts is rewards (Zichermann & Linder, 2010). Points and rewards have been shown to influence consumer choices and motivate specific behaviors (Temnyalov, 2019). In the green packaging recycling system, it takes time and other additional costs for consumers to return the reusable packaging to the return point. Therefore, symbolic reward elements, such as points, badges, or virtual goods, can be provided in gamification to incentivize users to participate in online shopping packaging reusing.

2.3.1.2. Social recognition

Social recognition refers to the behaviors that individuals take to obtain the recognition of others and avoid their disapproval; in other words, external social factors and the social environment may have an impact on an individual's psychology. How individuals view themselves depends on their performance in front of others, how they think that others evaluate them (Cooley, 1902), and the social feedback received for individual behavior (Huang & Zhou, 2021). Recognition means the value that users get from the approval and acceptance of others (Hennig-Thurau et al., 2004). In gamified systems, users' behavior is regulated by the admiration or approval of other users (Lafrenière et al., 2012).

2.3.2. Intrinsic motivation

2.3.2.1. Autonomy

Autonomy refers to the perception and motivation of an individual in mastering their own decisions, interacting with the environment, and taking actions from the heart (Deci & Ryan, 2004). The key to decision-making control is self-awareness, relying on self-will to choose the way to engage in activities (Wehmeyer et al., 2017). When

individuals can make their own choices from activities or tasks, or there is a mechanism that can provide immediate feedback during the process of performing tasks, their needs for autonomy will be satisfied (Rigby & Ryan, 2011). In addition, in the game system, users can choose different levels or tasks (Peng & Hsieh, 2012), choose how to interact with the game system and other players and define their own avatars in the game (Jahn et al., 2021) to interact with gamified systems in a more personal way. The abovementioned gamification design elements can be used to stimulate the user's free will and improve their sense of autonomy.

2.3.2.2. Competence

Competence is the degree to which an individual perceives control and competence when interacting with the environment (Rigby & Ryan, 2011). When acquiring new knowledge, skills, or abilities, individuals develop a sense of competence by receiving positive feedback and participating in challenges (Klein, 2019). There are tasks or challenges in the gamified environment, which are matched with individual abilities or skills, allowing users to express and enjoy themselves in the process of overcoming challenges or completing tasks, thereby gaining a sense of accomplishment (Tobon et al., 2020). Common achievement or progression-oriented gamification elements include points, badges, and leaderboards (Koivisto & Hamari, 2019), which are linked to competition, recognition, performance, and status (Santhanam et al., 2016) to stimulate users' competitiveness and influence their participation (Amo et al., 2020).

2.3.2.3. Relatedness

The sense of relatedness refers to the degree to which an individual perceives a sense of belonging in a group and a feeling of connection with important others (Ryan & Deci, 2000; Ryan et al., 2006), that is, a sense of having meaningful social relationships. Interacting and staying close to others are more enjoyable (Ryan & Deci, 2000). Gamification functions, such as teams, chats, blogs, and links to social media, can provide users with a stronger sense of connection and belonging through frequent communication, sharing, and mutual assistance (Reciprocity) (Francisco-Aparicio et al., 2013). When the needs of the users' sense of connection are met, it can make them more willing to accept difficulties and cope with challenges. Leaderboards and badges show the user's ability relative to those of the entire team, thereby inducing a sense of connection and meaningfulness of the activity (Rigby & Ryan, 2011). The shared experience of participating in tasks creates interesting memories and stories and further enhances the experience of connectedness (Sailer et al., 2017).

Green psychological benefits

The surge in e-commerce activity during and following the COVID-19 pandemic has significantly increased the demand for logistics services and packaging materials, thereby contributing to heightened carbon emissions and posing substantial challenges to environmental sustainability. Through green consumption, consumers form positive cognitive responses—such as favorable perceptions, evaluations, and beliefs—toward companies that provide green psychological benefits, including the warm glow benefit, the self-expressive benefit, and the nature experience benefit (Hwang & Choi, 2018; Majeed et al., 2023). Products perceived to deliver green psychological benefits can serve as a catalyst for encouraging consumers' pro-environmental behaviors (Hwang & Kim, 2021; Hwang & Choi, 2018). Green psychological benefit refers to the positive emotional states and psychological gratification experienced by consumers as a result of engaging in altruistic behaviors associated with sustainable practices (Hartmann & Apaolaza-Ibáñez, 2012; Jun et al., 2020). Pro-environmental behavior refers to voluntary actions undertaken by consumers with the intention of preserving and protecting the natural environment (Ahmed et al., 2020). Perceived associative benefits linked to the selection of green products have been shown to significantly enhance consumers' green consumption behaviors (Hwang et al., 2019).

2.4.1. Warm glow effect

Analyses of consumer behavior from the perspective of individual economics have shown that consumers tend to pursue the maximization of utility with limited resources (Mankiw, 2014). The utility that consumers perceive is measured not only by money or tangible materials but also through the moral satisfaction generated by contributing to common interests, such as society or the natural environment (Clark et al., 2003). The moral benefits that consumers get from participating in sustainable activities will evoke warm feelings, making individuals willing to exert a certain level of effort in exchange for contributing to environmental protection (Nunes & Schokkaert, 2003). Individuals' perception of the warm glow effect is also influenced by their sense of social responsibility (Brekke et al., 2003). People with a higher sense of social responsibility are more likely to obtain a warm glow effect by adopting pro-environmental behaviors. Thus, a warm glow reflects the moral satisfaction that consumers experience from contributing to environmental well-being. In the context of reusable packaging, this manifests when consumers return used containers knowing that their actions help reduce waste or carbon emissions, thereby reinforcing a sense of altruistic contribution.

2.4.2. Self-expression benefits

When consumers participate in sustainable activities, they show their attention to and efforts in sustainable behaviors to others and perform obvious sustainable behaviors to show their altruism to meet the needs of social approval (Hartmann & Apaolaza- Ibáñez, 2012). This involves the sense of self-fulfillment derived from a social group's positive evaluation and acceptance of the individual and the individual's ability to engage in sustainable behaviors that contribute to society and the environment. Self-expression benefits have been proven to be related to green consumer behavior in the past literature (Ahmad & Thyagaraj, 2015) and have an important impact on green consumer behavior (Hartmann & Apaolaza-Ibáñez, 2009). Thus, self-expressive benefits represent the extent to which consumers view sustainable behavior as a reflection of their environmental values and identity. This is evident when consumers choose reusable packaging options and proudly share their behavior (e.g., via social media or word-of-mouth) as an expression of their personal commitment to sustainability.

2.4.3. Natural experiences

Green visual images affect the psychological benefits of emotional responses. Consumers who care about the environment and are connected with nature-related things feel the improvement in their quality of life from green visual experiences (Andereck & Nyaupane, 2011). Photos related to nature will evoke emotional responses from individuals that are similar to the responses to real natural experiences (Chen & Lee, 2022). Images related to the natural environment may help construct positive product attributes (Kaplan, 1995), enhancing the value of products that are effective for environmental protection by users and positive emotion (Liao et al., 2020), thus positively affecting consumers' attitudes and values towards green products (Ahmed et al., 2023). Thus, nature experience captures the psychological connection to the natural environment that motivates eco-conscious choices. Consumers who feel emotionally connected to nature may be more inclined to engage in packaging reuse as a way of protecting ecosystems or reducing environmental degradation, thus aligning their behaviors with their environmental affinity.

2.5. Hypotheses development

2.5.1. The effect of motivational affordance (S) on green psychological benefits (O)

The warm glow effect produces emotional benefits of moral satisfaction and psychological pleasure for individuals when perceiving their contribution to environmental sustainability (Hartmann et al., 2017). Adding gamified design elements to life backgrounds makes tasks more interesting, bringing pleasure and positive emotions to users (Van der Kooij et al. al., 2019). The psychological needs of users can be satisfied through gamification design elements (Collier & Barnes, 2015). Thus, we hypothesize as follows:

H1a: Extrinsic motivational affordance has a positive impact on the warm glow effect.

H1b: Intrinsic motivational affordance has a positive impact on the warm glow effect.

Self-expression benefits refer to the emotional benefits of self-accomplishment generated by individuals' self-fulfillment when they participate in sustainable activities to show their sustainable behavior to others, as well as their ability to contribute to society and the environment (Jun et al., 2020). The user's sense of accomplishment can be enhanced by gamification design elements (Denny, 2013), and the desire for achievement will affect the feeling of enjoyment (Ghazali et al., 2019). Furthermore, gamification motivation can provide opportunities for social interaction between users during the gaming experience (Al-Dhanhani et al., 2014) and may trigger social identification, thus positively affecting users' psychology in their responses to the gamification system (Wolf et al., 2020). Thus, we hypothesize as follows:

H2a: Extrinsic motivational affordance has a positive effect on self-expression benefits.

H2b: Intrinsic motivational affordance has a positive effect on self-expression benefits.

Natural experiences are the emotional responses generated by green visual images related to the natural environment. The user's emotional perception can be enhanced by experiencing the interesting elements of gamification (Collier & Barnes, 2015). The game experience is reflected by the elements of gamification design. Motivational affordance will interact to arouse the user's emotional investment (Mullins & Sabherwal, 2020). This study believes that gamification elements that provide extrinsic and intrinsic motivations will positively strengthen the user's perception of the psychological benefits of natural experiences when experiencing sustainable gamification.

H3a: Extrinsic motivational affordance has a positive impact on natural experiences.

H3b: Intrinsic motivational affordance has a positive impact on natural experiences.

According to the two-factor theory, it is believed that intrinsic factors have a stronger influence on individual behavior than extrinsic factors (Herzberg, 1964) because the former aims to enhance the internal psychological process of positive emotions (such as satisfaction) while the latter is only the motivation driven by external factors. Balamoorthy and Chandra (2023) found that intrinsic motivation as a driving factor had a greater impact on consumers' attitudes towards online word-of-mouth than extrinsic motivation; intrinsic motivation has also been proven to have a

greater impact on consumers' brand authenticity than extrinsic motivation (Ahn & Dias Soeiro, 2022). Thus, we hypothesize as follows:

H1c: Intrinsic motivational affordance has a greater degree of influence on the warm glow effect than extrinsic motivational affordance.

H2c: Intrinsic motivational affordance affects self-expression benefits to a greater extent than extrinsic motivational affordance.

H3c: Intrinsic motivational affordance has a greater degree of influence on natural experiences than extrinsic motivational affordance.

2.5.2. The effect of green psychological benefits (O) on the use of reusable packaging and the intention to return (R)

The warm glow effect satisfies emotional value perception and allows users to have a positive emotional response to online shopping packaging reusing. Environmentally responsible consumers experience a sense of inner warmth, a psychological consequence of contributing to the public good of environmental protection, which can lead to positive attitudes towards pro-environmental behaviors (Brouwer et al., 1999). The warm glow effect is a way for individuals to obtain self-satisfaction (Baumann et al., 1981). Produced by experiencing gamification activities, this warm glow effect is a positive emotion, regarded as pure inner satisfaction (De Young, 1996) that can guide the behavior of giving (Harbaugh, 1998). Previous related studies have shown that the warm glow effect has often been used as a driving force for pro-environmental behavior (Irwin & Spira, 1997; Sharma et al., 2024). Thus, we hypothesize as follows:

H4a: The warm glow effect has a positive impact on the intention to use reusable packaging.

H4b: The warm glow effect has a positive impact on the intention to return reusable packaging.

Self-expression benefits refer to the social value perception brought about by the positive evaluation of social groups when individuals participate in sustainable activities. In the past related literature, it has been regarded as the psychological benefit of self-expression related to green consumption behavior (Lin et al., 2017). Individuals sometimes engage in pro-social behavior to gain social approval or to avoid disapproval from others (Becker, 1974). Thus, we hypothesize as follows:

H5a: Self-expression benefits have a positive impact on the intention to use reusable packaging.

H5b: Self-expression benefits have a positive impact on the intention to return reusable packaging.

Natural experiences belong to conditional value perception, that is, the additional value that can be obtained by participating in the use and return of reusable online shopping packaging. Environmental psychology has shown that natural experiences help to enhance positive emotional responses (Ulrich, 1981) and that individuals will form a higher awareness of natural protection through natural experiences, thereby leading to the generation of pro-environmental consumer behavior (Hartmann & Apaolaza-Ibáñez, 2008). The psychological benefits of natural experiences can help enhance the value of products that users might choose when engaging in effective environmental protection behaviors. Thus, we hypothesize as follows:

H6a: Natural experiences have a positive impact on the intention to use reusable packaging.

H6b: Natural experiences have a positive impact on the intention to return reusable packaging.

The research model is shown in Figure 1.

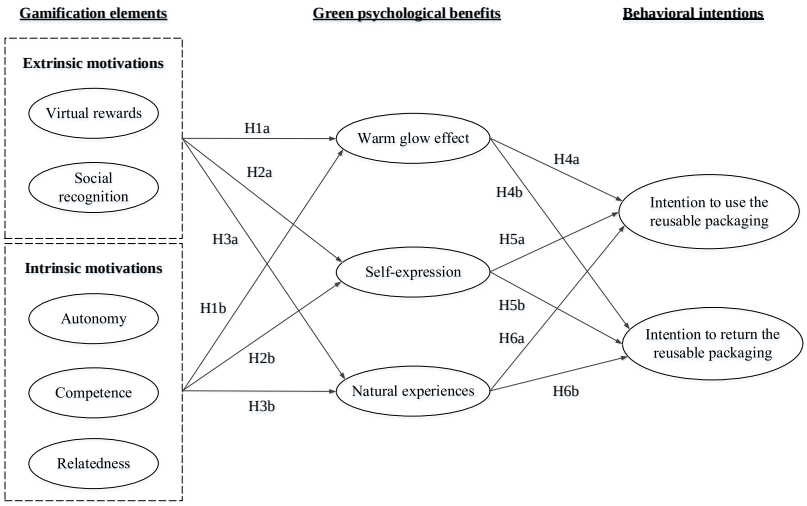

Figure 1. Research Model and Hypotheses

3. Methodology

3.1. Pre-test

This study conducted a pre-test to confirm that the wording of the measurement items was correctly constructed and translated, and to validate the measurement instruments. Specifically, the primary objective of the pre-test was not to generate inferential conclusions but to assess the clarity, internal consistency, and face validity of the measurement items while also identifying potential ambiguities in item wording or structural design. This approach is consistent with established methodological practice, wherein pre-tests are employed primarily for instrument refinement rather than hypothesis testing (Presser et al., 2004). The pre-test questionnaire was sent to consumers who had an online shopping experience in Taiwan. Taiwan presents a particularly relevant and timely context for examining green psychological benefits and sustainable consumer behavior for several reasons. First, Taiwan has witnessed a growing societal emphasis on environmental sustainability, driven by both governmental initiatives and heightened public awareness, especially in the aftermath of the COVID-19 pandemic. This societal shift has created fertile ground for studying consumers' eco-conscious motivations and their psychological responses to green marketing efforts. Second, Taiwan's advanced digital infrastructure and high penetration of e-commerce and social media platforms provide an ideal setting to observe and analyze the evolving patterns of sustainable consumption in digitally mediated environments. These conditions allow for richer insights into post-pandemic behavioral shifts that intersect with green consumerism and digital engagement. Third, Taiwan serves as a representative case of an emerging Asian market where cultural, economic, and regulatory factors uniquely shape green consumption behavior. Conducting the study in Taiwan allows us to contribute contextualized insights to the broader literature, which remains predominantly Western-centric.

A total of 43 valid responses were collected. This study used exploratory factor analysis (EFA) to look for common factors among the observed variables. The factor loadings of the measurement indicators of the pre-test constructs in this study were all greater than 0.5 (0.559 – 0.936). All items were included because the item - to - total correlations were more than 0.30 (Anderson & Gerbing, 1998). The reliability of each construct in the pre-test was proven to be satisfactory; namely, the Cronbach's alphas of each construct (0.706–0.912) exceeded the recommended criterion of 0.7 (Cortina, 1993). Further, the wording of the measurement items was modified based on participants' feedback.

3.2. Participants and procedure

An Internet - based survey that had been proven to be valid in the pre-test was used to collect the empirical data for this study. The target participants were those who had experiences of being online shopping customers. The surveys were conducted from 1 April to 18 April 2023, and 389 participants in total participated. Participants were recruited using convenience sampling via an online survey platform, with targeted outreach to individuals who had prior experience with online shopping and a basic understanding of packaging recycling. This recruitment strategy was employed to ensure that respondents possessed sufficient experiential and contextual knowledge to meaningfully assess the constructs under investigation (e.g., green psychological benefits and pro-environmental behavior). To further ensure data quality and relevance, a preliminary screening process was implemented. Respondents were asked two filter questions at the beginning of the survey: (1) "In the past year, how often have you ordered products on average through e-commerce platforms (e.g., momo, PChome, Shopee) or through the official online websites of

various brands?" and (2) "Have you ever heard of 'online shopping recycling' before filling out this questionnaire?" Individuals who indicated no prior engagement with online shopping or no familiarity with recycling-related concepts were excluded from completing the full questionnaire, as their lack of relevant experience would compromise the construct validity of their responses. Additionally, responses displaying patterned or repetitive answer behavior were removed during the data cleaning process. After applying these exclusion criteria, a total of 354 valid responses were retained for formal analysis. Table 1 displays the detailed profiles of respondents. The majority of participants were female (62.99%), with the remainder (37.01%) being male, while 42.09% of the participants were 20–30 years old. Most participants had a bachelor's degree (53.11%), followed by a high school degree or below (41.81%) and a graduate school degree or above (5.08%). For occupation, most participants were unemployed (e.g., student, retired, housewife) (35.88%), followed by working in the service industry (15.82%).

Table 1. The Profile of Respondents

Item	Demographics	Frequency	Percentage
Gender	Male	131	37.01%
	Female	223	62.99%
Age	Under 20 years old	9	2.54%
	21–25 years old	106	29.94%
	26–30 years old	43	12.15%
	31–35 years old	36	10.17%
	36–40 years old	38	10.73%
	41–45 years old	56	15.82%
	46–50 ears old	23	6.50%
	Over 50 years old	43	12.15%
Occupation	Public servant	56	15.82%
	Manufacturing	56	15.82%
	Business	28	7.91%
	Service industry	70	15.82%
	Unemployed (e.g., student, retired, housewife)	127	35.88%
Education level	High school or below	148	41.81%
	College	188	53.11%
	Graduate school or above	18	5.08%
Average monthly disposable income	Under 20,000	95	26.84%
	20,001–40,000	129	36.44%
	40,001–60,000	74	20.90%
	60,001–80,000	26	7.34%
	80,001–100,000	16	4.52%
	Over 100,000	14	3.95%

3.3. Measures

The questionnaire included two parts. The first part was demographic questions regarding age, gender, occupation, education, and average monthly disposable income. The second part was mainly to measure the variables of the study. All of the measurement items of each variable were referenced from previous studies. Items measuring virtual reward were referenced from García-Jurado et al. (2018), with minor modifications on wording that better fit the context of reusable packaging for online shopping. Social recognition was measured with the construct adapted from Huang and Zhou (2021), while autonomy, competence, and relatedness were measured by concepts adapted from the constructs developed by Bitrián et al. (2021). Items measuring the warm glow effect were adapted from Hartmann et al. (2017). Items measuring self-expressive benefits and natural experiences were adapted from Jun et al. (2020). The use intention was measured by a construct proposed by Song et al. (2023), whereas return intention was adapted from the same construct proposed by Song et al. (2023) and Dixit and Badgaiyan (2016). Finally, this study measured all items by using 5‐point Likert‐type scales ranging from "Strongly Agree" to "Strongly Disagree."

3.4. Gamification design context

To gain a better understanding of the psychological mechanism behind gamification, the motivation of users should be promoted and enhanced by gamification design elements (Deterding, Sicart, et al., 2011), that is, the application of gamification design elements to meet users' different motivational needs (Zhang et al., 2018). The stimulus constructed in this study was the gamification system of reusable packaging, which provided consumers with

extrinsic and intrinsic motivations through gamification design elements. This study was designed to arouse users' specific motivations. The gamification design elements were inspired by those examined by Alafouzou et al. (2018), Blohm and Leimeister (2013), Karra et al. (2019), Sailer et al. (2013), and Sigala (2015). Table 2 shows the design of the gamification of reusable packaging used in this study. The gamification of reusable packaging use was carried out in this research through situational simulation.

Table 2. Gamification Design Elements

Motivation type		Motivational affordance (gamification design elements)	Reference source
Extrinsic motivation	Virtual reward	Symbolic rewards: points, badges, virtual goods	Alafouzou et al. (2018); Blohm and Leimeister (2013); Karra et al. (2019); Sailer et al. (2013); Sigala (2015)
	Social recognition	Social elements: badges, ranks, leaderboards	
Intrinsic motivation	Autonomy	Clear goals: progress bars, feedback, records Personalization and freedom of choice: avatars	
	Competence	Achievements and progress: points, badges, leaderboards, quests, challenges, competitions	
	Relatedness	Social interaction: communicate, collaborate, connect to social media	

This theoretical mapping offers a more precise depiction of how each design element is functionally intended to activate distinct motivational pathways, whether intrinsic (e.g., autonomy, competence, relatedness) or extrinsic (e.g., virtual rewards, social recognition). For instance, progress bars and performance feedback mechanisms are associated with the enhancement of perceived autonomy, thereby fostering intrinsic motivation. Achievement badges and level systems serve as symbolic reinforcements, contributing to extrinsic motivation by recognizing user accomplishments. Social leaderboards and community interaction features are intended to strengthen relatedness, encouraging peer engagement and social comparison. This integrated explanation reinforces the conceptual rigor of the gamification design and its alignment with motivational theory, thereby strengthening the validity of the proposed framework.

The gamification of reusable packaging in this study combined the reusable model (Figure 2A) with the familiar concept of the Monopoly game, allowing users to have a deep understanding of each stage of packaging recycling while participating in the gamification. The schematic diagrams of each stage of the packaging recycling system used in this study and the online shopping packaging recycling bags were from the PackAge+ Official Website. The method of gamification was that the user could get a random seed and a chance to roll the dice whenever they used green reusable packaging during online shopping, after which they could plant the seed on the grid to which they were advancing. The user then obtains water droplets for watering after they successfully return the reusable packaging or perform a designated task (Figure 2D). After the seeds grow into trees, the user will be able to obtain a plant variety badge (Figure 2G). The saplings will release green energy during the growth stage to visualize the carbon emissions reduced by participating in reusable packaging use activities. When the user advances to each cycle stage on the map, information about each stage of the packaging recycling system will pop up. Knowing the relevant green information will help the user's intention to participate (Wang et al., 2020), increasing their awareness of their role in the circulatory system of reusable packaging.

Users of the gamified reusable packaging can set the carbon reduction goal that they want to achieve (Figure 2B), and their progress in this goal will be visualized with the progress bar (Figure 2A). The user can use the progress bar to learn about the carbon reduction history when participating in green online shopping packaging reusing. During the experience of the game, the user can choose different levels or tasks (Figure 2D) to obtain water droplets for watering. The rankings of green energy collected by other green reusable online shopping packaging users can be known through the weekly updated leaderboard (Figure 2F). Users can visit their friends' circular maps (Figure 2C) to interact, explore the badges unlocked by each other, and observe the green energy that they have collected; they can also cooperate by watering each other’s seeds. Users incarnate as reusable packaging in the gamified world of packaging reusing and create virtual avatars of their own style (Figure 2E) to promote their sense of psychological ownership. A sense of responsibility (Kwon, 2020) is developed, which in turn produces positive behaviors that are beneficial to packaging reusing (Ding et al., 2021) and strengthens the connection between reusable packaging and people by anthropomorphizing reusable packaging.

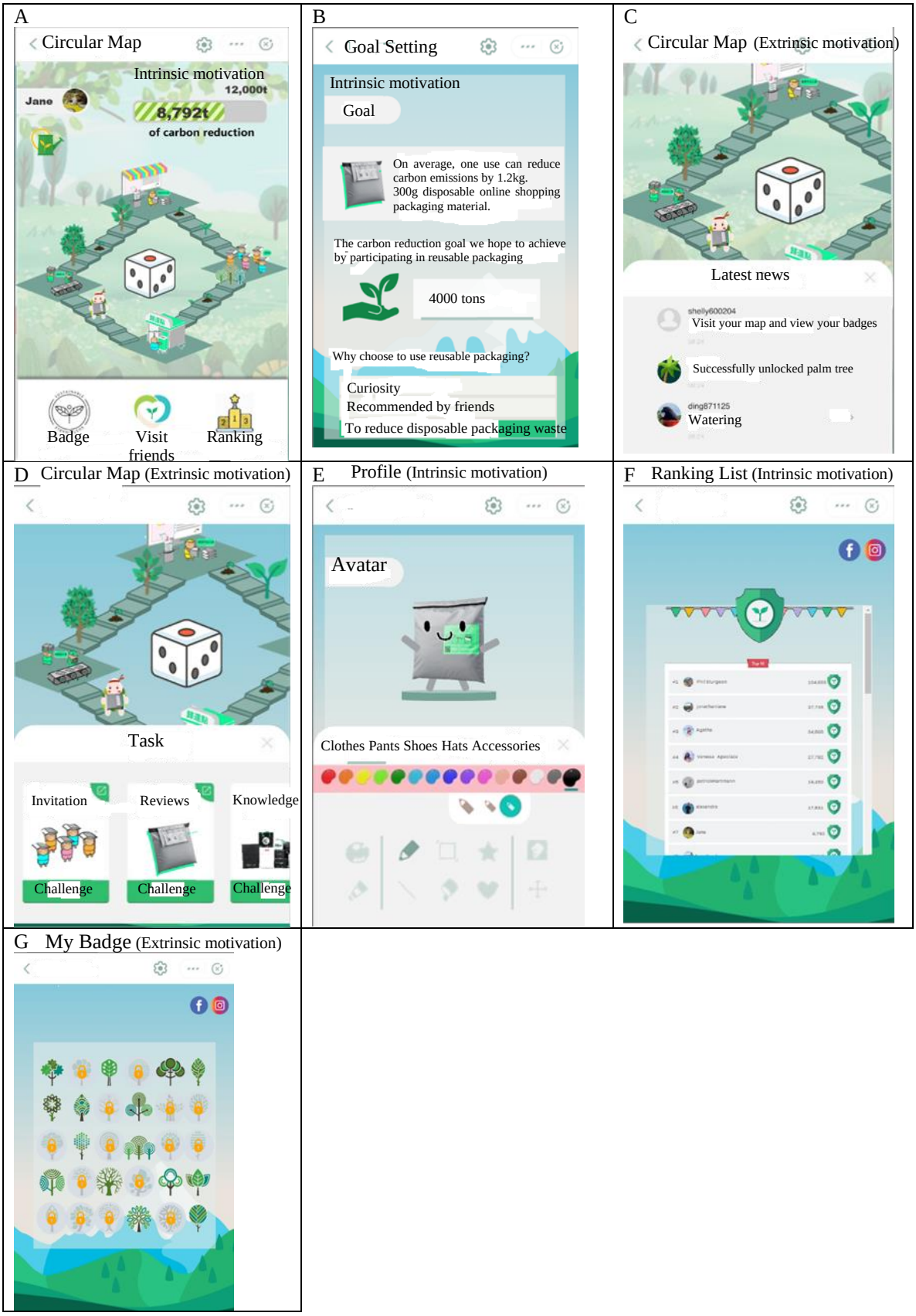

Figure 2. Schematic Diagram of the Gamification of Reusable Packaging Use

3.5. Non-response and common method bias

This study used non-response and common method bias to evaluate the collected data. According to the suggestions of Armstrong and Overton (1977), this study examined the non-response bias by comparing the first 30% of responses from the data with the last 30% of responses. The results found no significant differences between the two groups ($p > 0.05$) on the main constructs. Hence, this study did not have the problem of non-response bias. In addition, this study used the Harman single-factor analysis (Malhotra et al., 2006) to test the common method bias (Podsakoff & Organ, 1986). The results confirmed that the first factor accounted for 44.03% of the variance. Thus, this study was not concerned with common method bias. Further, the data were also assessed for multicollinearity (if any) by calculating the VIF (outer) values, which were all found to be less than the recommended threshold of 5 (Hair et al., 2017). Full (factor level) VIF analysis was conducted, and all of the inner VIF values were found to be less than the 3.3 criterion (Kock, 2015). Therefore, common method bias was not a concern in this study.

4. Literature review and hypotheses development

4.1 Validation of the measurement model

The quality of the constructs was evaluated using the measurement model evaluation criterion (Henseler et al., 2009). As shown in Table 3, results showed that the Cronbach's alpha (CA), composite reliability (CR), and average variance extracted (AVE) values were greater than the threshold of 0.70 for CA and CR (Nunnally & Bernstein, 1994) and the threshold of 0.50 for AVE (Fornell & Larcker, 1981). Thus, construct reliability and validity and convergent validity of the data were confirmed, respectively. Furthermore, discriminant validity for the data was also evaluated by checking the square root of the construct's AVE, which was greater than its correlation with the other constructs, as shown in Table 4.

Table 3. Construct Reliability and Validity

Construct	Cronbach's alpha	Composite reliability	Average variance extracted
Virtual reward (VR)	0.808	0.811	0.723
Social recognition (SR)	0.911	0.912	0.791
Autonomy (AUT)	0.853	0.901	0.695
Competence (COM)	0.897	0.899	0.765
Relatedness (REL)	0.925	0.926	0.817
Warm glow effect (WGE)	0.915	0.916	0.798
Self-expressive benefits (SEB)	0.900	0.902	0.833
Natural experiences (NE)	0.877	0.878	0.802
Use intention (UI)	0.909	0.926	0.789
Return intention (RI)	0.950	0.951	0.800

Table 4. Discriminant Validity

Construct	VR	SR	AUT	COM	REL	WGE	SEB	NE	UI	RI
VR	(0.850)									
SR	0.558**	(0.889)								
AUT	0.518**	0.500**	(0.834)							
COM	0.507**	0.555**	0.563**	(0.875)						
REL	0.452**	0.549**	0.446**	0.664**	(0.904)					
WGE	0.491**	0.425**	0.498**	0.607**	0.479**	(0.893)				
SEB	0.498**	0.457**	0.454**	0.590**	0.530**	0.773**	(0.913)			
NE	0.339**	0.334**	0.293**	0.457**	0.507**	0.361**	0.457**	(0.896)		
UI	0.289**	0.249**	0.335**	0.391**	0.288**	0.462**	0.411**	0.222**	(0.888)	
RI	0.314**	0.249**	0.364**	0.371**	0.279**	0.429**	0.404**	0.200**	0.748**	(0.894)

Notes: All correlations are significant at the .05 level. The diagonal values represent the square root of AVE.

4.2 Hypotheses testing

This study used structural equation modeling via SmartPLS 4 with a 5,000 resample bootstrapping procedure (Hair et al., 2017) to test the hypotheses and evaluate the structural model. As shown in Figure 3, the final model shows the standardized path coefficient and statistical significance ($p < 0.05$). External motivational affordance was found to be positively and significantly related to the warm glow effect ($\beta = 0.167$, $t = 2.256$, $p = 0.024$) and self-expressive benefits ($\beta = 0.221$, $t = 3.262$, $p = 0.001$) but lacked a significant relationship with natural experiences (β

= 0.058, t = 0.827, p = 0.408). This thus confirmed hypotheses 1a and 2a, respectively, but did not confirm Hypothesis 3a. Internal motivational affordance was significantly and positively related to the warm glow effect (β = 0.656, t = 9.569, p = 0.000), self-expressive benefits (β = 0.611, t = 9.620, p = 0.000), and natural experiences (β = 0.664, t = 9.327, p = 0.000), thereby confirming hypotheses 1b, 2b, and 3b. Furthermore, hypotheses 4a and 4b were supported as the warm glow effect demonstrated a significant relationship with use intention (β = 0.520, t = 5.100, p = 0.000) and return intention (β =0.424, t = 4.199, p = 0.000). Additionally, self-expressive benefits showed a significant and positive relationship with return intention (β =0.261, t = 2.344, p = 0.020), thus confirming Hypothesis 5b. However, the data for the study did not show a significant relationship between self-expressive benefits and use intention (β = 0.157, t = 1.387, p = 0.165); thus, Hypothesis 5a was not supported. Hypotheses 6a and 6b were not supported as natural experiences did not show a significant relationship with use intention (β = 0.051, t = 0.866, p = 0.386) and return intention (β =0.025, t = 0.392, p = 0.695). In addition, consistent with Sadiq et al. (2022), this study included socio-demographic variables as control variables to account for potential confounding effects on consumers' intention to use and return reusable packaging. The results indicate that these control variables exert no statistically significant influence on either behavioral intention. Specifically, gender (β = 0.003; p > 0.05), age (β = 0.006; p > 0.05), occupation (β = 0.002; p > 0.05), education (β = 0.008; p > 0.05), and average monthly disposable income (β = 0.003; p > 0.05) were not significant predictors of intention to use reusable packaging. Similarly, gender (β = 0.006; p > 0.05), age (β = 0.005; p > 0.05), occupation (β = 0.003; p > 0.05), education (β = 0.004; p > 0.05), and income (β = 0.003; p > 0.05) did not significantly affect intention to return reusable packaging. These findings suggest that socio-demographic characteristics do not materially alter consumers' behavioral intentions in the context of sustainable packaging engagement.

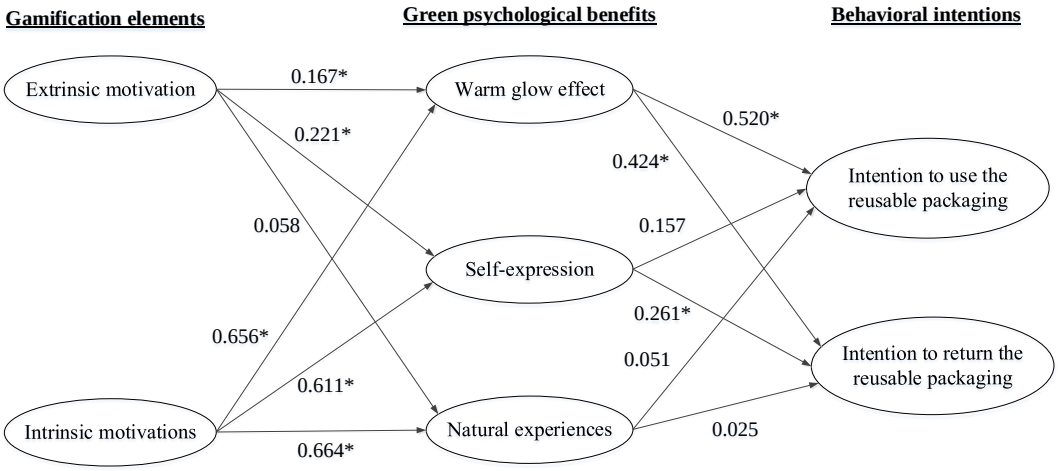

Figure 3. Results of the Structural Model Analysis (p < .05)

5. Discussion

5.1. Motivational affordance and green psychological benefits

According to the analysis results of this study, extrinsic motivational affordance positively and significantly affected the warm glow effect and self-expression benefits generated by users in the game experience. Further exploration of the sub-facets of extrinsic motivational affordance found that only virtual rewards had a positive and significant impact on the green psychological benefit dimension, while the motivational affordance of social recognition had no significant impact on the green psychological benefit items. When individuals perceive that they are in a group that pays more attention to the environment, the impact of individual sustainable behaviors on obtaining value from others will be more obvious (Sexton & Sexton, 2014). When consumers or the groups think that it is necessary to adopt sustainable behaviors, consumers will actively signal their contribution to environmental protection (Hartmann & Apaolaza-Ibáñez, 2012). Therefore, one possible reason why the gamification elements targeting social recognition had no significant impact on green psychological benefits was that the gamification environment designed in this study had not yet shaped enough motivational conditions to drive social recognition.

The research results showed that the intrinsic motivation endowed by the gamification design elements of online shopping packaging recycling positively and significantly affected the green psychological benefit items produced by users in the game experience: warm glow effect, self-expression benefits, and natural experiences. Further exploration of the impact of the sub-components of intrinsic motivational affordance on green psychological benefit items revealed

that the sense of autonomy had a positive and significant impact on the warm glow effect; the sense of connectedness had a positive and significant impact on self-expression benefits and natural experiences; and the sense of competence had a positive and significant impact on all green psychological benefit items. In intrinsic motivational affordance, satisfying the user's sense of competence can more effectively drive the warm glow effect and self-expression benefits, while the satisfaction of the sense of connection can more effectively drive the benefits of natural experiences.

Furthermore, past related literature has confirmed that intrinsic motivation yields better effects than extrinsic motivation (Feng et al., 2016), which was confirmed by the results of this study. The gamification design elements providing intrinsic motivation can strengthen green psychological benefits. The effect was greater than that of the gamification design elements that endowed extrinsic motivation, which meant that intrinsic motivation was more able to guide the generation of positive emotions than extrinsic motivation.

5.2. Green psychological benefits and intention to use and return reusable packaging

In the context of gamification, the warm glow effect perceived by users positively and significantly affected their use of and intention to return reusable packaging. This research result has been confirmed by those of previous literature; that is, the warm glow effect has a significant correlation with pro-environmental behavior (Bischoff & Krauskopf, 2015) and is often used to instigate pro-environmental behavior (Irwin & Spira, 1997). Self-expression benefits are also often used to drive sustainable consumption behaviors (Ahmad & Thyagaraj, 2015) and have been proven to be an important factor affecting green consumer behavior (Hartmann & Apaolaza-Ibáñez, 2009). According to the results of this study, self-expression benefits had a positive and significant impact on the intention to return reusable packaging. This study speculates that the possible reason may be that for users who actually return reusable packaging for online shopping, they can better demonstrate their dedication to environmental protection behaviors through self-expression. Therefore, to increase the intention to return reusable online shopping packaging, the warm glow effect and self-expression benefits of users can be strengthened in gamification.

Previous literature has confirmed that the benefits of natural experiences can promote the occurrence of positive emotions (Liao et al., 2020) and can enable consumers to have a positive attitude towards green products (Ahmed et al., 2023); however, according to the results of this study, the perceived natural experience benefits in gamification had no significant effect on increasing the use and return intentions of users towards reusable online shopping packaging. This result was verified by the research of Hartmann and Apaolaza-Ibáñez (2012). Natural experiences had the greatest impact on consumers' attitudes towards sustainability-related brands among all green psychological benefits items, but they did not affect consumers' intention to buy. Therefore, presenting a green visual image in the gamified context of online shopping packaging reusing had no effect on consumers' intention to participate in packaging reusing.

This study further explored the mediating effect of green psychological benefits. The study found that the warm glow effect had a partial mediating effect on intrinsic motivational affordance and the intention to use and return reusable packaging; that is, the intrinsic motivation provided by gamification was effective through the positive emotion of the warm glow effect. The partial mediation effect had a positive impact on users' intention to use and return reusable packaging. In the past, some scholars have also used psychological response as an intermediary variable to explore its impact on the relationship between motivational affordance and behavioral outcomes. Seiffert-Brockmann et al. (2018) used the sense of engagement as a psychological response and found that in gamification applications, it had a mediating effect on players' motivations and behavioral outcomes. Jun et al. (2020) found that psychological benefits had a mediating effect on the relationship between gamification design elements and customers' continued participation. This study identified underlying psychological mechanisms to explain how gamification design elements that provide intrinsic motivation affect the intention to use and return reusable packaging.

6. Contributions

6.1. Academic contributions

This study focused on the green practice to explore reusable packaging, filling the gaps in consumer behavior research on the application of gamification to green practice. This research framework integrated the conceptual framework of gamification (Hamari et al., 2014) and the self-determination theory (Deci & Ryan, 1985) to gain a better understanding of the mechanism behind gamification applied to consumer behavior and marketing-related fields; that is, the relationship between motivational affordance (gamification design elements), psychological response, and behavioral result. Gamification elements such as feedback, achievement badges, and progress tracking can enhance consumers' perceived competence and sense of accomplishment, thereby fostering intrinsic motivation. Similarly, green psychological benefits—such as warm glow, nature experience, and self-expressive benefits—can reinforce an individual's sense of autonomy and relatedness as they align personal values with socially beneficial outcomes. By integrating gamified engagement strategies with green value propositions, both intrinsic and extrinsic motivational pathways can be simultaneously activated. This integration not only enhances consumer participation in

sustainable behaviors but also aligns with the tenets of self-determination theory by creating a psychologically fulfilling consumption experience. Thus, from the perspective of sustainability, self-determination theory was applied in this study to explore the intermediary influence of green psychological benefits that consumers obtain when participating in green practices. Furthermore, gamification as a method to promote sustainable behaviors has not been fully researched (Morganti et al., 2017). Therefore, this study also provided preliminary research on the implementation of gamification mechanisms in the field of sustainability.

Due to the scarcity of empirical research on gamification mechanisms (Seaborn & Fels, 2015), most gamification research has focused on exploring the results of a single or small number of gamification design elements in guiding specific behaviors (Hamari et al., 2014; Seaborn & Fels, 2015) and ignored the underlying psychological mechanisms that explain the impact of gamification design elements on behavioral outcomes (Deterding, 2014), making it difficult to understand how gamification design elements can effectively meet the needs of users and the psychological aspects of gamification. As this impact has yet to be explored, this study sought to fill this research gap. According to the different types of motivational affordance, gamification elements designed to stimulate different motivations were applied in the gamification of reusable packaging use. This study sought to understand the impact of enhanced green psychological benefits on the relationship between intrinsic and extrinsic motivational affordance and reusable packaging use and return intentions. This study not only filled in some of the gaps in gamification research proposed by past scholars but also proved that the positive emotions generated by the warm glow effect have a significant positive mediating effect on intrinsic motivation and the intention to use and return reusable packaging.

6.2. Practical contributions

This study provides several practical lessons for key players in the packaging reusing system, namely e-commerce operators, to support and enhance their decision-making. To begin with, in terms of e-commerce business operators, on the gamification design of packaging reusing, this study referred to previous research and the views of scholars in the field of gamification to develop the corresponding gamification design elements for different types of motivational affordance. Gamification elements were systematically sorted according to the nature of extrinsic motivation and intrinsic motivation. The gamification design scenario of this research design idea can be used as a source of inspiration for e-commerce companies who want to implement reusable packaging use. To improve Taiwanese people's current intention to use and return reusable online shopping packaging, the gamification design should focus on evoking the warm glow effect and giving users the meaning of participating in online shopping packaging reusing. The warm glow effect can be driven by the external motivational affordance of virtual rewards and the internal motivational affordance of the sense of autonomy and competence. Virtual rewards can use symbolic gamification design elements, such as points, badges, and virtual goods. A sense of autonomy can be achieved from users setting carbon reduction goals presented visually by the carbon footprint in the gamified background; this would allow users to understand their own carbon reduction progress and history. Competency development could emphasize users' achievements and progress in the gamification of online shopping packaging reusing.

Although the gamification scenario designed in this study was presented in an independent App, to achieve consumers' continuous experience of gamification, the research suggests that gamification can be built on an original social platform of e-commerce platform operators or as a function of an original e-commerce platform App and can be combined with other promotional activities. In addition, reusable packaging can not only reduce the environmental burden caused by disposable online shopping packaging but also convey the concept of sustainability. A QR code can be attached to the reusing packaging to facilitate the connection to the gamification interface, and the QR code can be integrated into the gamification link so that the gamification can be integrated with the reusable packaging. In addition, the packaging gives the initial visual and tactile impression when consumers receive products (Heller et al., 2019), which can be used as a key tool to convey information about e-commerce companies and products (Pålsson et al., 2017); in the context of applying gamification, reusable packaging can serve as a bridge between consumers and gamification and is an important medium for tasks and information in gamification design elements.

7. Limitations and directions for future research

Most gamification research has focused on short-term and immediate effects (Hamari et al., 2014), which may lead to optimistic conclusions about gamification effects (Van Roy & Zaman, 2018). Time span may exclude potential effects, resulting in biased results (Seaborn & Fels, 2015). Although studies on the application of gamification in education in recent years have focused on how the effects of gamification change over time (Barata et al., 2017), there is still a lack of research on the long-term impacts of gamification on sustainable consumer behavior. As this study was restricted by the limited research time, it was impossible to explore the effect of consumers engaging in the gamification technology experience for a long time.

Further, since there is currently no gamification software designed for packaging reusing on the market and the limitation of resources in this research, this gamification research did not provide subjects with a real gamified

environment in an experimental way. The gamification context of this research was a gamification design element that could drive a specific type of motivation based on previous literature suggestions. It was constructed based on the researchers' own experiences and ideas and presented to the subjects in the form of recorded videos, which did not allow the subjects to explore the game in person or experience a process of transformation. Thus, if e-commerce operators or third-party develop reusable packaging platforms or introduce gamification in the future, they can refer to the model framework of this study for verification. Consumers' state of mind can be directed towards the flow to stimulate intrinsic motivation to promote a greater degree of engagement (Whittaker et al., 2021). Further, research on the sense of engagement and subsequent results of using mobile apps still remains to be explored and discussed (Ho & Chung, 2020).

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APPENDIX

Measures of Research Constructs

Construct	Adapted item	Citation
Virtual Reward (VR)	VR1: Green energy points and badges serve as positive reinforcement for my efforts. VR2: Green energy points, badges, and leaderboards reflect the effort I invest in using reusable packaging in online shopping. VR3: I am able to clearly understand how green energy points and badges are earned through the use of reusable packaging in online shopping.	García-Jurado et al. (2018)
Social Recognition (SR)	SR1: I feel good when my achievements in the reusable packaging gamification system are recognized. SR2: I hope my friends notice my performance or accomplishments in the reusable packaging gamification system. SR3: Seeing my friends view my achievements in the reusable packaging gamification system makes me feel positive. SR4: I hope my friends express positive evaluations of my participation in the reusable packaging gamification system.	Huang and Zhou (2021)
Autonomy (AUT)	AUT1: I can use the reusable packaging gamification system freely at my own discretion. AUT2: In the reusable packaging gamification system, I have various choices (e.g., I can decide how to interact with the system and with other users). AUT3: I can independently decide which activities to participate in within the reusable packaging gamification system (e.g., visiting other users' recycling maps or taking on challenge tasks).	Bitrián et al. (2021)

	AUT4: I use the reusable packaging gamification system because I genuinely want to.	
Competence: (COM)	COM1: I feel good about myself when I use the reusable packaging gamification system. COM2: I am satisfied with my performance when using the reusable packaging gamification system. COM3: I consider myself skilled at using the reusable packaging gamification system. COM4: When I use the reusable packaging gamification system, I feel like a capable person.	
Relatedness (REL)	REL1: I feel supported by others when I use the reusable packaging gamification system. REL2: When using the reusable packaging gamification system, I feel like a valuable person to others. REL3: I feel understood when I engage with the reusable packaging gamification system. REL4: I feel that others care about what I do when I use the reusable packaging gamification system.	
Warm Glow (WG)	WG1: Participating in the reusable packaging gamification system makes me feel good because I am contributing to environmental protection. WG2: Participating in the reusable packaging gamification system brings me a sense of joyful personal satisfaction. WG3: I feel happy participating in the reusable packaging gamification system because it allows me to contribute to human well-being and the natural environment. WG4: Participating in the reusable packaging gamification system gives me a sense of fulfillment from giving back to society and the environment.	Hartmann et al. (2017)
Self-expressive Benefits (SEB)	SEB1: Participating in the reusable packaging gamification system allows me to express my concern for and commitment to environmental protection. SEB2: Participating in the reusable packaging gamification system enables those around me to recognize my dedication to environmental issues. SEB3: When engaging in the reusable packaging gamification system, I feel a sense of achievement from my contributions to environmental protection.	Jun et al. (2020)
Natural Experience (NE)	NE1: The reusable packaging gamification system makes me feel connected to nature. NE2: The reusable packaging gamification system reminds me of the natural environment. NE3: The reusable packaging gamification system makes me feel as if I am immersed in nature.	Jun et al. (2020)
Use Intention (UI)	UI1: I plan to choose reusable packaging in future online purchases. UI2: I intend to use reusable packaging when shopping online. UI3: Whenever I have the opportunity to use reusable packaging in online shopping, I will do so. UI4: I would prefer to use reusable packaging rather than single-use packaging when shopping online.	Song et al. (2023)
Return Intention (RI)	RI1: I plan to return reusable packaging from online shopping to a designated collection point in the future. RI2: I intend to return the reusable packaging after using it in online shopping. RI3: Whenever I have the opportunity to return reusable packaging from online shopping, I will do so. RI4: I would rather return reusable packaging from online shopping than discard it. RI5: In the coming year, I intend to return used reusable packaging from online shopping to a designated return channel so it can be reused. RI6: Over the next year, I will try to return reusable packaging from online shopping to support its continued circulation.	Song et al. (2023) and Dixit and Badgaiyan (2016)