systems

MDPI

Article

The Influence of Introducing the Concept of Sustainable System Design Thinking on Consumer Cognition: A Designer's Perspective

Chun Yang [1], Linghao Zhang [1,*] and Wei Wei [2]

[1] School of Design, Jiangnan University, Wuxi 214122, China; 8202201014@jiangnan.edu.cn
[2] School of Design, Hunan University, Changsha 410082, China; doublewei@cslg.edu.cn
* Correspondence: wowo.zlh@jiangnan.edu.cn

Abstract: Environmental problems represent one of the most intensive focuses in the world. At present, the rate of environmental damage caused by peoples' consumption of products and services is still far faster than the rate of regeneration, processing, and recycling of natural ecosystems. In the face of increasingly severe environmental problems, consumers must change their consumption behavior toward a sustainable direction. Based on the ultimate goal of sustainable innovation and development, the introduction of sustainable system design thinking can enable the optimization of sustainable systems for production, manufacturing, consumption, or recycling. As with the concept of traditional system design thinking, sustainable system design thinking is not only a product form but also a creative systematic way to solve problems for the purpose of promoting innovation. It has been transformed from "giving form" to "design process", "design strategy", or "design system". Therefore, this study attempts to explore the potential structure of consumers' sustainable consumption cognition from the perspective of designers through the introduction of sustainable system design thinking. This study combined literature analysis and a questionnaire survey to propose a research model with seven constructs and eight hypotheses and then used a reliability test, validity test, and structural equation model to analyze and verify the data. The results show that the three constructs of design evaluation (aesthetics, innovation, and function) in system design thinking are feasible and effective in sustainable design. With the support of sustainability concept, the autonomy of consumers' consumption attitude and intention will be improved. This study can provide reference to governments, enterprises, and designers when formulating, implementing, and practicing sustainable innovative strategies. The results of this study can further influence the continuous promotion and deepening of sustainable design thinking in the cultivation of design talents in colleges and universities, and thus provide multi-field and recyclable theoretical guidance for sustainable design facing future life.

Keywords: sustainability; system design thinking; system innovation; designer

Citation: Yang, C.; Zhang, L.; Wei, W. The Influence of Introducing the Concept of Sustainable System Design Thinking on Consumer Cognition: A Designer's Perspective. *Systems* **2022**, *10*, 85. https://doi.org/10.3390/systems10040085

Academic Editors: Anders Hansen Henten and Iwona Windekilde

Received: 27 May 2022
Accepted: 22 June 2022
Published: 23 June 2022

1. Introduction

As one of the most important issues in the world at present, environmental problems are focused on by people all over the world. Due to the excessive exploitation of the earth's resources and the lack of corresponding management, resource depletion and environmental damage are caused, which concerns people about the earth's carrying capacity and the future of mankind [1]. Therefore, the United Nations and other international organizations and governments of various countries have put forward various ideas and suggestions to improve the current situation and reduce the damage to the environment and ecology. Among them, The Rio Declaration [2], the United Nations Guidelines for Consumer Protection [3], and other policies actively call on countries to reduce and eliminate unsustainable production and consumption patterns in economic, social, and environmental aspects. This

is to meet the needs of present and future generations for goods and services in a sustainable manner, and to include "sustainable consumption and production patterns" [4] as one of the 17 Sustainable Development Goals (SDGs), which aim to help the world completely solve social, economic, and environmental problems by 2030 and achieve sustainable social transformation worldwide. China listed "green" as one of the five development concepts for the first time in the 13th Five-Year Plan and reaffirmed the importance and necessity of "continuously improving environmental quality" and "accelerating the green transformation of development mode" in the 14th Five-year Plan. China has also actively carried out the practice of constructing sustainable developing-related concepts in "developing circular economy" [5], "accelerating the construction of ecological civilization", "promoting green lifestyle" [6], "promoting sustainable consumption" [7], and other aspects.

In fact, the rate of environmental damage caused by human consumption of products and services is still much faster than the rate of regeneration, processing, and recycling of natural ecosystems [8]. Considering increasingly severe environmental problems, consumers must change their consumption behavior toward a sustainable direction [9]. Surveys show that most consumers are willing to protect the environment by purchasing more sustainable products [10]. However, there is a contradiction between consumers' statements on sustainable behavior and the oral expressions and actual intentions (or behaviors) [11]. Although more and more international companies are engaged in sustainable production and consumers are paying more attention to sustainable products, this phenomenon does not translate directly into the actual purchasing behavior of sustainable products [12]. This phenomenon is also called the Green Gap. It is mainly used to explain the attitude–intention–behavior gap in sustainable consumption [10]. At present, consumers have not formed the concept that environmental protection issues take precedence over personal interests, and the imperfect environmental protection laws and regulations also lead to most consumers' superficial approach to environmental protection [13]. In addition, consumers generally believe that the attributes and quality of sustainable products are lower than that of general products, which also leads to the expansion of Green Gap [14]. However, it has been reported that smart cities have not been successful in promoting smart recycling and that the use of a large number of smart recycling systems has been inefficient. A change in the public's intention to participate in recycling affects its effectiveness and the utilization rate of the recycling facilities [15]. The use of recycling facilities is closely related to environmental awareness, but the intention of residents to participate in recycling is at odds with efforts to support the environmental initiative [16]. Therefore, encouraging active public participation in smart recycling is a real challenge [17,18]. On the other hand, the weak environmental consciousness of producers, government departments, and other stakeholders, and the unsystematic and imperfect concept of sustainable development are also important factors affecting sustainable consumption. Relevant surveys show that most enterprises are not aware of sustainable consumption and production. Even if they are aware of sustainable development, they will face downward competition from social consumption due to a lack of consumer recognition or low product profits, and the market cannot form internal motivation for sustainable consumption [19].

In response to this situation, the most common approaches at present are to extend the life cycle of products [20], produce recyclable products, and use recycled materials, innovate systems [21], or establish new business models. Regardless of which approach is adopted, design is considered to be the core of the driving force of system innovation and change [22] and complementary of technological innovation and social innovation [23]. Based on the ultimate goal of sustainable innovation and development, the introduction of sustainable system design thinking can complete the optimization of sustainable systems for production, manufacturing, consumption, or recycling and waste. As with the concept of traditional system design thinking, sustainable system design thinking is not only a product form but a creative systematic way to solve problems for the purpose of promoting innovation [24], which has been transformed from "giving form" to "design process", "design strategy", or "design system" [25]. This also means that designers need to be aware

of their new responsibilities and make concrete contributions to the green transition to a sustainable society [26]. If designers follow the concept of sustainability at the beginning of the design and development stage, it will definitely lead the design results in a more environmentally friendly and low-carbon direction. Designers' past consumption experience will also play a key role in the whole design system [27]. Under the influence of the trend of sustainable development, designers can introduce the design method into the sustainable system design thinking to design and develop various sustainable products and indirectly promote consumers' recognition of sustainable value through these sustainable products. Therefore, in the context of sustainable development, the power of design innovation not only drives more consumers to have more recognition of sustainability but also reduces the impact of environmental damage to a certain extent [28]. Therefore, designers play an even more important role in promoting sustainable development, in order to lead consumers to create a highly sustainable society through the professional ability of innovative design.

Designers are consumers themselves. Compared with ordinary consumers, designers have certain experience and levels of product innovation ability as well as aesthetic cultivation and evaluation. At the same time, designers have a deeper familiarity and understanding of sustainable design. Therefore, in a broad sense, designers themselves have dual identities, that is, designers are also consumers, or consumers with a designer identity. When designers are brought into the role of consumers, it is easier to think about how to attract consumers to identify and buy sustainable products through professional ability [29].

Therefore, this study attempts to explore the potential structure of consumers' sustainable consumption cognition from the perspective of designers through introducing sustainable system design thinking. This study mainly focuses on the following points. Firstly, what are the specific implementation methods of sustainable system design thinking? Secondly, from the perspective of causality prediction, a structural equation model is used to analyze the factors affecting consumers' cognition of sustainable consumption. Thirdly, through conceptualization and hypothesis verification, a consumer sustainable consumption cognition model is established for future research by introducing sustainable system design thinking.

2. Literature Review

2.1. Environmental Concerns

Environmental concerns refer to someone's views and concern about environmental issues, or attitude and willingness to protect the environment [30]. International public opinion surveys show that as the global environmental deterioration increases year by year [1], the public's concern about environmental issues remains high, and the vast majority of people regard environmental protection as one of their important personal goals [31]. Environmental concerns will influence the consumption value and consumption choice [32], and consumers' subjective environmental concerns and concern about the environment will influence their purchasing behavior of green products [33]. Consumers' behavioral decisions often depend on their attitude towards the environment [34]. When individuals have higher environmental concerns, they may be more environmentally friendly than others.

In recent years, many designers have realized that what they do is to promote the sales of commodities and products, which leads to consumers' unsustainable consumption behaviors [35]. Therefore, sustainable design thinking is attracting more and more attention from designers and researchers. Most designers feel that the sustainable design education they have received is not perfect because of the troubles brought by environmental problems in their daily life [36]. However, their work experience makes them recognize the importance of environmental protection and sustainability to design and development. To consumers, the production and manufacturing field is too specialized, but designers can serve as a communicator between consumers and the production and manufacturing field and establish a close relationship with them so that consumers can also understand the

importance of a sustainable society and their own responsibilities [37]. Moreover, designers are also consumers in life, so the double identity of designers is worth our attention. Therefore, the focus of this paper is to establish a new thinking of user-centered sustainable design by putting designers in the role of consumers.

2.2. Sustainable System Design Thinking

Sustainable system design thinking adds sustainability considerations on the basis of traditional design thinking. Generally, design thinking is considered to be a systematic, critical, and creative design method that explores solutions based on human values, needs, emotions, and desires [38]. In different scenarios or situations, design thinking is called logic, principles, practices, tools, discourse, philosophy, mental model, etc. [39]. Therefore, design thinking is multidimensional and needs to be defined in specific problems and objects. In this study, the role of design thinking in sustainability is emphasized. From the perspective of system design thinking, sustainable design refers to a rationalized and structured process of creating new things to solve problems related to sustainability [40]. It promotes people's understanding of sustainability by changing products, consumer behaviors, business services, and even the social and economic system [23,41]. The role of designers is not only to connect the whole development process but also to integrate the innovative ability and design methods of designers [42] so as to find the best sustainable solution for design and development. From the perspective of products, sustainable design usually needs to incorporate environmental factors and pollution prevention measures into product design at the design stage and take environmental performance as the design goal and starting point of products, so as to minimize the impact of products on the environment [43]—for example, using a product service system to reduce waste and resource consumption caused by product purchasing, using green design and ecological design to solve the impact of existing products on the environment, and connecting enterprises and community through social innovation design. Therefore, as a system attribute rather than an attribute of various elements in the system, sustainability needs to be gradually realized through system design thinking [23].

Christensen and Ball believe that the evaluation of design is reflected in three dimensions, including aesthetic value, innovation value, and functional value, and these three dimensions can help predict designers' thoughts or behaviors [44]. Innovation value is a very important attribute in design. Meanwhile, aesthetic value and functional value are "two high-level and important values in design" [44,45]. Buhl et al. believe that sustainability-oriented innovation should have a system scope to explain multidimensional objectives [46], while system design thinking is to implement design concepts into the design process and manufacturing process in a user-centered approach [47]. Therefore, we integrate the three dimensions of aesthetic value, innovation value, and functional value with system design thinking to form the concept of sustainable system design thinking and then introduce it into the consumer cognitive mode, and we carry out subsequent research and discussion on this basis and establish research models and hypotheses.

2.2.1. Sustainable Aesthetic Value

The essence of design is to make things in the world more beautiful, useful, elegant, and gorgeous [48]. Emphasis on beauty in product design is not only conducive to product usefulness but also to the success of products in the market [49]. However, when it comes to sustainable design, due to the principle of the reduction and recycling of materials, compared with general products, the aesthetic feeling and design sense are decreased. However, some scholars have found that if the method of design aesthetics is injected into sustainable design, this phenomenon can be improved. Claxton and Kent believe that consumers can carry out multi-season mixing and matching through reasonable color matching and prolong material life, thus extending the lifecycle of clothing products [50]. In a relatively simple way, the design aesthetic feeling of products can be maintained and the product strength can be greatly improved [51]. Meanwhile, it also caters to the

concept of sustainable design. For example, modern aesthetic techniques such as contrast, deconstruction, and realistic or minimalist style are used to express environmental thinking to consumers or emphasize the scientific and technological aesthetic feeling of innovative and sustainable technology.

On the other hand, the accumulation and training of aesthetic quality of designers come from the learning of professional design education, so they have a stronger perception of aesthetics than ordinary consumers and easily become pioneers in leading the trend. Designers' pursuit of both the beauty and function of products is the necessary attitude and responsibility of consumers. Therefore, designers must pay more attention to the transmission of sustainable concepts in the design-implementation process and ensure that sustainability is achieved through the use of the known design methods, such as sustainable design standards, product semantics, and emotional design approaches. Designers can deliver the basic requirement of the aesthetic feeling of product forms to consumers. Consumers can also effectively prolong the lifecycle of the product and understand the importance of sustainability concepts. As a result, designers can obtain balance in executing the concept of sustainable products and aesthetic pursuits. However, the perception of design aesthetics mainly depends on the quality of a specific individual (individual, group, or society), and the perceived aesthetic differences of different individuals may lead to the differentiation of product reputation. Therefore, from the perspective of perception, aesthetics is the most influential part of the three dimensions on consumers' judgment, so the aesthetic cultivation of designers is very important and even affects consumers' judgment on the aesthetic feeling of product types.

2.2.2. Sustainable Innovation Value

Under the 17 Sustainable Development Goals proposed by the United Nations, the prospect of sustainable development has more possibilities [52]. Therefore, the active international investment in sustainable development increasingly highlights the higher value attached to a sustainable future. The effective progress of sustainability is conducive to the continuous commitment of various economic and innovation activities at all industrial levels to sustainable development, transforming the traditional market into an emerging development prospect with sustainable innovation value [46,53]. The input of these industries to sustainable development also indirectly affects the effective utilization of resources and the innovation of production efficiency. Therefore, in addition to the sustainable social responsibility of the enterprise, the accumulated green image and sustainable business strategy also promote consumers to have more trust in the enterprise [54]. In addition to the industrial end of sustainable innovation, the active fields of sustainable innovation include the promotion of green activities of various circular economy so as to expand the breadth of enterprise product lifecycle from the perspective of effective development of circular economy [55]. Additionally, with the continuous increase in the concept and investment of the product service system, ordinary consumers have the opportunity and focus to transform into green consumers. It also lays a strong development condition and foundation for sustainable innovation and related industries, which not only expands future prospects but also establishes a complete green service system [56]. Therefore, as the population base of emerging sustainable consumers continues to grow, enterprises are willing to invest in more innovative research and development of sustainable products and become more enthusiastic about the production and supply of sustainable innovation [57].

In addition, sustainable innovation also means that designers add the concept of sustainable goals into their creative development process under existing constraints. In particular, designers strive to develop materials, assembly parts, and related hint symbols in accordance with the needs so as to enhance the value of sustainability [58]. In this way, the sustainable innovation value is immeasurable behind the creative products designed by designers. Correspondingly, enterprises are willing to invest more resources in the cultivation of sustainable talents so as to achieve a virtuous cycle mechanism of sustainable talents and a mutually beneficial multiplication of consumers, designers, and enterprises [59]. As

the most creative people in the whole enterprise, designers can provide added value to sustainable brands from a creative perspective, such as logo, mascot, brand packaging, etc. In this way, consumers can perceive the uniqueness of sustainable products [60], have more trust and goodwill towards products, and further perform more purchase behaviors.

2.2.3. Sustainable Function Value

In the design evaluation stage, the consideration of usefulness or functional value is an important part [61], and also one of the methods to improve consumer satisfaction [62]. The functional value of generally designed products is reflected in various social factors, such as culture, fashion, health, etc. [63]. From the perspective of sustainability, the functional value of a product is reflected in whether the product can effectively participate in sustainability in the stages of design, development, use, and recycling. Therefore, sustainable functional design and functional value require designers to consider more specific methods, tools, or steps of sustainable design development.

As tools for sustainable product design and development, the product life cycle and product simplification can better assist designers in their design work [64]. The reason is that if designers want to improve the environmental protection properties of the product and perceptions of consumers, they should aim to simplify the product to achieve the optimal manufacturing process and modular replacement (production or consumer use phase) or use lifecycle assessment analysis, which refers to the comprehensive consideration of the product from raw-material extraction to the final disposition of the environmental impact, to extend the product life [65]. Ortiz and Castells argued that product life-cycle assessment (LCA) can be used to evaluate individual product materials and components, thereby assessing the product life cycle after composition [66]. Similarly, designers often need to analyze the environmental lifecycle performance of their designed products through product LCA results [67]. Therefore, this study considers that product lifecycle assessment is an inevitable consideration for designers in sustainable design and development. In system design, in order to achieve the sustainable goal, it is necessary to reduce the generation of waste in the whole production system and establish the collaborative connection between the production process, natural process, and local resources [23]. Therefore, designers are also required to play a positive role in the whole system. Among the 6R concepts [68], the most relevant ones to designers are 'Reduce', 'Reuse', and 'Recycle', which are also in line with product lifecycle considerations. Designers must consider the complete 6R of the product design, development, production, and use phases, in other words, simplifying the product design. Common methods are design for disassembly, design for remanufacturing, design for recycling, and modular design. However, product simplification is performed not to reduce the function and beauty of the product but to reduce the waste of space, material, process, or use in the product through the design experience and ability of the designer, so as to achieve the effect of product sustainability [43].

2.3. Value–Attitude–Behavior (VAB) Model

Homer and Kahle put forward the value–attitude–behavior model in 1988 to explain the flow of individual cognition: "influence should flow from abstract values to midrange attitudes to specific behaviors" [69]. The model is considered to be a valid theoretical basis for predicting individual behavior or intentions. In their model, value is interpreted as an individual's persistent belief that a particular behavior or pattern of behavior is personally and morally preferable [70]. In the research of consumer behavior, value perception will affect the value of consumer domain and the product attribute belief. Consumers' value perception will affect the product attribute belief, while the product attribute belief will affect consumers' attitude towards products [71]. In this study, as with the dual identity of the designer, value also has a multi-meaning. In other words, aesthetic value, innovation value, and functional value under sustainability are the value embodiment of designers' design and development elements and sustainable products guided by sustainable system design thinking with environmental consciousness as a starting point. In addition, these

three values also need to be perceived by consumers and guide or change consumers' consumption attitudes and intentions through value guidance.

The value–attitude–behavior model is generally used to explain the direct and indirect relationship between value, attitude, and behavior. In addition to the basic model application, the value–attitude–behavior model has also been used variously by different scholars. Cheung and To established an extended value–attitude–behavior model and explained the green purchasing behavior of Chinese consumers [72]. Tajeddini et al. explored the decision-making process of guests in Airbnb and hotel accommodation by using value–attitude–behavior model and planned behavior theory [73]. Lee et al. explored the moderating effect of 3D-printed food attributes and food phobias, which explained behavioral stages with intention and tested the relationship between value and attitude [74]. This is consistent with the model constructed in this study and provides strong evidence for the research theory of this study.

The attitude and intention of individuals have been discussed in many models, including the Theory of Reasoned Action [75], Theory of Planned Behavior [76], and Technology Acceptance Model [77]. In these models, attitude is interpreted as an individual's internal experience that affects an individual's intention, while intention is an individual's tendency to take action [78]. Generally speaking, consumers' sustainable consumption attitude refers to individuals' positive or negative evaluation of sustainable products, while sustainable consumption intention refers to individuals' self-commitment to purchase sustainable products [79]. Thus, there is a correlation between sustainable consumption attitudes and intentions, especially when evaluating specific environmentally friendly products or behaviors, such as sustainable products, green hotels, or organic food. Verma et al. believe that attitude plays a more positive role in environmental protection behavior, and consumers' specific attitude towards energy-saving products will positively affect their purchase intention [80]. Malik and Singhal found that consumers with a stronger sustainable consumption attitude would prefer to buy environmentally friendly products [81]. If consumers' attitudes towards the environment are changed, their intentions and behaviors towards the environment can be further changed [82]. More and more consumers are willing to change their purchasing habits by buying more sustainable products [10].

2.4. Sustainable Policy

In recent years, due to high energy consumption, how to curb excessive carbon emissions has attracted high international attention. Governments of various countries and regions have formulated relevant laws and regulations on energy conservation and emission reduction to prohibit relevant enterprises from carrying out high-pollution manufacturing [83], and stimulate enterprise transformation with incentive policies [84]. In order to gain benefits from government incentive measures, enterprises must adopt green technologies or improve existing technologies to reduce carbon emissions [85]. Some automobile enterprises are also forced to produce three-cylinder vehicles or electric vehicles to meet the carbon emission targets set by the state. China is also actively formulating environmental policies, from national strategies to individual policies and regulations. The garbage classification system has been promoted in recent years, although the recovery rate is still very low at the present stage [86]; consumers also lack the corresponding cognition of garbage classification recovery. From the perspective of consumption, policies can help. For example, due to policy regulations, publicity, and reward and punishment systems, consumers have begun to understand dry waste and wet waste, and gradually learned about garbage classification; subsidy policies for new energy vehicles will affect consumers' attitudes towards new energy vehicles and stimulate their purchase intentions and behaviors [87], etc. Therefore, designers need to maintain high sensitivity, respond to current policies and regulations on green environmental protection, inject sustainable system design thinking into product design and development, assist enterprises in green production and manufacturing, and try to guide and change consumers' cognition and behavior. This also means that the higher consumers' perception of policies and regulations,

the more obvious the attitude and intention of sustainable consumption. As consumers, designers can perceive the rapid establishment and implementation of sustainable policies and also realize the important role of sustainability in design, so it will also affect the product design and development stage.

3. Research Structure and Methodology

3.1. Research Process

The purpose of this study is to investigate whether the concept introduction of sustainable system design thinking has guiding significance for consumers with designer identity in future design and development. In order to explore the relationship between different dimensions, structural equation modeling was used to analyze the data. Hair [88] pointed out that the steps to establish the research framework and process include the following (Figure 1): (1) the first step is to review and discuss the literature, revise the research results of previous scholars, construct the theoretical framework of this study, and establish statistical hypotheses for each dimension. (2) The second step is to establish a theoretical framework and design questionnaire and conduct survey, as well as questionnaire reliability analysis according to the topic discussed. (3) The third step is to establish a research model based on the theoretical framework of this study. Confirmatory factor analysis, convergence validity, and discriminant validity are used to verify the fitness of the model. (4) The fourth step is to use a structural equation model to analyze and verify the validity of the statistical hypothesis between each dimension.

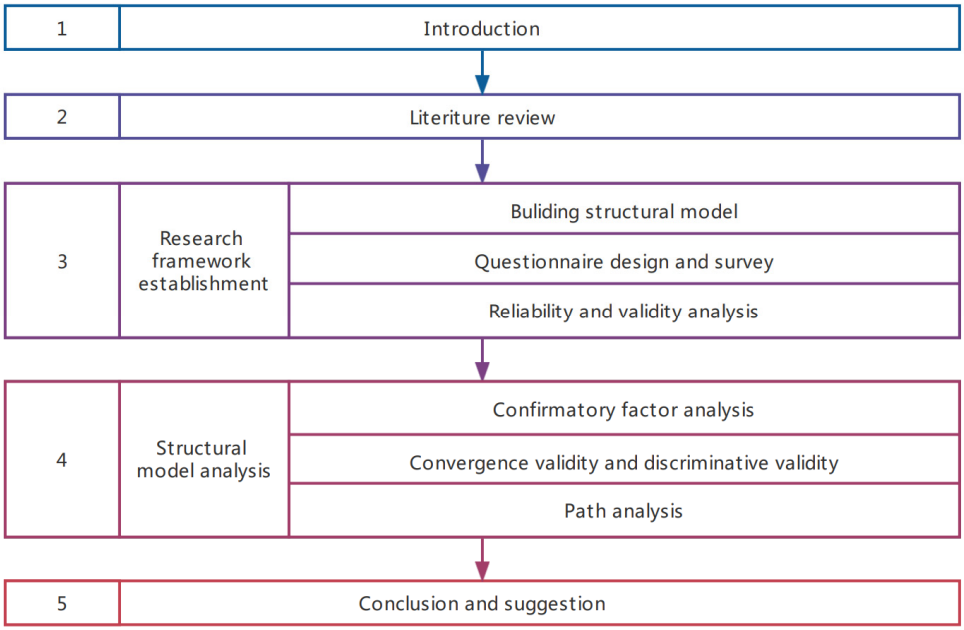

Figure 1. Research process.

3.2. Research Object

This research requires designers to substitute themselves into two identities (designer and consumer) and understand the consumer cognitive model introduced by the sustainable system design thinking concept constructed in this research through their own design skills and experience and consumption experience as consumers. This study believes that designers and consumers are mutually complementary and mutually reinforcing. Designers design products that meet consumer needs, and consumer satisfaction, in turn, fuels designers' inspiration and enthusiasm. Therefore, when designers have dual identities, they can better appreciate similarities and differences and deduce relevant results. Considering that sustainable products are not limited to industrial products, clothing, advertising, architecture, etc. can all be included in the scope of sustainable products; therefore, the

research object is designers from all fields. It is worth mentioning that the double identity that we emphasize is the consumer with the identity of designer. We asked the target respondents to reflect on the deficiencies in the design or environmental attributes of the items or products they used, and to explore the possibilities for improvement through the concept of sustainable design thinking in this study.

This study attempts to propose a consumer cognitive model of sustainable system design thinking based on the dual role of designers. It is hoped that the model will be introduced in the next stage for verification research. In the past, there have been a lot of introductory studies on participatory design methods that allow consumers to actively participate in the product design and development process. The introduction of participatory design is to narrow the distance between the mental model of design developers and consumers so that the final product will not fall into the vortex of "over-design" and reduce the failure rate of products. Especially in a consumer era of iteration and development, product design, development, and positioning are more likely to be dominated by consumers. Therefore, the rise of consumer awareness also promotes public participation in the progress of society more effectively than in the past. The dual identity given to the respondents of this study, that is, consumers with designer identity, can obviously play a more helpful and efficient role in the process of product design and development, reduce the product failure rate, and prolong the life cycle of products.

3.3. Research Structure and Model

Based on the literature review and the sustainable theme of this study, a theoretical model is constructed from the designer's environmental concerns and based on the value–attitude–behavior model. The three dimensions of aesthetic value, innovative value, and functional value of design evaluation are regarded as the necessary factors in the design and development stage to construct the design dimension. The consumption dimension is composed of sustainable policy, sustainable consumption attitude, and sustainable consumption intention. Finally, a consumer cognitive model combined with the concept of sustainable system design thinking in this study is formed (Figure 2), and eight related research hypotheses are established.

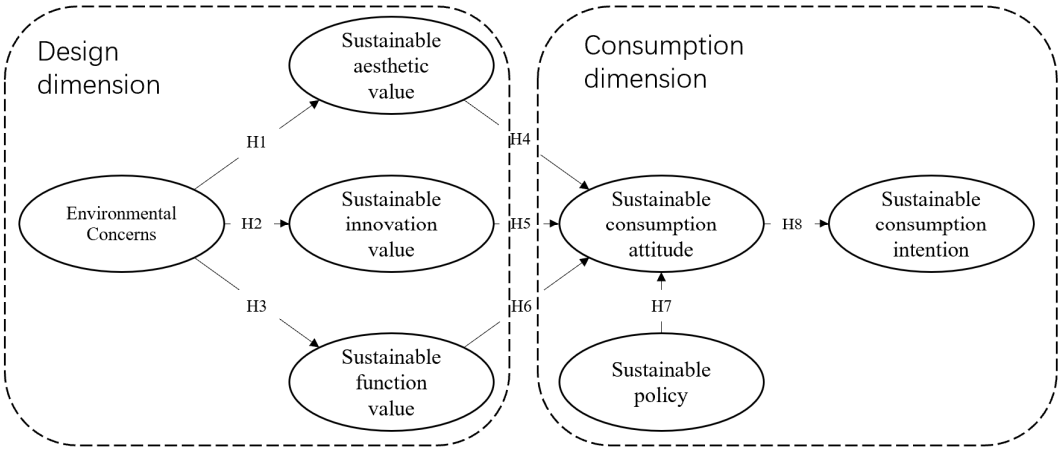

Figure 2. Theoretical model.

Hypothesis 1 (H1). *Environmental concerns significantly influence sustainable aesthetic value.*

Hypothesis 2 (H2). *Environmental concerns significantly influence sustainable innovation value.*

Hypothesis 3 (H3). *Environmental concerns significantly influence sustainable functional value.*

Hypothesis 4 (H4). *Sustainable aesthetic value significantly influences sustainable consumption attitude.*

Hypothesis 5 (H5). *Sustainable innovation value significantly influences sustainable consumption attitude.*

Hypothesis 6 (H6). *Sustainable functional value significantly influences sustainable consumption attitude.*

Hypothesis 7 (H7). *Sustainable policy significantly influences sustainable consumption attitude.*

Hypothesis 8 (H8). *Sustainable consumption attitude significantly influences sustainable consumption intention.*

3.4. Definitions of Research Variables

Structural equation modeling is generally used to verify the causal relationship between different permutations and combinations of inherent variables. In this study, four new factors are constructed according to the concept of sustainable system design thinking. Therefore, the items of the new factors will be reconstructed by referring to the existing literature and discussed internally by the authors. This study designed the questionnaire items according to the research theme and relevant literature. Reference sources for variable definitions, items and scales are shown in Table 1.

Table 1. Reference sources for variables and items.

Variable	Operational Definition	Reference
Sustainable policy	The extent to which policies and regulations affect consumers' attitudes towards sustainable consumption.	[89]
Sustainable aesthetic value	Designers' perception of aesthetic value and the impact of aesthetic value on sustainable consumption attitude.	[44,90]
Sustainable innovation value	Designers' perception of innovation value and the impact of innovation value on sustainable consumption attitude.	[44,90]
Sustainable functional value	Designers' perception of functional value and the impact of functional value on sustainable consumption attitude.	[44,90]
Environmental concerns	The designer's self-perception of environmental concerns.	[39,91]
Sustainable consumption attitude	The actual attitude and evaluation of sustainable products from the consumer perspective.	[92,93]
Sustainable consumption intention	The extent to which a consumer's perspective actually influences decisions about sustainable products.	[92,94]

3.5. Research Samples and Questionnaires

The survey was conducted online from January to March 2022. Ethical approval for this study was obtained from the National Cheng Kung University Human Research Ethics Committee. In addition to demographic variables, a 7-point Likert scale was used, ranging from 1 (strongly disagree) to 7 (strongly agree). Considering that the subject of this study was a specific profession (designer), a snowball sampling method was adopted by inviting designer friends to fill in the form and then asking them to send forms out to other designers [95]. The specific way of questionnaire distribution is to push QRcode and webpage links through Wechat private chat, Wechat moments, Weibo, and other forms. All respondents browsed the questionnaire's website to view the research description. They volunteered to answer questionnaires and could withdraw from the survey at any time. Therefore, all respondents agreed to complete the questionnaire under the principle of being fully informed and voluntarily participating.

At the beginning of the questionnaire, in addition to the basic research statement, designer respondents are required to understand the aesthetic value, innovation value, and functional value defined in this study, and perceive the role of the three values in the design dimension as designers, and then perceive the role of the three values in the consumption dimension as consumers. For example, in functional value, this study will inform designers

of the definition, practice, and significance of functional value in the study: the presentation form of functional value can improve and design environmental protection packaging of existing products and new products (such as using less paper and plastic materials; using the minimum amount of materials to develop and design products; considering whether the product is easy to recycle, reuse, decompose; etc.). It is used to facilitate the designer to understand and answer the questionnaire. At the same time, we asked designers to recall whether they found any deficiencies or defects in design or environmental-protection attributes of some products in their daily life, and to evaluate whether the sustainable system design thinking of this study would have any guiding role or significance in product design or improvement if they were developing or modifying products.

Finally, 433 samples were collected in this study. After removing invalid samples (due to logical errors or too many of the same options), 386 samples were left, and the validity rate was 89.15%. In this study, there were 28 questionnaire items, and 386 questionnaires met Jackson's standard that the ratio of estimated parameters to sample number should be higher than 1:10 [96], so the sample size was suitable for subsequent data analysis. According to the data of subjects in valid questionnaires, the distribution of demographic variables in this study is shown in Table 2.

Table 2. Sample description.

Category	Items	Frequency (n = 386)	Ratio (%)
Gender	Male	117	30.31
	Female	269	69.69
Age	Younger than 30	161	41.71
	31–40	189	48.96
	41–50	27	7.00
	Older than 51	9	2.33
Marriage status	Unmarried	197	51.04
	Married	189	48.96
Monthly income	Less than 4000	30	7.77
	4001–8000	129	33.32
	8001–12,000	165	42.75
	12,001–16,000	45	11.66
	More than 16,001	17	4.40
Educational status	Junior high school or below	0	0.00
	High school or junior college	0	0.00
	University	198	51.29
	Graduate school or above	188	48.71
Major	Industrial Design/Product Design	172	44.56
	Visual Communication Design	57	14.78
	Environmental Art Design	22	5.7
	Architectural Design	26	6.7
	Digital Media Design	35	9.07
	Clothing Design	74	19.17

4. Results and Discussion

4.1. Reliability Analysis

In order to make the results more reliable, this study first conducted reliability analysis and item analysis on the questionnaire data to delete the unstable items and test the reliability and identification degree of the questionnaire data. As shown in Table 3, Cronbach's α values of each dimension were all greater than 0.7, and Cronbach's α values of any dimension after deleting any of the included items were all lower than the current results, indicating that none of the items should not be deleted in this test. It shows that the reliability quality of the data is good and the data can be used for further analysis.

Table 3. Reliability and item analysis of dimension items.

Dimension	Item	CITC	Cronbach's α after Item Deletion	Cronbach's α
EC	EC1	0.650	0.727	0.798
	EC2	0.582	0.762	
	EC3	0.629	0.739	
	EC4	0.580	0.762	
AV	AV1	0.571	0.680	0.751
	AV2	0.595	0.666	
	AV3	0.566	0.682	
	AV4	0.458	0.739	
IV	IV1	0.527	0.734	0.768
	IV2	0.604	0.693	
	IV3	0.575	0.709	
	IV4	0.569	0.713	
FV	FV1	0.649	0.753	0.811
	FV2	0.637	0.759	
	FV3	0.640	0.757	
	FV4	0.588	0.782	
SP	SP1	0.601	0.737	0.790
	SP2	0.576	0.751	
	SP3	0.628	0.723	
	SP4	0.591	0.742	
SA	SA1	0.654	0.722	0.797
	SA2	0.562	0.769	
	SA3	0.591	0.754	
	SA4	0.625	0.738	
SI	SI1	0.628	0.738	0.798
	SI2	0.540	0.782	
	SI3	0.674	0.716	
	SI4	0.602	0.751	

4.2. Exploratory Factor Analysis

In this study, exploratory factor analysis was used to test the unidimensionality of the seven dimensions of the hypothesis model. Firstly, principal component analysis was used to extract new factors with eigenvalues greater than 1 in each dimension. The results showed that the KMO (Kaiser–Meyer–Olkin) value of each dimension was greater than 0.7, and the significance of Bartlett sphericity test was less than 0.05, indicating that the questionnaire samples in this study were suitable for exploratory factor analysis [97,98]. A total of seven dimensions with eigenvalues greater than 1 were extracted, and the cumulative interpretation of variation was 62.7%, while the interpretation of single dimension was less than 40%. There was no single dimension that explained most of the interpretation of variation, which was in line with Thompson's criteria. Therefore, it can be proved that the questionnaire in this study did not show common method variation [99]. In addition, it can be seen from Table 4 that in the default model, the items of each dimension are well aggregated in the corresponding dimension, which indicates that the default model of this study is reliable. In addition, the factor loading of AV4 item in the aesthetic value dimension was lower than 0.4, so AV4 was deleted at this stage for subsequent structural equation model analysis.

Table 4. Rotated factor analysis component matrix of dimension items.

Dimension	Item	Component						
		1	**2**	**3**	**4**	**5**	**6**	**7**
EC	EC1	0.124	0.730	0.142	0.101	0.162	0.174	0.198
	EC2	0.196	0.667	0.175	0.188	−0.019	0.190	0.120
	EC3	0.179	0.719	0.095	0.163	0.235	0.140	0.070
	EC4	0.049	0.692	0.201	0.146	0.162	0.131	0.111
AV	AV1	0.069	0.201	0.281	0.102	0.197	0.268	0.601
	AV2	0.143	0.040	0.146	0.134	0.143	0.240	0.746
	AV3	0.173	0.236	0.027	0.160	0.122	0.061	0.755
	AV4	0.305	0.133	0.233	0.232	0.223	0.149	0.364
IV	IV1	0.220	0.198	0.080	0.165	0.308	0.552	0.075
	IV2	0.137	0.174	0.139	0.101	0.113	0.740	0.183
	IV3	0.047	0.163	0.295	0.175	0.168	0.628	0.200
	IV4	0.266	0.176	0.115	0.155	0.086	0.672	0.143
FV	FV1	0.068	0.166	0.149	0.725	0.299	0.163	0.071
	FV2	0.186	0.164	0.126	0.736	0.197	0.147	0.050
	FV3	0.175	0.111	0.254	0.682	0.142	0.117	0.203
	FV4	0.226	0.239	0.150	0.621	0.029	0.146	0.265
SP	SP1	0.322	0.129	−0.008	0.075	0.688	0.212	0.136
	SP2	0.208	0.118	0.259	0.166	0.627	0.016	0.217
	SP3	0.098	0.231	0.156	0.200	0.720	0.135	0.092
	SP4	0.128	0.090	0.205	0.234	0.649	0.236	0.135
SA	SA1	0.708	0.205	0.094	0.148	0.207	0.172	0.186
	SA2	0.614	0.099	0.179	0.211	0.206	0.192	0.032
	SA3	0.702	0.087	0.262	0.076	0.118	0.126	0.134
	SA4	0.693	0.159	0.207	0.167	0.142	0.109	0.133
SI	SI1	0.279	0.125	0.691	0.199	0.124	0.111	0.089
	SI2	0.091	0.114	0.633	0.157	0.151	0.269	0.134
	SI3	0.217	0.216	0.738	0.169	0.144	0.109	0.084
	SI4	0.270	0.271	0.588	0.140	0.147	0.123	0.211
Eigenvalue		2.729	2.666	2.561	2.552	2.532	2.364	2.151
Variance interpretation		9.746	9.521	9.145	9.115	9.042	8.444	7.684
Cumulative variance interpretation					62.7%			
Kaiser–Meyer–Olkin						0.947		
Bartlett's sphericity test	Approximate chi-square					4559.037		
	df					378		
	Sig.					0.000		

4.3. Measurement Model

AMOS V22.0 was used in this study to conduct confirmatory factor analysis on the measurement model. AMOS was used for analysis in a large number of studies, which proved to be reliable structural equation modeling software. According to a study by Anderson and Gerbing, data analysis can be divided into two stages [100]. The first stage is the measurement model, which adopts the maximum likelihood estimation method, and the estimated parameters include factor loading, reliability, convergent validity, and discriminant validity [100]. According to the studies of convergent validity by Hair et al. [89], Nunnally [101], Fornell and Larcker [102], and the standardized factor loading by Chin [103] and Hooper et al. [104], the standardized factor loading in this study is higher than 0.7. In this study, the standardized factor loading is higher than 0.7, and the reliability of the composition of the research dimension is higher than 0.7, while the mean variance extraction is between 0.456 and 0.519 (close to or higher than 0.5) [88], indicating that the dimension has good convergent validity (Table 5).

Table 5. Convergent validity results of measurement model.

Dimension	Item	Unstd. Factor Loading	S.D.	Unstd. Factor Loading/S.D.	*p* Value	Std. Factor Loading	Composite Reliability	AVE
EC	EC1	1.000	-	-	-	0.751	0.800	0.501
	EC2	0.886	0.072	12.224	0.000	0.675		
	EC3	0.922	0.070	13.142	0.000	0.729		
	EC4	0.831	0.068	12.133	0.000	0.670		
AV	AV1	1.000	-	-	-	0.732	0.737	0.484
	AV2	1.040	0.090	11.523	0.000	0.689		
	AV3	0.926	0.083	11.219	0.000	0.667		
IV	IV1	1.000	-	-	-	0.645	0.769	0.456
	IV2	1.157	0.105	10.981	0.000	0.690		
	IV3	1.115	0.101	11.003	0.000	0.692		
	IV4	1.024	0.095	10.733	0.000	0.669		
FV	FV1	1.000	-	-	-	0.739	0.812	0.519
	FV2	0.990	0.076	13.037	0.000	0.719		
	FV3	0.999	0.075	13.316	0.000	0.736		
	FV4	0.902	0.072	12.455	0.000	0.686		
SP	SP1	1.000	-	-	-	0.693	0.791	0.486
	SP2	1.040	0.090	11.550	0.000	0.677		
	SP3	1.076	0.089	12.116	0.000	0.717		
	SP4	0.996	0.084	11.916	0.000	0.702		
SA	SA1	1.000	-	-	-	0.760	0.799	0.499
	SA2	0.860	0.070	12.220	0.000	0.662		
	SA3	0.864	0.069	12.610	0.000	0.683		
	SA4	0.900	0.068	13.189	0.000	0.714		
SI	SI1	1.000	-	-	-	0.714	0.800	0.501
	SI2	0.872	0.078	11.129	0.000	0.624		
	SI3	1.004	0.075	13.381	0.000	0.764		
	SI4	0.963	0.075	12.884	0.000	0.731		

Fornell and Larcker's [102] study was adopted for discriminant validity analysis. If the square root of AVE of each dimension is greater than the correlation coefficient between any pair of dimensions, the model has discriminant validity. The results show that all the values on diagonal in this study are greater than those outside the diagonals, indicating that each dimension of this study has good discriminant validity (Table 6). Therefore, the data in this study have good convergent validity and discriminant validity, so they can be used for further analysis.

Table 6. Discriminant validity results of measurement model.

	AVE	SD	AV	IV	FV	SP	SA	SI
SD	0.501	0.708						
AV	0.435	0.482	0.696					
IV	0.456	0.552	0.551	0.675				
FV	0.519	0.527	0.493	0.537	0.721			
SP	0.484	0.498	0.502	0.558	0.567	0.697		
SA	0.499	0.490	0.479	0.543	0.535	0.568	0.706	
SI	0.501	0.541	0.502	0.558	0.569	0.535	0.598	0.708

NOTE: The items in bold on the diagonal are the square root of AVE. Other elements are correlation value.

4.4. Model Estimantion

Based on the studies of Jackson et al. [105], Kline [106], Schumacker and Lomax [107], and Hu and Bentler [108], several indexes (MLχ^2, DF, χ^2/DF, RMSEA, SRMR, NNFI, CFI, GFI, AGFI, PGFI, PNFI, IFI) were selected to evaluate the fitness of the structural

model. Environmental concerns, sustainable aesthetic value, sustainable innovation value, sustainable functional value, sustainable policy, sustainable consumption attitude, and sustainable consumption intention were measured according to the research hypotheses and model. It can be seen from Table 7 that, except for NFI, all standard model fitness evaluation indices meet both the independent level and combination rules of the recommended fitness, which proves that the structural model has good fitness. The theoretical framework of the research hypothesis is consistent with the actual survey results.

Table 7. Results of measurement model fitness.

Fitness Indices	Ideal Range	Results	Judgement
MLχ^2	Larger is better	517.113	
DF	Larger is better	315.000	
χ^2/DF	$1 < \chi^2/DF < 5$	1.642	support
RMSEA	<0.08	0.041	support
SRMR	<0.08	0.049	support
TLI (NNFI)	>0.9	0.946	support
CFI	>0.9	0.951	support
NFI	>0.9	0.885	nonsupport
GFI	>0.8	0.907	support
PGFI	>0.5	0.756	support
PNFI	>0.5	0.795	support
IFI	>0.9	0.952	support

Note: MLχ^2 = maximum likelihood chi-square test, DF = degree of freedom, χ^2/DF = ratio of χ^2 to degree of freedom, RMSEA = root mean square error of approximation, SRMR = standardized root mean squared residual, CFI = comparative fitness index, NNFI = non-normed fit index, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, PGFI = parsimony goodness-of-fit index, PNFI = parsimony normed fit index, IFI = incremental fitness index.

4.5. Path Analysis

According to the path analysis results, environmental concerns (EC) significantly affected the sustainable aesthetic value (AV) (b = 0.747, p = 0.000), sustainable innovation value (IV) (b = 0.726, p = 0.000), and sustainable functional value (FV) (b= 0.795, p = 0.000). Sustainable aesthetic value (AV) (b = 0.156, p = 0.043), sustainable innovation value (IV) (b = 0.312, p = 0.001), sustainable functional value (FV) (b =0.253, p = 0.000), and sustainable policy (SP) (b = 0.332, p = 0.000) significantly affected the sustainable consumption attitude (SA). The sustainable consumption attitude (SA) (b = 0.829, p = 0.000) significantly affected the sustainable consumption intention (SI).

The explanatory power of environmental concerns (EC) to sustainable aesthetic value (AV), sustainable innovation value (IV), and sustainable functional value (FV) was 59.1%, 69.1%, and 59.9%, respectively. Sustainable aesthetic value (AV), sustainable innovation value (IV), sustainable functional value (FV), and sustainable policy (SP) had 70.0% explanatory power to the sustainable consumption attitude (SA). The explanatory power of the sustainable consumption attitude (SA) to sustainable consumption intention (SI) was 67.5%.

4.6. Hypothesis Verification

The purpose of this study is to use the structural equation model (SEM) to find out the consumer's sustainable consumption cognition model integrated with sustainable system design thinking, and form the research strategy based on this, so as to provide reference for relevant scholars and practitioners. Table 8 shows the regression coefficients of the structural equation model in this study. The larger the coefficient is, the more important the independent variable is in the dependent variable. The results show that all the hypotheses of this research model are valid, and Figure 3 shows the relationship between factors.

Table 8. Regression coefficient.

Fitness Indices	Dependent Variable	Independent Variable	Unstd. Estimate	S.D.	Unstd. Estimate /S.D.	*p* Value	Std. Estimate	R^2	Results
H1	AV	EC	0.747	0.073	10.201	0.000	0.769	0.591	Valid
H2	IV	EC	0.726	0.073	10.008	0.000	0.831	0.691	Valid
H3	FV	EC	0.795	0.075	10.628	0.000	0.774	0.599	Valid
H4	SA	AV	0.156	0.077	2.024	0.043	0.150	0.700	Valid
H5	SA	IV	0.312	0.096	3.262	0.001	0.269		Valid
H6	SA	FV	0.253	0.070	3.597	0.000	0.257		Valid
H7	SA	SP	0.332	0.080	4.144	0.000	0.309		Valid
H8	SI	SA	0.829	0.074	11.269	0.000	0.822	0.675	Valid

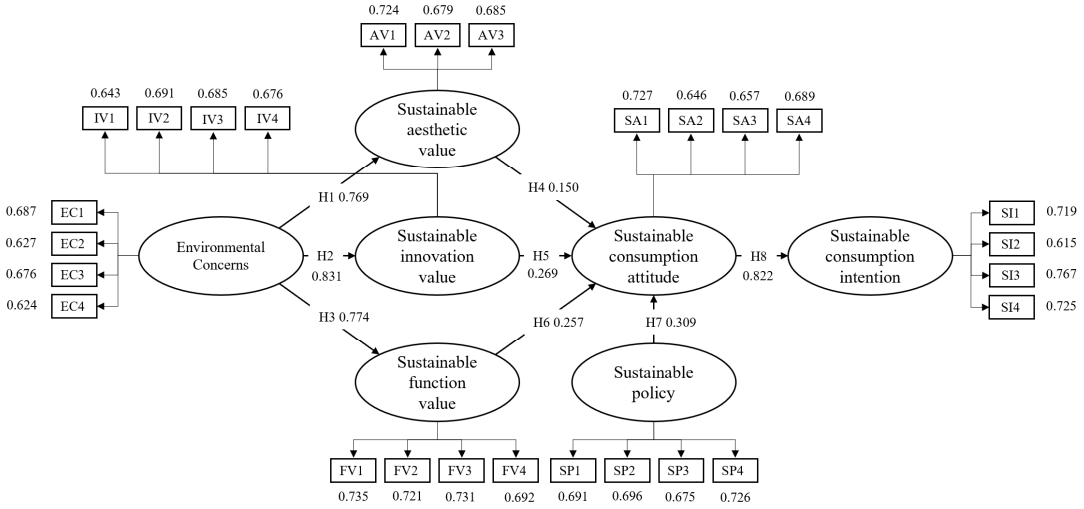

Figure 3. Validation of research results.

4.7. Discussion

The results of the empirical analysis provide some key findings, which are discussed below.

H1 is valid, indicating that environmental concerns significantly affect the sustainable aesthetic value. H2 is valid, indicating that environmental concerns significantly affect the sustainable innovation value. H3 is valid, indicating that environmental concerns significantly affect the sustainable functional value. These three hypotheses indicate that environmental concern is an important motivation for designers to design sustainable systems. In sustainability, individual environmental concerns are always very important and are considered as an important prerequisite for environmental intentions or behaviors [109]. Such environmental protection intention or behavior is not only the consumer's consumption intention or behavior but also makes designers change their mind and behavior from the perspective of design. That is, environmental concerns are added to exploration, demonstration, development, and other stages of design so as to achieve sustainable system design. The high path coefficients of EC on AV, IV, and FV also indicate that designers' thinking on environmental issues is highly relevant to sustainable system design. It also indicates that sustainable design is designers' independent behavior and responsibility for the environment.

H4 is valid, indicating that sustainable aesthetic value significantly affects sustainable consumption attitude. It means that the aesthetic value of sustainable products is one of the factors that determines consumer attitudes. As one of the cores of design, design aesthetics is the theoretical basis to make products have a better sense of design. Designers themselves, as designers and consumers, believe that products with aesthetics will attract consumers' attention so as to achieve better sales volume and create profits for enterprises [110]. It also

means that aesthetic value still needs to be emphasized in sustainable design. Integrating environmental aesthetics or ecological aesthetics into products can help consumers perceive the environmental value of green products and improve their purchase intention [111].

The validity of H5 represents the significant impact of sustainable innovation value on the sustainable consumption attitude. Innovation has always been considered as the core of sustainable development. For consumers, the concept of sustainability enables them to switch from ordinary consumers to green consumers, so sustainable innovation is extremely important to consumers. It includes industry investment and research on sustainable development goals, business strategies with sustainable ideas, and even the promotion and popularization of sustainable product and service systems. In addition, sustainable innovation also includes designers' innovative thinking on products, the mastery of sustainable design rules, and breakthroughs in product assembly methods and material applications so that consumers can be more independent in their consumption attitudes towards purchasing products. Therefore, in addition to the aesthetic value of the products, consumers will also more closely examine the attitude and enthusiasm of the manufacturers of the products available on the market, which will be reflected in their sustainable consumption attitude.

The validity of H6 indicates that sustainable functional value significantly affects the sustainable consumption attitude. This study has always emphasized that the significance of three design values is perceived by consumers. Therefore, from the perspective of sustainable functional value, products should have special functional attributes that are different from other products. In sustainable design, the functional differences between sustainable products and ordinary products are reflected in the design concept, structure, material and use mode, etc. Some sustainable products with modular functions also have functional attributes that are convenient for assembly, disassembly, and recycling. For consumers' sustainable consumption attitude, these functions with environmental attributes can meet their demand for environmental protection and also serve as the purchase incentive. Regarding the design concept, structure, and material, designers should also simplify steps to improve the efficiency of product design and development and improve sustainability. In sustainable design, there are material selection, green structure design, modular design, and easy disassembly design criteria corresponding to this [112]. The simplified design helps to avoid the inconvenience caused by the use, waste, maintenance, or recycling of products; reduce the impact on the environment; and improve the eco-efficiency of enterprises.

The validity of H7 indicates that sustainable policy significantly affects sustainable consumption attitude. This indicates that the more consumers pay attention to or understand the policies and regulations, the more they will change their attitudes towards sustainable consumption, thus affecting their intentions. In other words, the friendlier the policies are towards sustainable consumption, the more positive the attitudes and intentions of consumers will be. However, in general, policies are made primarily for business and are of great importance to business. For example, energy-saving policies would increase the economic costs of a business, and businesses must find new ways to maintain profits. When policies and regulations are strict enough, they will restrict the production, manufacture, and sale of conventional products, thus triggering market demand for green products [113]. For designers, keeping high sensitivity to policies and regulations can ensure targeted design innovation and adjust design strategies so as to maximize the interpretation and utilization of policies and regulations, and also ensures that products are not subject to resistance in production and sales.

The validity of H8 indicates that the sustainable consumption attitude significantly affects sustainable consumption intention. This means that when consumers have a more positive attitude towards sustainability, their intention of sustainable consumption also increases. Attitude has become one of the most critical factors in determining intention and behavior, reflecting the gradual improvement of individual environmental concerns in recent years [114]. Most consumers also hold a positive attitude towards green products,

believing that they have a good prospect [115], and are willing to replace general products with sustainable products, although the cost may be relatively high. This study also proves that the three elements of sustainable design are also important factors to improve consumers' sustainable consumption attitude and intention, which means that the more designers focus on these three elements, the more consumers may have higher purchasing attitude and intention. More and more consumption cases are also showing that consumers' attitudes and behaviors will also affect designers' attitudes and intentions and behaviors of subsequent design and development. If consumers have higher demands for sustainable products, designers will also provide more sustainable design products to cater to the market demand.

5. Conclusions and Suggestions

The main contribution of this study is the establishment of consumers' cognitive model, which is integrated with the concept of sustainable system design thinking (Figure 4). In the conclusion, this study also answers the research questions raised in the first chapter. Through the consumer cognitive model established in this study, we confirm and verify the feasibility and effectiveness of the three dimensions of design evaluation in system design thinking (namely aesthetics, innovation, and function) under sustainable design. Through the dual identity of designers, this study also explores the flow process of the sustainable concept from the design dimension to the consumption dimension. Through the verification results, it is confirmed that sustainable system design thinking has an important impact on consumers' attitudes and intentions. However, the results also show that we cannot ignore the impact of policy. With the support of the sustainability concept, the autonomy of consumers' consumption attitude and intention cannot be ignored.

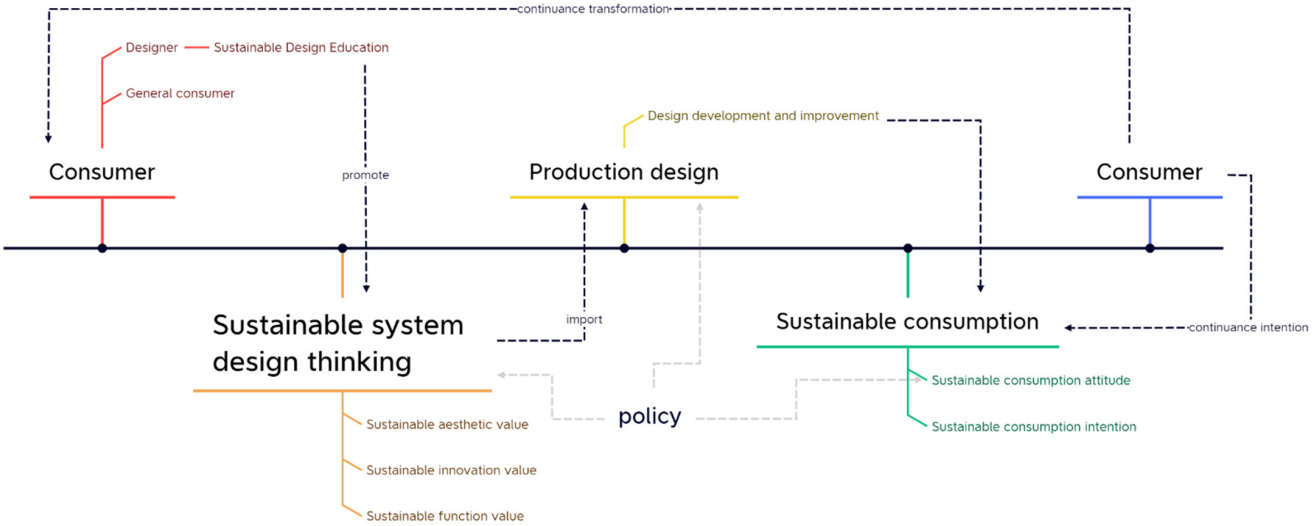

Figure 4. Consumption cognition model under sustainable systems thinking.

The results obtained in this study can not only serve as a reference for designers to implement sustainable design but also serve as an auxiliary reference for governments and enterprises to formulate sustainable innovation strategies and invest in implementation. Moreover, it can also be imported and planned as a reference for the training of design talents in colleges and universities, so that the knowledge and thinking quality of sustainable design majors can effectively root and promote more talent with sustainable practical design ability, to effectively and continuously promote the concept and goal of sustainability.

Some limitations of this study also imply the development and construction of future research directions, including that the object of this study is mainly discussed from the perspective of designers' dual identity. Therefore, future research can focus on the perspective of ordinary consumers and explore from different perspectives, such as sustainable

perceived value and risk, to echo or verify the conclusion of this study. In addition, the three dimensions of design evaluation discussed in this study, namely aesthetic value, innovation value, and functional value, also deserve further exploration, including the use of new dimensions, such as the use of second-order dimensions and mediating variables, so as to enhance the explanatory power of the constructed model and improve the model perfection. Finally, qualitative research and exploration and investigation and interview can be added to supplement the depth of thinking and expression of meaning that quantitative statistical data cannot show, so that the follow-up research and exploration and the content and results can be more perfect.

Author Contributions: Conceptualization, C.Y.; methodology, C.Y.; formal analysis, C.Y. and W.W.; data curation, C.Y.; writing—original draft preparation, C.Y.; writing—review and editing, W.W.; supervision, L.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgments: We are grateful to Ku-Hsi Chu, Wang-Chin Tsai and Meng Xia for their work. We also thank the anonymous reviewers who provided valuable comments on the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Hardin, G. The tragedy of the commons. *Science* **1968**, *162*, 1243. [CrossRef]
2. Weiss, E.B. United nations conference on environment and development. *Int. Leg. Mater.* **1992**, *31*, 814–817. [CrossRef]
3. Harland, D. The united nations guidelines for consumer protection. *J. Consum. Policy* **1987**, *10*, 245–266. [CrossRef]
4. United Nations. *Report of the Secretary-General: Progress towards the Sustainable Development Goals*; United Nations: San Francisco, CA, USA, 2020.
5. Several Opinions of the State Council on Speeding up the Development of Circular Economy. 2005. Available online: http://www.gov.cn/zwgk/2005-09/08/content_30305.htm (accessed on 29 May 2022).
6. Information Office of the State Council. The Opinions on Accelerating the Construction of Ecological Civilization is a Programmatic Document for the Construction of Ecological Civilization in China. Available online: http://www.gov.cn/2015-06/03/content_2872658.htm (accessed on 29 May 2022).
7. National Development and Reform Commission. Guidelines on Promoting Green Consumption. Available online: http://www.mofcom.gov.cn/article/bh/201604/20160401305077.shtml (accessed on 29 May 2022).
8. Rees, W.E. Ecological economics for humanity's plague phase. *Ecol. Econ.* **2020**, *169*, 106519. [CrossRef]
9. Saari, U.A.; Damberg, S.; Frömbling, L.; Ringle, C.M. Sustainable consumption behavior of europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. *Ecol. Econ.* **2021**, *189*, 107155. [CrossRef]
10. ElHaffar, G.; Durif, F.; Dubé, L. Towards closing the attitude-intention-behavior gap in green consumption: A narrative review of the literature and an overview of future research directions. *J. Clean. Prod.* **2020**, *275*, 122556. [CrossRef]
11. Gleim, M.; Stephanie, J.L. Spanning the gap: An examination of the factors leading to the green gap. *J. Consum. Mark.* **2014**, *31*, 503–514. [CrossRef]
12. Guyader, H.; Ottosson, M.; Witell, L. You can't buy what you can't see: Retailer practices to increase the green premium. *J. Retail. Consum. Serv.* **2017**, *34*, 319–325. [CrossRef]
13. Gruber, V.; Schlegelmilch, B.B. How techniques of neutralization legitimize norm- and attitude-inconsistent consumer behavior. *J. Bus. Ethics* **2014**, *121*, 29–45. [CrossRef]
14. Kulshreshtha, K.; Tripathi, V.; Bajpai, N.; Dubey, P. Discriminating market segments using preferential green shift: A conjoint approach. *Foresight* **2017**, *19*, 386–408. [CrossRef]
15. Bonino, D.; Alizo, M.T.D.; Pastrone, C.; Spirito, M. Wasteapp: Smarter Waste Recycling for Smart Citizens. In Proceedings of the 2016 International Multidisciplinary Conference on Computer and Energy Science (SpliTech), Split, Croatia, 13–15 July 2016; IEEE: Split, Croatia, 2016; pp. 1–6.
16. Zhang, B.; Lai, K.-H.; Wang, B.; Wang, Z. From intention to action: How do personal attitudes, facilities accessibility, and government stimulus matter for household waste sorting? *J. Environ. Manag.* **2019**, *233*, 447–458. [CrossRef] [PubMed]

17. Xiao, L.; Zhang, G.; Zhu, Y.; Lin, T. Promoting public participation in household waste management: A survey based method and case study in xiamen city, china. *J. Clean. Prod.* **2017**, *144*, 313–322. [CrossRef]
18. Ma, J.; Hipel, K.W.; Hanson, M.L. Public participation in municipal solid waste source-separated collection in guilin, china: Status and influencing factors. *J. Environ. Plan. Manag.* **2017**, *60*, 2174–2191. [CrossRef]
19. Matsutani, L.; Rampasso, I.S.; Serafim, M.P.; Quelhas, O.L.G.; Leal Filho, W.; Anholon, R. Critical analysis of corporate social responsibility projects developed by brazilian companies: Providing new insights for debates. *Clean. Eng. Technol.* **2022**, *7*, 100412. [CrossRef]
20. Charter, M.; Tischner, U. *Sustainable Solutions: Developing Products and Services for the Future*; Routledge: London, UK, 2017.
21. Gaziulusoy, A.I. A critical review of approaches available for design and innovation teams through the perspective of sustainability science and system innovation theories. *J. Clean. Prod.* **2015**, *107*, 366–377. [CrossRef]
22. Liedtka, J. Perspective: Linking design thinking with innovation outcomes through cognitive bias reduction. *J. Prod. Innov. Manag.* **2015**, *32*, 925–938. [CrossRef]
23. Ceschin, F.; Gaziulusoy, I. Evolution of design for sustainability: From product design to design for system innovations and transitions. *Des. Stud.* **2016**, *47*, 118–163. [CrossRef]
24. Liedtka, J.; King, A.; Bennett, K. *Solving Problems with Design Thinking: Ten Stories of What Works*; Columbia University Press: New York, NY, USA, 2013.
25. Luchs, M.; Swan, K. The emergence of product design as a field of marketing enquiry. In Proceedings of the 17th International Product Development Management Conference, Murcia, Spain, 13–15 June 2010; pp. 14–15.
26. Brezet, H. Dynamics in ecodesign practice. *Ind. Environ.* **1997**, *20*, 21–24.
27. Lindahl, M. Engineering designers' experience of design for environment methods and tools—requirement definitions from an interview study. *J. Clean. Prod.* **2006**, *14*, 487–496. [CrossRef]
28. Steenis, N.D.; van der Lans, I.A.; van Herpen, E.; van Trijp, H.C.M. Effects of sustainable design strategies on consumer preferences for redesigned packaging. *J. Clean. Prod.* **2018**, *205*, 854–865. [CrossRef]
29. Irani, R.; Frankel, L. The role of design in consumer behaviour: How design can influence consumer decision making at a point of purchase. In *International Conference on Applied Human Factors and Ergonomics*; Di Bucchianico, G., Shin, C.S., Shim, S., Fukuda, S., Montagna, G., Carvalho, C., Eds.; Springer International Publishing: Cham, Switzerland, 2020; pp. 316–322.
30. Crosby, L.A.; Gill, J.D.; Taylor, J.R. Consumer/voter behavior in the passage of the michigan container law. *J. Mark.* **1981**, *45*, 19–32. [CrossRef]
31. Tam, K.-P.; Chan, H.-W. Environmental concern has a weaker association with pro-environmental behavior in some societies than others: A cross-cultural psychology perspective. *J. Environ. Psychol.* **2017**, *53*, 213–223. [CrossRef]
32. Lin, P.-C.; Huang, Y.-H. The influence factors on choice behavior regarding green products based on the theory of consumption values. *J. Clean. Prod.* **2012**, *22*, 11–18. [CrossRef]
33. Tong, Q.; Anders, S.; Zhang, J.; Zhang, L. The roles of pollution concerns and environmental knowledge in making green food choices: Evidence from chinese consumers. *Food Res. Int.* **2020**, *130*, 108881. [CrossRef]
34. Schwepker, C.H.; Cornwell, T.B. An examination of ecologically concerned consumers and their intention to purchase ecologically packaged products. *J. Public Policy Mark.* **2018**, *10*, 77–101. [CrossRef]
35. Campbell, E. You know More than You Think You Do: Design as Resourcefulness & Self-Reliance. 2009. Available online: https://www.thersa.org/globalassets/pdfs/blogs/rsa_designandsociety_pamphlet.pdf (accessed on 29 May 2022).
36. Osmani, M.; Glass, J.; Price, A. Architect and contractor attitudes to waste minimisation. *Proc. Inst. Civ. Eng. Waste Resour. Manag.* **2006**, *159*, 65–72. [CrossRef]
37. Vezzoli, C. A new generation of designers: Perspectives for education and training in the field of sustainable design. Experiences and projects at the politecnico di milano university. *J. Clean. Prod.* **2003**, *11*, 1–9. [CrossRef]
38. Massari, S. Food design and food studies: Discussing creative and critical thinking in food system education and research. *Int. J. Food Des.* **2017**, *2*, 117–133. [CrossRef]
39. Nakata, C.; Hwang, J. Design thinking for innovation: Composition, consequence, and contingency. *J. Bus. Res.* **2020**, *118*, 117–128. [CrossRef]
40. Manzini, E. New design knowledge. *Des. Stud.* **2009**, *30*, 4–12. [CrossRef]
41. Gaziulusoy, İ.; Erdoğan Öztekin, E. Design for sustainability transitions: Origins, attitudes and future directions. *Sustainability* **2019**, *11*, 3601. [CrossRef]
42. Chang, Y.; Kim, J.; Joo, J. An exploratory study on the evolution of design thinking: Comparison of apple and samsung. *Des. Manag. J.* **2013**, *8*, 22–34. [CrossRef]
43. Tu, J.-C.; Ko, Y.-T.; Chen, H.-C.; Chang, H.-T.; Huang, Y.-C.; Lo, T.-Y.; Hu, C.-L.; Tsai, T.-I.; Wu, P.-Y.; Kao, T.-F. *Green Design—Innovation and Design Practice*; Kico Innovation Inc.: Taichung, Taiwan, 2017.
44. Christensen, B.T.; Ball, L.J. Dimensions of creative evaluation: Distinct design and reasoning strategies for aesthetic, functional and originality judgments. *Des. Stud.* **2016**, *45*, 116–136. [CrossRef]
45. Casakin, H.; Kreitler, S. Correspondences and divergences between teachers and students in the evaluation of design creativity in the design studio. *Environ. Plan. B Plan. Des.* **2008**, *35*, 666–678. [CrossRef]

46. Buhl, A.; Schmidt-Keilich, M.; Muster, V.; Blazejewski, S.; Schrader, U.; Harrach, C.; Schäfer, M.; Süßbauer, E. Design thinking for sustainability: Why and how design thinking can foster sustainability-oriented innovation development. *J. Clean. Prod.* **2019**, *231*, 1248–1257. [CrossRef]
47. Chen, S.; Benedicktus, R.; Kim, Y.; Shih, E. Teaching design thinking in marketing: Linking product design and marketing strategy in a product development class. *J. Mark. Educ.* **2018**, *40*, 176–187. [CrossRef]
48. Murphy, P. Design research: Aesthetic epistemology and explanatory knowledge. *She Ji J. Des. Econ. Innov.* **2017**, *3*, 117–132. [CrossRef]
49. Landwehr, J.R.; Wentzel, D.; Herrmann, A. Product design for the long run: Consumer responses to typical and atypical designs at different stages of exposure. *J. Mark.* **2013**, *77*, 92–107. [CrossRef]
50. Claxton, S.; Kent, A. The management of sustainable fashion design strategies: An analysis of the designer's role. *J. Clean. Prod.* **2020**, *268*, 122112. [CrossRef]
51. de Aguiar, J.; de Oliveira, L.; da Silva, J.O.; Bond, D.; Scalice, R.K.; Becker, D. A design tool to diagnose product recyclability during product design phase. *J. Clean. Prod.* **2017**, *141*, 219–229. [CrossRef]
52. Desa, U.N. Transforming Our world: The 2030 Agenda for Sustainable Development. 2015. Available online: https://sdgs.un.org/2030agenda (accessed on 29 May 2022).
53. Geissdoerfer, M.; Vladimirova, D.; Evans, S. Sustainable business model innovation: A review. *J. Clean. Prod.* **2018**, *198*, 401–416. [CrossRef]
54. Lin, J.; Lobo, A.; Leckie, C. The role of benefits and transparency in shaping consumers' green perceived value, self-brand connection and brand loyalty. *J. Retail. Consum. Serv.* **2017**, *35*, 133–141. [CrossRef]
55. Fischer, M. Design it! Solving sustainability problems by applying design thinking. *GAIA-Ecol. Perspect. Sci. Soc.* **2015**, *24*, 174–178. [CrossRef]
56. Goodman, J.; Korsunova, A.; Halme, M. Our collaborative future: Activities and roles of stakeholders in sustainability-oriented innovation. *Bus. Strategy Environ.* **2017**, *26*, 731–753. [CrossRef]
57. Hall, J.K.; Martin, M.J.C. Disruptive technologies, stakeholders and the innovation value-added chain: A framework for evaluating radical technology development. *RD Manag.* **2005**, *35*, 273–284. [CrossRef]
58. Holehonnur, A.; Raymond, M.A.; Hopkins, C.D.; Fine, A.C. Examining the customer equity framework from a consumer perspective. *J. Brand Manag.* **2009**, *17*, 165–180. [CrossRef]
59. He, J.; Ortiz, J. Sustainable business modeling: The need for innovative design thinking. *J. Clean. Prod.* **2021**, *298*, 126751. [CrossRef]
60. Moldovan, S.; Goldenberg, J.; Chattopadhyay, A. The different roles of product originality and usefulness in generating word-of-mouth. *Int. J. Res. Mark.* **2011**, *28*, 109–119. [CrossRef]
61. Doboli, A.; Umbarkar, A. The role of precedents in increasing creativity during iterative design of electronic embedded systems. *Des. Stud.* **2014**, *35*, 298–326. [CrossRef]
62. Shah, J.J.; Smith, S.M.; Vargas-Hernandez, N. Metrics for measuring ideation effectiveness. *Des. Stud.* **2003**, *24*, 111–134. [CrossRef]
63. Liu, A.; Lu, S. Functional design framework for innovative design thinking in product development. *CIRP J. Manuf. Sci. Technol.* **2020**, *30*, 105–117. [CrossRef]
64. Favi, C.; Marconi, M.; Germani, M. Teaching eco-design by using lca analysis of company's product portfolio: The case study of an italian manufacturing firm. *Procedia CIRP* **2019**, *80*, 452–457. [CrossRef]
65. Boks, C.; McAloone, T.C. Transitions in sustainable product design research. *Int. J. Prod. Dev.* **2009**, *9*, 429–449. [CrossRef]
66. Ortiz, O.; Castells, F.; Sonnemann, G. Sustainability in the construction industry: A review of recent developments based on lca. *Constr. Build. Mater.* **2009**, *23*, 28–39. [CrossRef]
67. Rio, M.; Blondin, F.; Zwolinski, P. Investigating product designer lca preferred logics and visualisations. *Procedia CIRP* **2019**, *84*, 191–196. [CrossRef]
68. Ishikawa, H.; Sasaki, N. A balanced design for plural performances of technology, economy and environment in product design. *Procedia Manuf.* **2020**, *43*, 119–126. [CrossRef]
69. Homer, P.; Kahle, L. A structural equation test of the value-attitude-behavior hierarchy. *J. Personal. Soc. Psychol.* **1988**, *54*, 638–646. [CrossRef]
70. Rokeach, M. *The Nature of Human Values*; Free Press: Washington, DC, USA, 1973.
71. Vinson, D.E.; Scott, J.E.; Lamont, L.M. The role of personal values in marketing and consumer behavior. *J. Mark.* **2018**, *41*, 44–50. [CrossRef]
72. Cheung, M.F.Y.; To, W.M. An extended model of value-attitude-behavior to explain chinese consumers' green purchase behavior. *J. Retail. Consum. Serv.* **2019**, *50*, 145–153. [CrossRef]
73. Tajeddini, K.; Mostafa Rasoolimanesh, S.; Chathurika Gamage, T.; Martin, E. Exploring the visitors' decision-making process for airbnb and hotel accommodations using value-attitude-behavior and theory of planned behavior. *Int. J. Hosp. Manag.* **2021**, *96*, 102950. [CrossRef]
74. Lee, K.H.; Hwang, K.H.; Kim, M.; Cho, M. 3d printed food attributes and their roles within the value-attitude-behavior model: Moderating effects of food neophobia and food technology neophobia. *J. Hosp. Tour. Manag.* **2021**, *48*, 46–54. [CrossRef]
75. Fishbein, M.; Ajzen, I. *Understanding Attitudes and Predicting Social Behavior*; Prentice-Hall: Englewood Cliffs, NI, USA, 1980; p. 278.

76. Ajzen, I. From intentions to actions: A theory of planned behavior. In *Action Control*; Springer: Berlin/Heidelberg, Germany, 1985; pp. 11–39.
77. Davis, F.D.; Bagozzi, R.P.; Warshaw, P.R. User acceptance of computer technology: A comparison of two theoretical models. *Manag. Sci.* **1989**, *35*, 982–1003. [CrossRef]
78. Fishbein, M.; Ajzen, I. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*; Addison-Wesley: Boston, MA, USA, 1977.
79. Ru, X.; Wang, S.; Chen, Q.; Yan, S. Exploring the interaction effects of norms and attitudes on green travel intention: An empirical study in eastern china. *J. Clean. Prod.* **2018**, *197*, 1317–1327. [CrossRef]
80. Verma, V.K.; Chandra, B.; Kumar, S. Values and ascribed responsibility to predict consumers' attitude and concern towards green hotel visit intention. *J. Bus. Res.* **2019**, *96*, 206–216. [CrossRef]
81. Malik, C.; Singhal, N. Consumer environmental attitude and willingness to purchase environmentally friendly products: An sem approach. *Vision* **2017**, *21*, 152–161. [CrossRef]
82. Liu, P.; Teng, M.; Han, C. How does environmental knowledge translate into pro-environmental behaviors?: The mediating role of environmental attitudes and behavioral intentions. *Sci. Total Environ.* **2020**, *728*, 138126. [CrossRef]
83. Majuri, P. Ground source heat pumps and environmental policy—The finnish practitioner's point of view. *J. Clean. Prod.* **2016**, *139*, 740–749. [CrossRef]
84. Sakr, D.; Abo Sena, A. Cleaner production status in the middle east and north africa region with special focus on egypt. *J. Clean. Prod.* **2017**, *141*, 1074–1086. [CrossRef]
85. Zhou, M.; Pan, Y.; Chen, Z.; Chen, X. Environmental resource planning under cap-and-trade: Models for optimization. *J. Clean. Prod.* **2016**, *112*, 1582–1590. [CrossRef]
86. Hahladakis, J.N.; Purnell, P.; Iacovidou, E.; Velis, C.A.; Atseyinku, M. Post-consumer plastic packaging waste in england: Assessing the yield of multiple collection-recycling schemes. *Waste Manag.* **2018**, *75*, 149–159. [CrossRef]
87. International Energy Agency. *Global ev Outlook 2016*; OECD Publishing: Paris, France, 2016. [CrossRef]
88. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E.; Tatham, R.L. *Multivariate Data Analysis*; Prentice Hall: Upper Saddle River, NJ, USA, 1998; Volume 5.
89. Jin, B.; Park, J.Y.; Kim, H.-S. What makes online community members commit? A social exchange perspective. *Behav. Inf. Technol.* **2010**, *29*, 587–599. [CrossRef]
90. Bhardwaj, A. A study on consumer preference towards sustainability and post-use consumption of product package in chandigarh. *IUP J. Bus. Strategy* **2019**, *16*, 127–146.
91. Zhang, L.; Zhou, H.; Liu, Y.; Lu, R. Optimal environmental quality and price with consumer environmental awareness and retailer's fairness concerns in supply chain. *J. Clean. Prod.* **2019**, *213*, 1063–1079. [CrossRef]
92. Taylor, S.; Todd, P.A. Understanding information technology usage: A test of competing models. *Inf. Syst. Res.* **1995**, *6*, 144–176. [CrossRef]
93. Lao, K.-F.; Wang, L.-L. The influence of chinese traditional cultural values on environmental protection behavior: Based on consumers' purchasing behavior of green products. *J. Shanghai Univ. Financ. Econ.* **2015**, *17*.
94. Ke-Fu, L.; Jia, W. The influence mechanism of green consumption behavior based on ajzen planned behavior theory. *Financ. Econ.* **2013**, *299*, 91–100.
95. Wright, R.; Stein, M. Snowball sampling. In *Encyclopedia of Social Measurement*; Kempf-Leonard, K., Ed.; Elsevier: New York, NY, USA, 2005; pp. 495–500.
96. Jackson, D.L. Revisiting sample size and number of parameter estimates: Some support for the n:Q hypothesis. *Struct. Equ. Modeling A Multidiscip. J.* **2003**, *10*, 128–141. [CrossRef]
97. Norusis, M.J. *Spss for Windows: Base System User's Guide, Release 5.0.*; SPSS Incorporated: Chicago, IL, USA, 1992.
98. Kaiser, H.F. An index of factorial simplicity. *Psychometrika* **1974**, *39*, 31–36. [CrossRef]
99. Thompson, B. *Exploratory and Confirmatory Factor Analysis*; American Psychological Association: Washington, DC, USA, 2004.
100. Anderson, J.C.; Gerbing, D.W. Structural equation modeling in practice: A review and recommended two-step approach. *Psychol. Bull.* **1988**, *103*, 411–423. [CrossRef]
101. Nunnally, J.; Jum, N.; Bernstein, I.H.; Bernstein, I. *Psychometric Theory*; McGraw-Hill Companies, Incorporated: New York, NY, USA, 1994.
102. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **2018**, *18*, 39–50. [CrossRef]
103. Chin, W.W. Commentary: Issues and opinion on structural equation modeling. *Commentary* **1998**, *22*, 7–16.
104. Hooper, D.; Coughlan, J.; Mullen, M.R. Structural equation modelling: Guidelines for determining model fit. *Electron. J. Bus. Res. Methods* **2008**, *6*, 53–60.
105. Jackson, D.L.; Gillaspy, J.A., Jr.; Purc-Stephenson, R. Reporting practices in confirmatory factor analysis: An overview and some recommendations. *Psychol. Methods* **2009**, *14*, 6. [CrossRef]
106. Kline, R.B. *Principles and Practice of Structural Equation Modeling*, 4th ed.; Guilford publications: New York, NY, USA, 2015.
107. Whittaker, T.A. *A Beginner's Guide to Structural Equation Modeling*; Taylor & Francis: Oxford, UK, 2011.
108. Hu, L.T.; Bentler, P.M. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Equ. Modeling A Multidiscip. J.* **1999**, *6*, 1–55. [CrossRef]

109. Kushwah, S.; Dhir, A.; Sagar, M. Ethical consumption intentions and choice behavior towards organic food. Moderation role of buying and environmental concerns. *J. Clean. Prod.* **2019**, *236*, 117519. [CrossRef]
110. Candi, M.; Saemundsson, R.J. Exploring the relationship between aesthetic design as an element of new service development and performance. *J. Prod. Innov. Manag.* **2011**, *28*, 536–557. [CrossRef]
111. Lin, I.Y. Effects of visual servicescape aesthetics comprehension and appreciation on consumer experience. *J. Serv. Mark.* **2016**, *30*, 692–712. [CrossRef]
112. Shih, L.-H. *Product Sustainable Design—Green Design in Theory and Practice*; Tsang Hai Book Publishing Co.: Taichung, Taiwan, 2010.
113. Lanoie, P.; Laurent-Lucchetti, J.; Johnstone, N.; Ambec, S. Environmental policy, innovation and performance: New insights on the porter hypothesis. *J. Econ. Manag. Strategy* **2011**, *20*, 803–842. [CrossRef]
114. Taufique, K.M.R.; Vaithianathan, S. A fresh look at understanding green consumer behavior among young urban indian consumers through the lens of theory of planned behavior. *J. Clean. Prod.* **2018**, *183*, 46–55. [CrossRef]
115. Laroche, M.; Bergeron, J.; Barbaro-Forleo, G. Targeting consumers who are willing to pay more for environmentally friendly products. *J. Consum. Mark.* **2001**, *18*, 503–520. [CrossRef]