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Influence of Utilitarian and Hedonic Attributes on Willingness to Pay Green Product Premiums and Neural Mechanisms in China: An ERP Study

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Abstract: Green consumption is expected to become a new driving force for sustainable economic growth. The production cost of green products leads to the existence of a green premium, which affects the willingness to pay for green consumption. Moreover, willingness to pay is influenced by the product's own attributes, such as its hedonic and utilitarian attributes. Our study used the event-related potentials (ERPs) technique to investigate how product attributes and premiums affect information processing and subsequent decision-making by comparing consumers' acceptance of hedonic and utilitarian green products with different levels of premiums. Behavioral results indicated that consumers were more willing to pay premiums for utilitarian attributes than for hedonic attributes. ERPs results showed that hedonic attributes induced a greater P2 component, suggesting that price increases for hedonic products elicited more cognitive attention in the early cognitive stage and that the high premium condition did not match the hedonic attributes. In the late cognitive stage, where the utilitarian attribute induced higher N4, the consumers used the green consumption concept as a reason to reduce the negative emotions generated by the hedonic attribute and thus were more willing to accept the green premium for the hedonic product. The findings can be used to explain the psychological and neural activities of consumers at different stages when faced with the degree of product attribute-premium and help companies optimize their pricing strategies by using green products' attributes.

Keywords: green consumption; green premium; green marketing; event-related potentials (ERPs); P2; N4

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1. Introduction

The concept of green consumption advocates that consumers adopt a consumption pattern of purchasing green products, focusing on environmental protection, saving resources and energy, and paying attention to waste disposal and recycling [1]. The Survey and Research Report on the Current Situation of Green Consumption among the Chinese Public (2019 Edition) showed that 83.34% of respondents supported green consumption behavior, and green development is expected to become a new driving force to promote sustainable economic growth. Green consumption behavior is a pro-social behavior that contributes to the sustainable development of the environment and society [2]. Li Yan (2019) considers green consumption behavior as the behavior of consumers who choose to buy green products [3]. Green consumption plays an important role in reducing the negative impact of consumption on the environment and ecosystem. With the increasing concern for green consumption, companies continue to innovate and launch environmentally friendly green products to meet the needs of green consumption, and green innovation and environmental protection values play an important role in the sustainability of companies [4,5].

Consumers buying green products can effectively force enterprises to produce green transformation, thus promoting the sustainable development of the overall economic structure. However, the fact that corporations are required to purchase green manufacturing equipment and obtain green product certification results in an increase in the production cost of green products [6]. Price is one of the decisive factors in purchasing decisions, and buying green products requires consumers to bear the additional production costs of companies, which prominently affects consumers' willingness to purchase green products and leads to inconsistency between attitudes and behaviors [7].

The premium price of green products is defined as the additional cost of the environmental value of the product [8]. The possibility exists for consumers, the final demand side of green products, to engage in green consumption if they are reluctant to pay a green premium. Price is usually considered one of the pivotal determinants in purchasing decisions, and consumers tend to choose green products based on price. Consumers are willing to pay a 10% premium for green products compared to non-green products, and consumers with high environmental consciousness are willing to pay a 30% premium for green products [9]. Studies have proven that product attributes have a greater impact on premium acceptance and that it would be more likely for customers to accept a premium for a hedonic organic product than a utilitarian organic product [10]. With a high product premium, a utilitarian product premium would be more popular with consumers than a hedonic product premium [11]. However, the premium price of green products may also be influenced by product attributes. Therefore, it is important to comprehensively assess the impact of hedonic and utilitarian attributes on green premiums.

Previous studies have examined consumers' acceptance of green product premiums through active and conscious processing. However, most consumers' decisions occur without attention and awareness. It has been demonstrated that price significantly influences the unconscious cognitive processes of consumers in their purchase decisions [12]. The dual process theory proposes that cognitive processes are divided into two categories: system 1 is an unconscious, automatic process, and system 2 is a conscious, controlled process [13]. Traditional marketing research is conducted from the consumer's conscious perspective, assuming that consumers can accurately describe the reasons for their purchase decisions. However, the majority of decisions are made through unconscious processes [14]. The traditional research approaches focus on verbally expressed cognitive and affective experiences at the conscious level. The unconscious processes that play a key role in actual behaviors can be distinguished only through neuroscience techniques [15].

To date, many researchers on green premiums have focused almost exclusively on consumers' consciously controlled processing but have neglected consumers' automatic, unconscious processing. How to understand the important role of consumers' unconscious processes in green premium purchase decisions and in driving cognitive biases is an important question that has not been fully answered in previous studies. Therefore, based on the dual-processing model, our study aims to measure the magnitude of psychological conflict and the degree of emotional arousal when consumers are confronted with products of different attributes and different levels of premiums, so as to better understand consumers' acceptance of premiums for green products of different attributes and their psychological change processes. Our study is groundbreaking because previous green premium studies have not provided insight into unconscious consumer processes or considered how hedonic and utilitarian product attributes affect premium acceptance. The purpose of our study is to explore the influence of product attributes on the purchase decision of green products under different stages of the dual process theory and also to assist marketers to better predict consumer behavior, develop optimal pricing strategies on the basis of the products' attributes, and effectively abandon marketing approaches that do not match the consumer's perception and value assessment process.

EEG can be properly applied in the marketing field with the advantages of high temporal resolution, allowing investigation into discrete processing steps [16], which can effectively present the neural correlates of consumers' rational and emotional responses to

different policies [17]. Given that neuromarketing approaches are beneficial in revealing the public's cognitive processing of green premiums, our study combined behavioral and event-related potentials (ERPs) measures to develop a neuromarketing framework to measure the relationship between hedonic versus utilitarian products and green premiums, exploring how green product hedonic versus utilitarian attributes and premium levels influence information processing and subsequent decision making in our brains. The willingness to pay a premium for green products' hedonic and utility attributes is assessed through changes in product price, which represent the three scenarios of no, low, and high premiums. Because neuromarketing techniques reveal the unconscious processes behind consumer decisions, our study uses the event-related potential approach to measure the neural responses elicited by the influence of product type on the purchase decision and the willingness to pay a premium. This offers a theoretical basis for how green products are priced and practical suggestions about how marketing managers can improve the evaluation of green premiums.

2. Literature Review

2.1. Green Premium

From a value pricing perspective, green products possess a price premium because they provide green value to consumers. However, consumers who purchase green products are not direct beneficiaries, so they are generally not willing to pay the green product premium [18]. The cost of market development is relatively high, so the public's willingness to pay a premium for green products is generally low at present [19]. However, with people's demand perceptions changing, green advertising has made the public generally realize that the cost of green consumer products will be higher than the average product. As a result, some consumers are willing to pay a premium for green products [20]. Green labels and green value recognition would effectively increase consumer acceptance of green premiums. Onishi (2021) estimated green office rental premiums through a hedonic approach and found that rental premiums were higher for office properties with green labels [21]. Advertising claims significantly affected willingness to pay green product premiums, and green advertising claims were effective in increasing green premium acceptance [22]. Knowledge was also an important factor influencing the green premium, with consumers more familiar with the benefits of green buildings willing to pay a 25% price premium [23]. Attitudes toward green products had an important and positive impact on willingness to pay the green premium, and an in-depth understanding of attitudes toward green products could effectively help marketers develop marketing strategies to increase consumer acceptance of the green premium [7]. Consumers with low environmental concerns were reluctant to pay green premiums, whereas those with high ecological literacy tended to pay premiums [24]. The signaling theory suggests that the green signal of green products enables consumers to demonstrate their desirable personal characteristics, such as pro-environmental and pro-social values, by consuming green products, which gives consumers an advantage in social interactions and serves as an additional incentive, so they are willing to pay a premium for eco-friendly products [25]. Most of the current studies have looked at how consumers' motivations, attitudes, values, and outside pressures affect their willingness to pay more for green products [26].

2.2. Product Attributes (Hedonic vs. Utilitarian)

In the field of marketing, we commonly classify product attributes into hedonic and utilitarian attributes. Hedonic products are products that provide consumers with pleasure and joy in their emotional experience and provide them with a sense of satisfaction and superiority [27]. Utilitarian products are products based on rational cognition and are mainly characterized by instrumentality and functionality [28], such as air conditioners, dishwashers, and laptops [29]. Consumers instinctively prefer hedonic products, but hedonic products can make consumers feel guilty [30]. The sense of inequity is reduced more when consumers pay more money than others for utilitarian products [31]. Con-

sumers prefer the absolute best choice of hedonic products and the relatively best choice of utilitarian products [32]. People show higher negative emotions after missing out on superior utility consumption opportunities than after missing out on superior hedonic consumption opportunities [33]. At the cognitive level, consumers process cognitive information for utility products and emotions for hedonic products [34]. For example, for utilitarian products, consumers collect as much product information as possible related to them, pay more attention to the objective attributes and knowledge of the product, compare more options, and engage in analytical information processing [35]. In the context of promotions, premiums for hedonic products are preferred over utility-based products [36]. In promotional contexts where the fit between the promotional item and the premium is high, the utilitarian product premium is more acceptable to consumers than the hedonic product premium [11]. Discount promotions offer a reason for consumers to increase the likelihood of hedonic product purchases but do not affect utilitarian product purchases [37]. Hedonic and utilitarian marketing messages can influence the evaluation of hedonic versus utilitarian product premiums [38].

2.3. Neuromarketing and Price Study

The devices adopted in neuroscientific studies can record the brain's activities during a consumer's cognition and decision-making immediately and objectively so as to better interpret and predict the consumer's behavior. Neuromarketing is a combination of neuroscience and marketing, which is a popular research topic in marketing research that investigates consumer behavior from the perspective of brain mechanisms [39]. The concept was first introduced by Alec Semidt and is known as "the study of brain mechanisms" [40]. Neuromarketing can be defined as "the field of research that applies neuroscientific methods to the analysis and understanding of marketing and economic exchanges related to human behavior". Researchers adopt neurophysiological methods such as eye-tracking, EEG, and functional magnetic resonance imaging (fMRI) to study prices, brands, products, and others in the market [41].

From a neuromarketing perspective, pricing and price adjustments will cause neurological activation in cognition and emotion. Numerous researchers have applied neuromarketing approaches to the study of price levels, where overpricing activates the insula and deactivates the medial prefrontal cortex (MPFC) prior to the purchase decision [42]. High prices also lead to greater activation of the parietal lobe during the purchase decision [43]. Strong internal cognitive conflict is triggered when consumers decide to purchase a product above the average price or not to purchase a product below the average price [16]. Product attribute evaluation is a cognitive process that modulates attention in the posterior parietal and occipital regions when consumers are considering their personal preferences [44]. Knutson et al. used fMRI to explore the neural circuit mechanisms of price and preference in the purchase decision process [42].

Studies of ERPs have shown that the evocation of P2 usually starts around 150 ms after the stimulus appearance, returns to baseline around 300 ms, and is mainly distributed in the frontal and central regions of the scalp [45,46]. The P2 component has been found to involve risk-related cognitive processing [47], be influenced by the decision maker's perceived risk, and reflect the decision maker's degree of recognition of the decision problem [48], where the volatility of P2 reflects the decision-maker's familiarity with the decision problem [49]. The P2 component is mostly induced in the early unconscious perceptual stages of decision-making and has a significant impact on decision-making, involving perceptual matching and stimulus categorization and serving as an indicator of congruent/incongruent evaluation [50]. Green product attributes in our study affect consumers' perceived risk and cognitive processing, and we hypothesize that differences between product attributes and green premiums affect the extent to which consumers identify and match the decision problem and may generate significant cognitive attention during the purchase decision process. Therefore, Hypothesis 1 can be assumed as follows.

H1. *When hedonic and utilitarian attributes are inconsistently matched with the premium level perception, a relatively larger P2 component is induced.*

The N4 component is a negative wave that appears in the prefrontal and central parietal regions 400 ms after the stimulus occurs, and this component is generally associated with higher cognitive conflict. In addition, this component is associated with the automatic extraction and processing of implicit memory, responding to unconscious decision information. It has been shown that N4 can be used to display products or symbols that are inconsistent with expectations [51]. The N4 component is a suitable indicator to detect semantic inconsistencies or conflicts, and label prices that are inconsistent with expectations will induce a larger N4 component [52]. Additionally, the N4 component is widely used in stereotype and worker crowd attitude studies [53], and the N4 component and P2 component may represent different stages of cognitive processes [54]. In the late cognitive stage, participants face inconsistencies between premium levels and product attributes, and the purchase decision process may result in significant cognitive and decision conflicts. In the late cognitive stage, participants face inconsistencies between premium levels and product attributes, and the purchase decision process may result in significant cognitive and decision conflicts. Therefore, Hypothesis 2 can be assumed as follows.

H2. *When hedonic and utilitarian attributes are inconsistent with the premium level expectations, a relatively larger N4 component is induced.*

3. Methodology

3.1. Participants

Twenty-two participants were recruited from the database of the Jianghan University for Psychology and Behavior Research Center. Three participants were excluded because of excessive EEG recording artifacts [55]. The remaining 19 participants (23.37 $\pm$ 2.03 years; 10 females) were healthy, had no history of mental disorders, and had normal or corrected vision. Our study was approved by the ethics committee of Jianghan University, and written informed consent was obtained from all participants before the experiment.

3.2. Materials

In our study, 60 products were selected as stimulus materials from high-selling green products such as household items, daily necessities, electronic devices, furniture, and home textiles. The material was screened using a green product type questionnaire. A total of 24 volunteers who had not participated in the ERP experiment rated the hedonicity and utilitarianism of the selected products in the pre-experiment on a 7-point Likert scale, ranging from 1 for pure hedonicity to 7 for pure utilitarianism. The 10 products with the lowest scores were defined as hedonic green products, and the 10 products with the highest scores were defined as utilitarian green products. Hedonic green products include energy-saving toy robots, environmental protection material bracelets, etc. Utilitarian green products include energy-saving washing machines, solar water heaters, etc. Results from the paired *t*-test revealed significant differences in the mean scores of the two product groups mentioned above (t = -11.15, $p < 0.001$, Cohen's D = 2.27). In order to meet the ERP experimental overlay number and signal-to-noise ratio requirements, the number of images was expanded for each product based on the screening of 20 products, and the criteria for expansion were similar products, A total of 30 hedonic green product images and 30 utilitarian green product images were obtained as stimulus materials. For the determination of different premium levels, our study uses the estimation method of the contingent valuation method (CVM) on willingness to pay (WTP) [56,57]. Through the formula $E(WTP) = \sum_i Pi * Vi$, the expected value of the premium level was calculated to estimate the consumer's acceptance of premiums for green products with different attributes, and a total of 502 participants were surveyed. It was found that consumers were willing to accept a premium of 26.49% for practical green products and 20.66% for hedonic green products. Based on the results, our study defines a 0% premium as no premium level,

a 10% premium as a low-level premium, and a 35% premium as a high-level premium. Figure 1 displays some examples of experimental product picture stimulation and premium message stimulation.

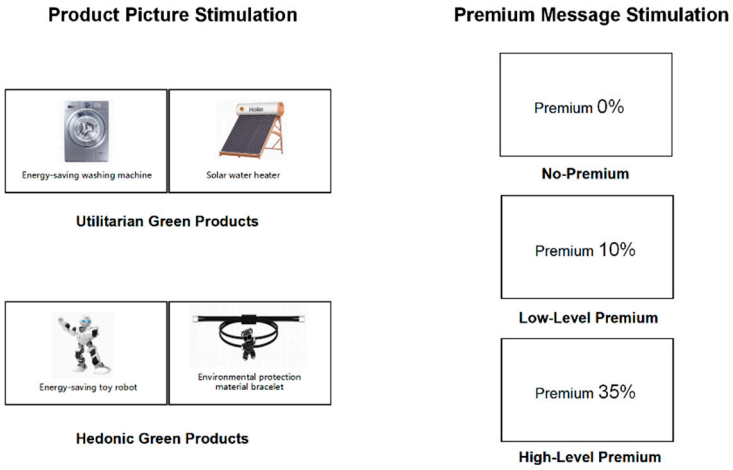

Figure 1. Examples of the experimental stimuli.

3.3. Procedures

The experiment was a 2 (product attribute: hedonic and utilitarian) × 3 (premium level: no premium, low-level premium, and high-level premium) within-subjects design. The experiment was run on an E-prime 2.0 software package, and the entire experiment consisted of 360 trials, which were pseudo-randomly assigned to 6 blocks. During the experiment, participants were seated comfortably with dim lights in a sound-attenuated, electrically shielded room, 100 cm from the screen, with a viewing angle of 2.58° × 2.4°. Before the experiment, participants were given a brief explanation of the reasons for the existence of a premium for green products and the environmental benefits of purchasing green products, using a priming paradigm to bring participants into the situation. Each participant was required to complete 10 practice trials to familiarize themselves with the task before the formal experiment, which was divided into 6 blocks (each containing 60 trials), with 3-minute breaks in the middle before proceeding to the next block. As shown in Figure 2, during the experiment, the background color was gray. At the beginning of each trial, fixation was presented for 1000 ms. After that, product pictures were displayed for 1500 ms, followed by 2000 ms stimuli that clarified premium levels. Finally, participants would have 2000 ms to choose whether they accept the premium by pressing the key "z" to "accept" or pressing the key "x" to "reject".

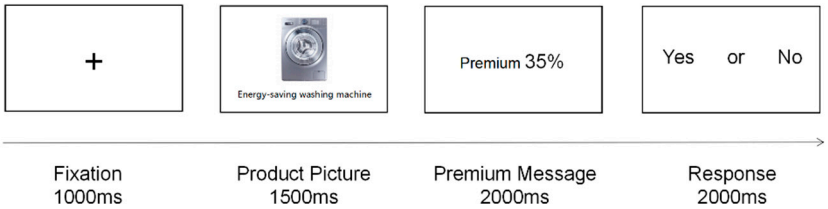

Figure 2. A trial of the experimental process. Participants were shown a picture of a green product, then a premium message, and their choice was recorded at the conclusion.

3.4. Data Acquisition and Analysis

EEG data were recorded using a Brain actiCHamp amplifier (Brain Products GmbH, Munich, Germany) and a cap containing 64 Ag/AgCl electrodes with a sampling rate of 500 Hz. The impedance between the scalp and electrodes at each electrode was less than 10 kΩ, and vertical electrooculography (VEOG) was recorded using bilateral mastoids as

reference electrodes and electrodes placed in the inferior orbit of the right eye. ERPs were analyzed by the BrainVision Analyzer 2.1 (Brain Products GmbH, Munich, Germany) with an offline filtered bandpass of 0.5 to 40 Hz, and data accompanied by artifacts such as blinks, eye movements, and EMG were excluded semi-automatically using an independent component analysis. The data from different conditions were superimposed, averaged, and segmented from 200 ms before the start of the premium information to 100 ms after the start, with the target first 200 ms interval as the baseline.

According to the visual observation of the grand average waveforms and associated studies mentioned in the introduction, P2 and N4 components were analyzed [58,59]. The latency of the P2 component is approximately between 150 and 300 ms after stimulus presentation, and this component is associated with emotional activation and generally occurs in prefrontal and central brain regions. In the present study, a total of 6 electrodes from 2 brain regions in the frontal (F3, Fz, and F4) and central (C3, Cz, and C4) areas were selected for analysis [60]. The N4 component appears in the late cognitive phase and is a negative wave that appears in the frontal, central, and parietal areas around 400 ms after stimulus presentation, and this component is generally associated with higher cognitive conflict [54]. In the present study, a total of nine electrodes from three brain regions in the frontal (F3, Fz, and F4), central (C3, Cz, and C4), and parietal (P3, Pz, and P4) areas were selected for analysis.

4. Results

4.1. Behavioral Results

The purchase rate refers to the ratio of the number of times subjects chose to purchase a product under a certain condition to the total number of times the product appeared. As can be seen in Figure 3, the mean and standard error of the purchase rate of utilitarian products without a premium (M = 97.47%, SE = 0.03252); the mean and standard error of the purchase rate of utilitarian products with a low level of premium (M = 86.08%, SE = 0.1491); the mean and standard error of the purchase rate of utilitarian products with a high level of premium (M = 31.66%, SE = 0.2905); the mean and standard error of purchase rate of the hedonic products without a premium (M = 91.54%, SE = 0.1117); mean and standard error of purchase rate of hedonic products with a low level of premium (M = 50.63%, SE = 0.3657); and mean and standard error of purchase rate of hedonic products with a high level of premium (M = 13.86%, SE = 0.1598).

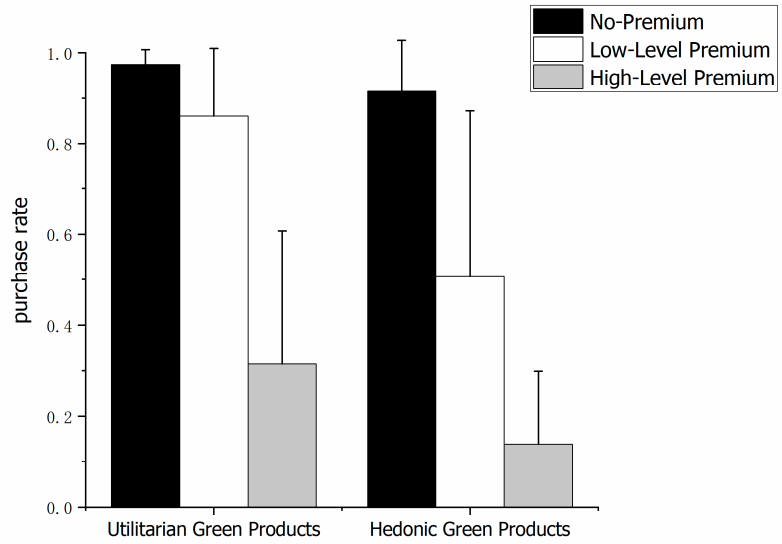

Figure 3. Purchase intentions of participants.

Repeated measures ANOVA was used for the purchase rates for the six conditions. Results showed that for product type, utilitarian and hedonic products caused signifi-

cant differences in consumer purchase rates ($F(1, 18) = 29.740$, $p < 0.001$, $\eta p^2 = 0.623$); different premium levels caused significant differences in consumer purchase rates ($F(1, 18) = 111.773$, $p < 0.001$, $\eta p^2 = 0.929$). The interaction of product type and the premium level was significant ($F(2, 17) = 8.199$, $p = 0.003 < 0.05$, $\eta p^2 = 0.491$). The simple effects test showed that the purchase rate of utilitarian green products (M = 0.975, SD = 0.007) was significantly higher than the purchase rate of hedonic green products (M = 0.915, SD = 0.026, $p = 0.022 < 0.05$) in the absence of a price premium. In the case of the low-level premium, the purchase rate of utilitarian green products (M = 0.861, SD = 0.034) was significantly higher than that of hedonic green products (M = 0.506, SD = 0.084, $p < 0.001$). At a high level of premium, the purchase rate of utilitarian green products (M = 0.317, SD = 0.067) was significantly higher than that of hedonic green products (M = 0.139, SD = 0.037, $p = 0.027 < 0.05$). The purchase rate for the no-premium case (M = 0.975, SD = 0.007) was significantly higher than the purchase rate for the low-level premium (M = 0.861, SD = 0.034, $p = 0.002 < 0.05$) and the high-level premium (M = 0.317, SD = 0.067, $p < 0.001$) when the goods were utilitarian-oriented green products. The purchase rate of a low-level premium (M = 0.861, SD = 0.034) was significantly higher than the purchase rate of a high-level premium (M = 0.317, SD = 0.067, $p < 0.001$). The purchase rate for the no-premium case (M = 0.915, SD = 0.026) was significantly higher than the purchase rate for the low-level premium (M = 0.506, SD = 0.084, $p < 0.001$) and the high-level premium (M = 0.139, SD = 0.037, $p < 0.001$) when the goods were hedonic green products. The purchase rate of the low-level premium (M = 0.506, SD = 0.084) was significantly higher than the purchase rate of the high-level premium (M = 0.139, SD = 0.037, $p < 0.001$).

4.2. ERP Results

The EEG waveforms were plotted in the −200–1000 ms time window for the frontal brain electrode Fz, the central brain electrode Cz, and the parietal brain electrode Pz. Shown in Figure 4, the P2 waveform amplitudes of the 6 conditions differed significantly in the 190–270 ms time window, with all 6 waves reaching their maximum amplitude at around 200 ms. To further analyze the differences in waveform amplitudes between the 6 conditions, a 2 (product attribute) × 3 (premium level) × 2 (brain region) repeated measures ANOVA was conducted on the P2 components of the 6 electrode sites by R language. The results showed that on the P2 component, the main effect of brain area was significant ($F(1, 18) = 6.509$, $p = 0.02 < 0.05$, $\eta p^2 = 0.266$); the main effect of product type was not significant ($F(1, 18) = 0.659$, $p = 0.428 > 0.05$, $\eta p^2 = 0.035$); the main effect of the premium level was significant ($F(2, 17) = 8.144$, $p = 0.003 < 0.05$, $\eta p^2 = 0.489$); significant brain area and product type interaction effect ($F(1, 18) = 11.362$, $p = 0.003 < 0.05$, $\eta p^2 = 0.387$); and insignificant brain area and premium level interaction effect ($F(2, 17) = 0.690$, $p = 0.515 > 0.05$, $\eta p^2 = 0.075$). The interaction effect of product type and the premium level was significant ($F(2, 17) = 4.495$, $p = 0.027 < 0.05$, $\eta p^2 = 0.346$).

The simple effect test results indicated that when the green product was utilitarian, the P2 amplitude induced in the central region (1.981 ± 0.764 μV) was significantly higher than that induced in the frontal region (1.243 ± 0.888 μV; $p = 0.006 < 0.05$). When the premium level was high, the P2 amplitude induced by hedonic green products (2.767 ± 0.862 μV) was significantly higher than that induced by utilitarian green products (1.766 ± 0.908 μV; $p = 0.004 < 0.05$). When the green product was utilitarian, the P2 amplitude induced by the high level of premium (1.766 ± 0.908 μV) was marginally higher than that induced by the low level of premium (1.263 ± 0.869 μV; $p = 0.067$). When the green product was hedonic, the P2 amplitude induced by the high-level premium (2.767 ± 0.862 μV) was significantly higher than that induced by no premium (1.335 ± 0.735 μV; $p = 0.011 < 0.05$) and the low-level premium (1.274 ± 0.886 μV; $p = 0.004 < 0.05$).

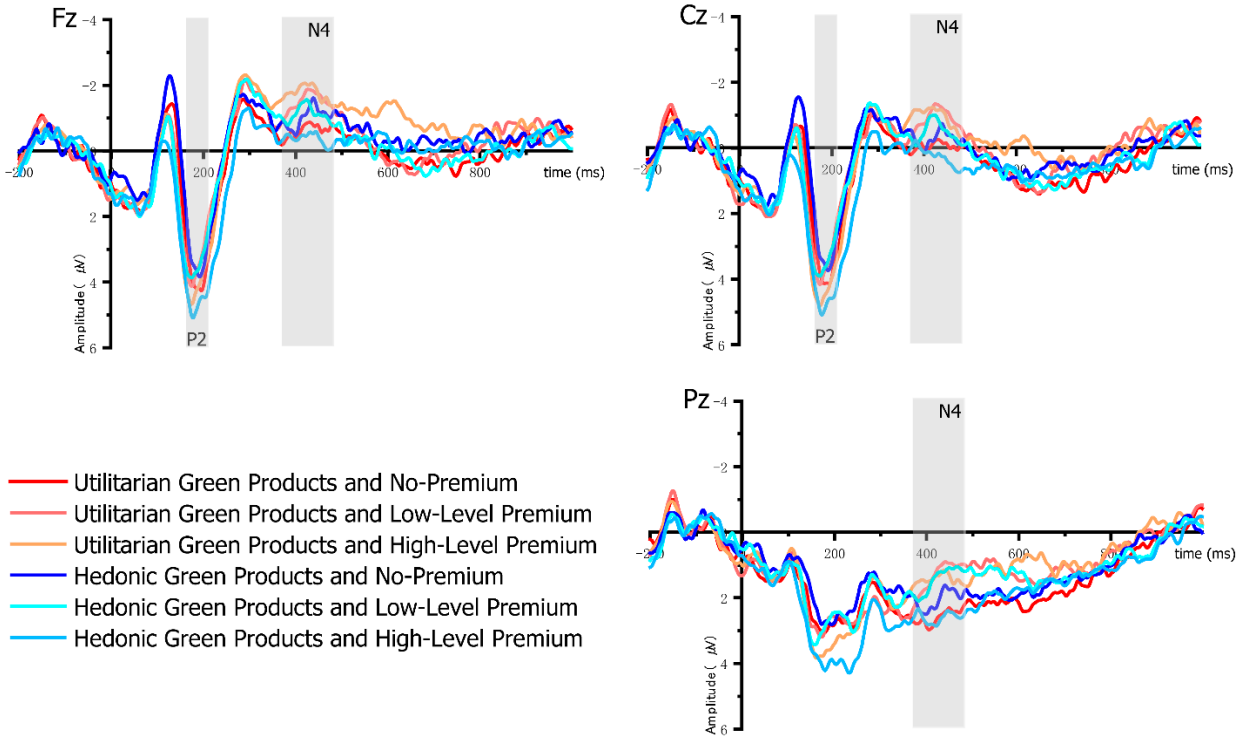

Figure 4. Grand average ERPs for all six conditions recorded at the specified electrode sites.

Shown in Figure 4, it could be observed that the N4 wave amplitudes of the 6 conditions differed significantly in the 370–470 ms time window, with all 6 waves reaching their maximum amplitude around 420 ms. To further analyze the differences in wave amplitudes between the 6 conditions, a 2 (product attribute) × 3 (premium level) × 3 (brain region) repeated measures ANOVA was conducted on the P2 component at the 9 electrode sites by R language. The results presented a significant main effect of brain region on the N4 component ($F(2, 17) = 34.493$, $p < 0.001$, $\eta p^2 = 0.802$). The product type's main effect was not significant ($F(1, 18)=1.269$, $p = 0.275 > 0.05$, $\eta p^2 = 0.066$) and the premium level's main effect was not significant ($F(2, 17) = 2.989$, $p = 0.077 > 0.05$, $\eta p^2 = 0.260$). The brain area and product type interaction effect was significant ($F(2, 17) = 4.809$, $p = 0.022 < 0.05$, $\eta p^2 = 0.361$), the brain area and premium level interaction effect was not significant ($F(4, 15) = 0.327$, $p = 0.856 > 0.05$, $\eta p^2 = 0.080$), and the product type and premium level interaction effect was significant ($F(2, 17) = 6.023$, $p = 0.011 < 0.05$, $\eta p^2 = 0.415$).

The simple effect found that when the green product was utilitarian, the N4 amplitude evoked in the frontal lobe region (-0.941 ± 0.352 μV) was significantly greater than that evoked in the central lobe region (0.046 ± 0.252 μV; $p < 0.001$) and in the parietal lobe region (2.118 ± 0.273 μV; $p < 0.001$), and the N4 amplitude evoked in the central lobe region (0.046 ± 0.252 μV) was significantly greater than the N4 amplitude induced in the parietal zone (2.118 ± 0.273 μV; $p < 0.001$). When the green product was hedonic, the N4 amplitude evoked in the frontal lobe region (-0.473 ± 0.398 μV) was significantly greater than the N4 amplitude evoked in the central lobe region (0.341 ± 0.308 μV; $p = 0.004 < 0.05$) and the N4 amplitude evoked in the parietal lobe region (2.244 ± 0.358 μV; $p < 0.001$) when the green product was hedonic, and the N4 amplitude evoked in the central lobe region (0.341 ± 0.308 μV) was significantly greater than the N4 amplitude induced by the parietal zone (2.244 ± 0.358 μV; $p < 0.001$). When the premium level was a high-level premium, the N4 amplitude induced by utilitarian green products (-0.026 ± 0.404 μV) was significantly higher than that induced by hedonic green products (1.103 ± 0.327 μV; $p = 0.021 < 0.05$). When the green product was utilitarian, the N4 amplitude induced by a high-level premium (-0.026 ± 0.404 μV) was significantly greater than that induced by no premium (1.113 ± 0.267 μV; $p = 0.033 < 0.05$).

5. Discussion

Our study explored the effects of hedonic and utilitarian attributes of green products on willingness to pay a premium and their neural basis. Specifically, in this experiment, the premium price of green products was coupled with their product attributes, and participants had to make a purchase decision within a limited time. Moreover, the results of the experiment contributed to the understanding that utilitarian versus hedonic attributes of green products have different effects on green consumption with respect to the level of the premium.

The behavioral results implied that in the context of green marketing, consumers possessed a higher willingness to purchase utilitarian green products. This might be due to the fact that utilitarian green products focus on practicality and functionality, compared with hedonic green products that focus on emotionality, and the public would conduct a more rational analysis when purchasing utilitarian green products. The public also rationally recognized the benefits of utilitarian green products for environmental development, so consumers were more willing to buy utilitarian green products. Additionally, due to the presence of premiums, it is much more likely for consumers to accept the premiums for utilitarian green products than hedonic green products, which validates Palazon et al.'s study that found that utilitarian products, because of their instrumental and practical nature, would be more acceptable than hedonic products due to their premiums [11]. The comparison between premium levels revealed that the green premium will seriously affect consumers' willingness to purchase both hedonic and utilitarian green products and that higher premiums for green products have become a barrier to green consumption, causing a gap between consumer attitudes and actual purchase behavior [61].

5.1. Early Automatic Perception Phase of Green Premium Decisions

Based on the dual process model, our study proposes two main stages of the neurocognitive process of the green premium decision: the early processing stage, reflected by the P2 component, and the later cognitive stage, reflected by the N4 component. At the neural level, the P2 component is an early ERP component associated with attentional resources, often presented in the cognitive stage of the decision [54]. Attention is a resource that consumers assign a higher level of attention to products, which is a prerequisite for their selection and purchase. When consumers are given information cues about a product, they evaluate the product's attributes based on their previous purchase experience, purchase goals, and other factors. Meanwhile, attentional resources are limited, and stimuli that trigger individual emotional resonance attract more attentional resources, so consumers apply their limited attention to the most important product attributes. The P2 components are associated with the rapid and automatic evaluation of stimuli that attract more attention, demonstrating that the P2 components can reflect consumers' early detection of the process of product category definition [54]. Since early neural processing produces greater P2 components for inconsistent stimuli, it is important to select the P2 components to explore the allocation of consumers' attention to hedonic versus utilitarian attributes of green products. The consistency between product attributes and premium levels can be determined by the changes in the P2 components.

In the current study, significant main effects for brain regions and different premium levels were observed. Premium levels were found to be an obvious price signal that attracted more cognitive resources from participants, and high levels of premiums would lead to greater P2 amplitude and more attention. Specifically, when exposed to different price information, consumers automatically searched for noteworthy aspects of the price information, and high premiums were perceived as a signal to allocate cognitive resources, which resulted in greater P2 amplitude and more attentional resources being attracted to the high-level premium condition. As shown by the statistical results of the P2 component EEG data, when the green product was utilitarian, the P2 component evoked by the central brain region was more significant than that of the frontal brain region. The simple effect found that regardless of product attributes, the P2 component induced by a high-level pre-

mium was greater than that induced by a low-level premium, suggesting that a high-level premium can effectively mobilize consumers' attentional resources and that consumers reflect more attention to higher prices. One of the most important product attributes was the price, and a high price resulted in the allocation of more cognitive resources, while a high-level premium resulted in greater P2 amplitude and more attentional resources [62]. When consumers were presented with hedonic green product stimuli, the P2 amplitude was higher than the P2 component amplitude caused by utilitarian green product stimuli. Utilitarian green products are functional and practical, and they are often instrumental products that consumers must use. Consumers are more rational in choosing utilitarian green products [28], and they focus on product functions; these products tend not to attract much attention, while hedonic green products are novel, interesting, and innovative. In the early cognitive stage, when consumers were faced with the stimulation of hedonic green products, they tended to have pleasant associations and would automatically allocate more attention resources and devote more attention to them. Therefore, the volatility of the P2 components induced by hedonic green products is significantly higher than that of utilitarian green products, and the price increase of hedonic products focusing on emotional needs would significantly attract consumers' cognitive attention [59]. Additionally, the P2 components can reflect perceptual matching in the early automatic perception stage [50]. When participants automatically processed the relationship between product attributes and premium levels, system 1 was activated unconsciously, which means that consumers perceived that the high level of premium conditions did not match hedonic green products and had difficulty accepting high premiums for hedonic green products. This result was consistent with Isabella et al., who found that consumers preferred to pay a premium for utilitarian products and that payment of a premium for hedonic products creates a sense of unfairness [31].

5.2. Late Perception Phase of Green Premium Decisions

The N4 component is a negative late component that is associated with the cognitive processes of categorization and attitude conflict. Related research in neuromarketing has linked the N4 component to the cognitive process of acceptance attitudes and stereotypes involving categorization in purchase decisions, i.e., participants were involved in attitude conflict during the late cognitive processing stage of product selection [53]. In our study, we examined price expectations for different types of green products based on their hedonic and utilitarian attributes at different premium levels. During the experiment, the displayed product type and price information were automatically compared with the participants' expectations. The N4 component evoked by different brain regions differed, with the frontal brain region producing the largest N4 component regardless of product type, followed by the central brain region and the parietal lobe.

The interaction effect between the product type condition and the premium level condition suggested that participants were more willing to accept a premium for hedonic green products because the N4 component focuses on categorization and stereotypes, while hedonic green products bring more of a relaxing and pleasant emotional experience, so it was more likely to accept a high level of premium for hedonic products, proving that participants were generally receptive to a premium for hedonic green products. It was demonstrated that when the premium for hedonic products and the premium for utilitarian products are both equal in terms of enhancing product functionality, the premium for utilitarian products would be more acceptable due to their relatively instrumental and practical nature [11]. Consumers would give priority to functional attributes over hedonic attributes when choosing products, and consumers would feel stronger guilt and anxiety when choosing products with hedonic attributes [63]. The intrinsic reason why people had difficulty giving up utilitarian products in favor of hedonic products was that it was more difficult for people to find good reasons for their consumption of hedonic products [64], while it was easier to buy utilitarian products [65]. A promotional environment that was favorable to public acceptance of hedonic products would reduce the guilt associated

with hedonic products [66]. In contrast to the P2 component induced by system 1, the N4 component induced by system 2 reflects that participants are more willing to accept a premium for hedonic green products, and the possible reason for this is that participants use the concept of green consumption and environmental protection as a good reason to reduce the guilt generated by participants' choices of hedonic products, making participants more willing to accept a green premium for hedonic products. However, at the same time, the result contradicts Ofir C's study, which argued that the lower the price of a good, the more acceptable it is to consumers, but did not consider product hedonic and utilitarian attributes in that study [67]. Utilitarian products triggered more rational thinking and evoked more awareness among participants, while consumers' rationality was to refuse to pay a higher price. The N4 component induced by high levels of premiums was significantly greater than that induced by low levels of premiums, and the N4 component induced by low levels of premiums was significantly greater than that induced by no premiums, and consumers were more sensitive to changes in the premiums of utilitarian green products, which was explained by consumers' broader processing of cognitive information about utilitarian products [34]. In contrast, when the green product was hedonic, the N4 components induced by different premium levels did not differ significantly, proving that the emotional processing induced by hedonic green is not sensitive to price changes. The relaxed and pleasant emotional experience makes consumers more likely to accept green products with high premiums.

5.3. Theoretical Implication

Theoretically, our study provided experimental evidence of the effects of utilitarian and hedonic attributes of green products on willingness to pay green premiums. Although some studies have analyzed the effects of hedonic and utilitarian attributes on willingness to pay premiums, no study has yet explored the application of hedonic and utilitarian attributes to green premiums. Our study applied dual-process theory to investigate the neural mechanisms of hedonic and utilitarian attributes on green premium willingness to pay through the ERPs technique and explored the effects of different stages of dual-process theory on green product purchase decisions, extending a new path for the study of premium willingness to pay and expanding the scope of application of decision neuroscience. Additionally, our study verified that N4 can be used to detect the expected consistency between a product and its price [52]. We analyzed the N4 component in the dual-process model and compared it with the earlier component. We discovered that the N4 component can reflect consumers' internal justification-seeking purchase decision, which deepens the understanding of the "justification heuristic" theory. Consumers use the environmental concept as a justification to alleviate the guilt caused by accepting the premium price of hedonic green products. Our study provided valuable information for the application of the N4 component. Our study also improved the understanding of the difference between hedonic and utilitarian products in that consumers' purchase of hedonic products at a premium price is accompanied by guilt, and if this negative emotion is attenuated, the difference in impact on subsequent purchase behavior will not exist. This weakening of negative emotions could be caused by internal factors, such as the participants in our study who cited the concept of environmental protection as a reason. Thus, we discovered that in green consumption, the "green value" of a product could be used as a justification or reason to induce consumers to accept a premium for hedonic products and to weaken consumers' guilt for purchasing or choosing hedonic products.

5.4. Managerial Implication

Our study would offer certain managerial implications. First, marketers should optimize pricing strategies considering the green attributes of the goods. For green products with higher price premiums, different promotional policies are supposed to be adopted to enhance consumers' willingness to purchase. Specifically, marketers should emphasize the green value of the products to familiarize consumers with it and make them recognize

it, eventually including them in the green consumption mode. Second, companies can set reasonable prices based on the hedonic and utilitarian attributes of green products. Consumers are more willing to accept the green premiums of hedonistic products and are more averse to the premiums of utilitarian green products. Enterprises can appropriately adjust the pricing strategies of different types of products to obtain the maximum profit. Third, marketers should pay attention to the influence of hedonic and utilitarian attributes of products on consumers' psychological decision-making processes. As the utilitarian and hedonic attributes of green products will influence the participants, and considering that consumers will feel guilty for buying hedonic products, marketers should construct their advertising claims based on the concept of green consumption and environmental protection. Highlighting the green value of the products may enhance consumers' willingness to accept premium prices for hedonic products. Fourth, the hedonic attributes of green products capture the initial attention of participants, as reflected in the early P2 volatility. Highlighting the hedonic value of the product in product promotion helps to gain consumers' attention in the early stages, which may stimulate deeper attention to the product. Finally, through neuromarketing methods, it is likely to obtain valuable information about consumers' preferences, emotions, and motivations that cannot be examined through conventional marketing methods. Our study found that consumers will undermine the negative emotions of choosing a hedonic product through rational reasons, so marketers can offer explanations in product promotion so that consumers' inherent perceptions or negative emotions about the product can be reduced, thereby increasing the willingness to purchase. Our findings supported the use of EEG experiments to examine consumer purchase decisions. Based on the neuromarketing framework to measure the relationship between hedonic products and utilitarian products and green premiums, we can obtain an insight into how hedonic and utilitarian attributes and premium levels of green products affect information processing and subsequent decision making in our brain, which can help marketers better predict consumer behavior, select appropriate target markets, and effectively avoid using marketing approaches that do not match consumer perceptions and value assessment processes.

5.5. Limitations and Directions for Future Research

We acknowledge that there are some limitations to our study. First, our study only focused on the hedonic and utilitarian attributes of green products, while other attributes of green products certainly have an impact on the willingness to pay premiums. Future research should broaden the research scope in terms of product attributes. In addition to hedonic and utilitarian attributes, altruistic attributes of green products, green attributes, etc., can also be studied. Secondly, our study only focused on the acceptance of green premium products in the Chinese population. Considering the cultural diversity among various countries and regions, our detailed experiment design and methodology can be tailored for studies of the neural mechanisms behind people's decision-making about green consumption in other countries. Third, our study used the ERPs method to conduct a lab experiment. Nevertheless, there are differences between the simulated purchase scenarios and those in the real world, i.e., participants' performances under experimental conditions may differ from those under real-life scenarios. Therefore, future research should further explore combining the questionnaire or interview with a lab experiment to achieve higher external validity and offer more profound implications for market practitioners.

6. Conclusions

In summary, our study measured the relationship between hedonic and utilitarian products and green premiums based on a neuromarketing framework, attempting to explore the effects of hedonic and utilitarian attributes of green products and the level of green premiums on consumer purchase decisions and their neural basis. Significant differences between consumers' perceptions and levels of acceptable premiums for hedonic and utilitarian green products were confirmed. The behavioral results found that consumers

were more willing to purchase utilitarian green products in the context of green marketing, and the public rationally recognized more of the benefits of utilitarian green products for environmental development. The EEG results imply that in the early cognitive stage, consumers' P2 amplitude was higher when they were presented with hedonic green product stimuli than with utilitarian green product stimuli, that price increases of hedonic products focused on emotional needs would significantly increase consumers' cognitive attention, and that consumers perceived the high level of premium conditions as not matching hedonic green products and had difficulty accepting high premiums for hedonic green products. The N4 component results proved that it was more likely to accept the high level of premium for hedonic products in the late cognitive stage, contrary to consumers' choices made in the early cognitive stage. Consumers used the concept of green consumption and environmental protection as a reason to reduce the negative emotions generated by the choice of hedonic products, making them more willing to accept the green premium for hedonic products. Consumers were more sensitive to changes in premiums for utilitarian green products, and extensive cognitive information processing made consumers more sensitive to price perceptions. The P2 component and the N4 component were subjected to changes in green product attributes and premium levels, which provide suggestive insight into the understanding of the hedonic and utilitarian attributes of green products in green marketing.

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