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Value Perception of Green Products: An Exploratory Study Combining Conscious Answers and Unconscious Behavioral Aspects

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Abstract: Previous studies have failed to provide a comprehensive view on the value perception of green products. The present research takes up this challenge through an experiment in which 43 participants have interacted with and evaluated 40 products—20 baseline products and 20 green products of the same categories. The experiment included both self-assessments to monitor conscious evaluations of the products and biometric measurements (Eye-Tracking and Galvanic Skin Response) to capture unconscious aspects. The results show that different forms of perceived value emerge clearly. Green products, for which participants required greater efforts in the search for relevant information, boost the value attributed to creative solutions still believed of high quality. This effect is significantly more evident for participants showing remarkable interest for sustainability issues. Conversely, alternative products feature greater value perception because they are acknowledged to be functional and reliable.

Keywords: green products; value perception; eco-design; eye-tracking; biometric measures; attitude-behavior gap; willingness to pay; estimated price; creativity; principal component analysis

1. Introduction

Presently, e-commerce applications, supermarkets, and shopping malls allow consumers to easily find and compare a wide range of competitive products. The literature has widely demonstrated that purchase decisions are highly affected by consumer value perception (CVP) [1,2]. CVP resulted as a critical factor to a product's success, which is, in turn, the scope of design [3,4]. However, value-oriented design methods that target innovation do not ensure the achievement of success [5]. Therefore, the challenge of developing products that engender valuable experiences and interactions is unsurprisingly attracting interest in the design field [6], as design is ultimately responsible for providing features and fulfilling requirements to be quickly interpreted and appreciated.

The present research specifically focuses on eco-design and Green Products (GPs), i.e., products that are intentionally designed to decrease environmental impact with respect to the status quo. The particular importance of the CVP in this area is motivated by the following reasons.

- GPs require market success to fulfill sustainable objectives [7]. Indeed, a product that shows a low environmental impact, but it is not purchased, does not contribute to sustainable development [8]. In other words, truly sustainable products must be successful in the market [9] or, at least, avoid flops.

- Success enables GPs to replace alternative products with greater environmental impact [10]. Then, it is imperative to understand GPs' strengths and weaknesses, as well as those of alternative products in a CVP perspective. This helps designers to develop products' profiles that target both consumer satisfaction and the reduction of the environmental impact [11].
- Pro-environmental strategies adopted in the past have led to considerable confusion in today's consumers [12]. On the one hand, GPs designed with the sole objective of reducing the environmental impact (without taking into account the CVP) have brought to market solutions with higher price, lower quality, and/or reduced performance [13]. This has discouraged the purchase of GPs, especially for consumers not particularly sensitive to environmental issues. On the other hand, the abuse or misuse of eco-labels for attracting more green consumers had negative implications for GPs, as these people have matured a sense of mistrust too. In this respect, extensive literature about the "greenwashing" phenomenon is available [14,15].
- Conflicting issues emerge in the marketing field of green consumerism. For instance, Chekima et al. [16] studied reproducible factors that trigger intention of green consumption, while Akenji [17] individuated fundamental limits to green consumerism, especially in terms of the key role attributed to customers' sensitivity to environmental issues and following decisions. In any case, a recent review in the field [18] has stressed the different approaches required by traditional marketing and marketing of GPs—hence, it can be inferred that GPs give rise to distinct CVP phenomena to be studied separately.

In light of the above considerations, eco-design might particularly benefit from the involvement of (potential) consumers, whose perceptions, expectations and preferences are extracted [19]. Several experimental studies aimed to understand perception and attitude of participants towards GPs. All these contributions have provided valuable knowledge and included a plurality of dimensions potentially involved in the CVP of GPs. However, the results are still fragmented and not yet harmonized. In addition, to the best of authors' knowledge, no research results have combined sufficiently large sets of aspects to take into account in the CVP of GPs. Therefore, results collected so far may have described just a portion of the reality and the corresponding contributions potentially inflated partial outcomes. For instance, some of the reviewed experiments included surveys only, others were carried out by scrutinizing the human perception and behavior during product interaction. Thus, the present paper aims to (a) enlarge the set of measures taken to investigate people's perception of products, and (b) evaluate whether perception is affected by the application of eco-design. Additionally, the research highlights whether people's environmental attitudes modulate product perception. The research questions addressed in the present paper are:

1. Does consumer perception of products depend on design efforts to improve their sustainable level?
2. Does the environmental attitude of consumers affect the above relationship?

The paper is structured as follows. Relevant studies about the perception of sustainable products are reviewed in Section 2. With a focus on GPs, Section 3 explains the lack of theoretical frameworks suitable for the present study and analyzes the concept of CVP through the lenses of acknowledged literature sources that identify the meaningful dimensions of CVP. Section 4 introduces the methodological aspects of the study that are supposed to overcome limitations of past research and pinpoints the objectives accordingly. Section 5 describes the procedure of the experiment. Section 6 focuses on materials and measures, by describing the detected biometric measures and their relationship with CVP. Section 7 presents the results of the experiment, which are discussed in Section 8 together with its limitations. Section 9 concludes the paper by suggesting future work.

2. Studies in the Perception of Sustainable Products: A Critical State of the Art

This section presents a critical literature review about the perception of GPs.

One of the first experiments is presented by Luchs et al. [20] in a seminal study in the field, whose relevance is witnessed by the excellent bibliometric performance of the manuscript. The scholars

provided a series of different product pairs represented as lists of attributes where sustainability-related ones were explicitly the focus of the investigation. They asked participants to identify which product the "average person" would prefer between the two. The correlations between choices and attributes highlighted that participants often perceive the presence of a design compromise between performance and sustainability. Subsequently, building upon these results, Luchs et al. [21] studied the emotional factors affecting the choice of GPs rather than products with higher performance, revealing that consumer feelings of confidence and guilt increase the chances of choosing the former. In addition, their findings pointed out that aesthetic design could be the key for overcoming the potential lack of confidence in GPs. These results were enabled by participants' self-assessment of their sense of guilt and confidence while balancing the options.

An increasing number of factors that are considered for explaining preferences, markedly related to both products' (and GPs') characteristics and human aspects, is observable in the evolution of survey-based studies from Luchs and colleagues.

Products' characteristics are at the core of several contributions that use surveys in their methodological approaches. Goucher-Lambert and Cagan [22] involved 94 participants for evaluating product prototypes in different experimental conditions. They found that the presentation of information concerning product's environmental impacts alters the judgment of other performance too. In particular, when sustainability information was present, participants attributed paramount importance to product functionality, whereas the relevance of aesthetics-related characteristics decreased. Through an online survey, Petersen and Brockhaus [23] investigated the perception of 512 consumers as for quality, aesthetic, and sustainability about recycled plastic, bio-plastic and the stereotyped "green" exterior design implemented in a headphone and in a garbage bag. According to findings, the color of the product influenced participants' quality perception while its material had no effect at all. In addition, in contrast to other research studies, they found that more sustainable materials are perceived as high quality. Cerri et al. [24] stressed the importance of making information about product's sustainability accessible, especially because the lack of information is perceived as a major limitation presently. Through a web survey of about 8000 Italian consumers, they confirmed that the presence of eco-labels and sustainable information stimulates a positive attitude towards GPs.

Other contributions focused on people's reactions and interpretation rather than products' features. After having conducted an online survey of 775 Hangzhou residents, Wang and Wu [25] showed that four emotions, i.e., pride, guilt, respect, and anger, affect consumer intention of sustainable consumption significantly and to a similar extent. Here, participants were asked to rate, through a 7-point scale, the intensity of the emotion evoked by different sentences ascribable to purchase behavior that participants and/or other consumers do (not) adopt. In another study, consumer perceptions, inferences and attitudes were also investigated with respect to packaging sustainability in 249 students [26]. Participants were presented with seven sets each composed by three pictures showing tomato soups and asked to express, using their own words, perceived differences based on packaging designs. In particular, they should indicate similarities and differences among illustrated products, their pros and cons, as well as how these would influence their purchase decision. The study included the investigation of participants' level of agreement in asserting that a tomato soup presents certain characteristics and fulfills certain requirements, including sustainability-related ones. The results indicated that consumers have misleading and inaccurate beliefs regarding packaging sustainability and, then, they are inclined to make ineffective environmental decisions. Decisions on the purchase of GPs are also affected by the self-perception about being part of a society (doing good) and the perception of making choices for the personal well-being (doing well) [27].

These two lines of research (product- and consumer-oriented) are, however, seemingly unrelated, maybe because of interests and expertise of the scholars involved. To our knowledge, only a few articles attempted to bridge people and product-related factors. In one of these papers, de Medeiros et al. [28] evaluated how perceived value may affect purchasing decisions through two questionnaires. The first questionnaire investigated consumer attitudes and preferences for several attributes that could

affect the purchasing decision for cars and furniture. Attitudes were explicitly investigated by asking participants about their level of concern with environmental issues, among others. In the second questionnaire, a series of different purchase scenarios of a car and furniture was proposed. Each scenario was composed by a list of attributes (price, performance, materials, production techniques and design) whose values varied between scenarios. Participants were asked to indicate the probability of purchase for each scenario through a 5-point Likert scale. Results showed that if the price of all the products were the same, 95% of the participants would have preferred to buy GPs. The 60% (50%, in the case of cars) of the participants would have preferred GPs even if their price were 10% higher. Eventually, a 30% premium price for GPs would have been accepted by 20% of participants for the purchase of furniture (10% for cars). These results were supported and extended by O'Rourke and Ringer [29], who found that providing information on sustainability has a positive impact on consumers with pro-environmental attitudes.

Despite this extensive set of literature using surveys, such a tool is under debate. It is claimed that the exclusive use of surveys might fail to capture human factors in a reliable way, leading to the attitude-behavior gap or value-behavior gap [13,30,31]. Indeed, research has shown that when potential consumers are explicitly asked about sustainability issues, the declared interest in environmental issues and the actual purchasing behavior are often inconsistent [27].

To overcome these limitations, sustainability studies were solicited for the adoption of neurophysiological and biometric devices, which are increasingly diffused in experimental design research [32]. This area of research revealed how the investigation of the underlying cognitive processes could be capable of elucidating, for example, relevant unconscious aspects of people's interaction with GPs as well as environment-related aspects embedded into products and their communication. Goucher-Lambert et al.'s [33] experiment involved 11 subjects monitored through a functional Magnetic Resonance Imaging scanner; the task was to choose between two virtual prototypes of bottles that exhibited a different shape and a varying list of performances. Results showed that participants make quicker decisions when information about the environmental impact is present. In addition, data elaboration showed that sustainability can be deemed as "an impersonal moral judgment"; this means that people disentangle from their responsibility for the consequences of their decision and (purchasing) behavior when sustainability is in play. She and MacDonald [34], after having simulated a real-word decision scenario, demonstrated that the implementation of sustainable features favors the choice of a GP in a purchasing situation. Subsequently, through the exploitation of remote eye-tracking (ET), they discovered that participants paid more attention to sustainable attributes written in a list adjacent to a product picture than those ascribable to other performances. Pérez-Belis et al. [35] engaged 26 participants to investigate their knowledge and perception of sustainable labels (concerning environment, workers' respect and customer health) applied to furniture. Through the ET technology, they found that the youngest participants showed a greater interest for and knowledge of these labels. Eventually, Royo et al. [36] conducted an experimental campaign through 40 participants monitored by an electroencephalogram (EEG) headset. They observed emotional and cognitive differences between watching a visual narrative and showing the functionality and use of a pushchair (that provides pro-environmental solutions) and a verbal narrative advertisement that explains the problems and the advantages of using the new product. The results showed that viewing the verbal narrative advertisement first triggers higher emotional values of excitement as well as frustration. However, it is difficult to obtain reliable data; for example, preferences of GPs could be affected by the social desirability bias, already insightfully studied in the 1980s [37].

The above state of the art shows how insightful studies have contributed to the knowledge about the perception and the acceptance of GPs and the circumstances in which these are preferred over alternatives. Very different aspects have been investigated, but the variability among objectives and methods has given rise to useful and interest insights, but not to a comprehensive framework regarding the CVP of GPs.

3. Green Consumer Perceived Value and Its Relevant Dimensions

The study of green CVP can benefit from established theories on consumption. One of the most relevant contributions was proposed by Sheth and colleagues with their Theory of Consumption Values [2]. The theory aimed at proving a unified framework to describe consumption behavior. According to the scholars' view, consumer decision-making depends on five consumption values: functional, conditional, social, emotional, and epistemic. Although influential, the theory seems to be somehow outdated given that it does not correspond, for example, to the current leading theories in the psychological field. In facts, theories about emotions and motivation (the latter being connected to the epistemic value) have capitalized on the development of research and those proposed more than 30 years ago are no longer considered reliable [38,39]. After this attempt, it was acknowledged that the creation of well-grounded theoretical frameworks is a hard task and an even greater challenge if green behavior is focused on [40]. Among the few that proposed a structure, do Paço and colleagues [41] showed that General Prosocial Attitudes positively affect individual green consumption values that in turn influence both receptivity to green advertisement and purchasing behavior. Many other scholars, instead, focused on factors relevant to describe and explain green CVP [40,42]. Moreover, since many behaviors, emotions, and cognitive loads can be investigated by means of biometric measurements, the green CVP dimensions could vary depending on the method used to collect data. The papers indicated so far in this section mainly used self-reported answers only.

Due to the lack of an appropriate theoretical reference for studying the CVP of GPs, the authors decided to focus on dimensions of CVP that are not inferable from biometric data and that should complement the extrapolation of unconscious reactions and behaviors. To the scope, a large number of CVP conceptualizations were individuated; several reviews on the topic are also available [43–50]. Among these, it is possible to individuate a consensus in ascribing a double nature to the CVP: a utilitarian/functional dimension and a hedonic/emotional one. The following dimensions are those accredited to be the most commonly used in the literature. Those leveraged in the experiment of the present paper are indicated in italics in the text below.

It is acknowledged that the CVP drives the consumer *Preference* in a decision-making context [51], e.g., a consumer has perceived greater value in the product bought compared to alternatives. Consistently, a clear picture of the consumer *Preferences* and perceptions plays a key role in the design of successful products [52]. This dimension has been clearly captured also by most of the studies reviewed in Section 2. Initial studies on CVP have focused on the relationship between *Perceived Quality* and *Price* [53,54], leading to the understanding of CVP as a cognitive trade-off between the *Perceived Quality* and the product cost [55]. Therefore, the *Perceived Quality*, in terms of a product's overall excellence or superiority in utilitarian performance and consumer *Willingness to Pay (WTP)* or to buy [56,57] was mostly investigated to understand the CVP. The practical effect of this CVP conceptualization was to delineate the economic value dimension in terms of (Estimated) *Price* with respect to the products' performance/characteristics. Indeed, the product *Price* is understood as product's value indicator [55]. With a higher abstraction level with respect to the above contributions, Woodal [56] highlighted the strong relationship between CVP and the balancing of "pleasure" and "pain", being they real and/or perceived, featured by the product. Indeed, the models the scholar summarizes quantify the CVP as a difference or trade-off between benefits, in terms of *Advantages* that the use or the ownership of the solution provides to the consumer, and sacrifices, in terms of resources that the use or the ownership of the solution requires of the consumer. It is worth noting that here, an improvement of the CVP can be achieved through both an increase of the product *Advantages* (benefits) and the decrease of the *Disadvantages* (sacrifices). Holbrook [58] emphasized that the CVP requires an interaction or an experience that takes place between the consumer and the product. This experience affects the CVP also in terms of consumer *Knowledge* after buying or using the product [44]. Indeed, the product's experience, *Knowledge* or familiarity plays a fundamental role in its evaluation [59]. Moreover, a pillar of the CVP is the consumer' *Interest* for the product [60]. Indeed, consumers could develop *Knowledge* about a product, they could individuate *Advantages*

and *Disadvantages* in the use or ownership of a product, and they could indicate a *Preference* among products, but if they are not interested in that family of products, the CVP is inhibited and this affects consumer behavior. Eventually, the *Perception of Novelty-Creativity* plays a key role in the CVP [61]. Indeed, developing creative solutions is a milestone for achieving innovation and it is considered a success driver by many scholars [62–64]. In a different perspective, the presence of changes in products' profiles, i.e., the modification of the set of benefits offered by products, is a determinant of value and subsequent success chances [65].

4. Rationale and Objectives

The present paper represents a first attempt of an exploratory comprehensive study on the overall CVP phenomenon, which has been besides often limited to the elicitation of preferences so far. In doing so, this paper attempts to overcome limitations that can be highlighted in previous research. Overall, many of the analyzed studies provide textual information regarding products' performance and attributes, including environmental and sustainable aspects. This introduces a fundamental bias with respect to a real-word purchasing decision scenario, apart from certain circumstances potentially applying to e-commerce. Besides, Du and MacDonald [66] found different cognitive responses between shared text attributes and shared image features based on data collected through a survey and the monitoring of gaze behavior during the comparison of products' pictures. As aforementioned, survey-based studies might have failed to include unconscious aspects by either neglecting the chance to use biometric instruments for monitoring spontaneous reactions or overlooking the attitude-behavior gap. Eventually, many results emerging from the reviewed literature arise from experiments including few product categories and, consequently, they might describe phenomena applying just in the reference sector(s); therefore, the generalizability of these findings is arguable.

The research questions were aimed at investigating (a) consumer perception of products communicating sustainable features, and (b) the contribution of consumer environmental attitude. Given that literature has shown contrastive results, both hypotheses must be explorative: the goal is to merge the several sources of information consolidated in the literature, and to evaluate what factors could predict behavior. Clearly, while previous studies have overall paid attention to some of the above issues, all these aspects have never been studied simultaneously hitherto. Therefore, the implemented methodology was thought to be fundamental to disentangle the contribution of the several possible measures. To pursue this objective, the following measures were taken in the present study.

- It includes both people's conscious evaluations and unconscious reactions (measured with biometric instruments) when they are exposed to sustainable triggers.
- It studies the CVP as a comprehensive phenomenon instead of single aspects. Besides, the concept of CVP, initially referred to the marketing field, is conceptualized as a transdisciplinary and multidimensional construct [45,67]. An overview of the phenomena ascribable to CVP is provided in Section 3, which serves as guide to identify the relevant factors to be observed.
- It conceals references to sustainability- and environment-related terms ascribable to GPs to limit bias towards sustainable aspects, as elicited by the attitude-behavior gap.
- An experiment is organized in which the product/industry domains are various and not limited to specific contexts.

5. Materials, Methods and Indicators Relevant for the Study

The experiment to test the research questions is described below. In the followings, it will become apparent how the requirements to be fulfilled (end of Section 2) have been met thanks to the implementation of measures the organization of the experiment has considered.

The experiment has involved 43 participants (Section 5.1) observing the pictures of 40 products to evaluate (Section 5.2). The use of real pictures of commercial products (with no accompanying text) displayed on a computer screen as a form to illustrate products was chosen because of:

- Their availability for a large number of product categories.
- Practical reasons, e.g., money and space required for physical objects.
- Possibility to present the products in a consistent way with no need to hide other objects at the same time.
- Presentation of products in a similar fashion with respect to situations in which the participants behave as consumers.
- Possibility to display all the information participants required without forcing them to focus on specifically declared performance.

The participants' environmental attitude and their spending power (potentially affecting preferences) were collected through a preliminary paper-and-pencil questionnaire (Section 5.3.1). During the interaction with products, the participants evaluated each product through a specific paper-based template (Section 5.3.2) and they were monitored by means of biometric instruments (Section 5.4). Eventually, in Section 5.5, the whole procedure is presented.

The subsections introduce the variables extracted for the scope of the present study. In the residual of the paper, the term "indicator" is used to mean a variable referable to each product observed by each participant ascribable to the participant's behavior, perception, or perceptive process. Each indicator has 1720 (43 participants $\times$ 40 products) observations. Indicators either correspond to initially extracted variables or are the result of their post-processing.

Two pilot tests have been conducted to assess the duration and feasibility of the procedure, so that specific aspects, e.g., the number of presented products, could be streamlined.

5.1. Participants

The present experiment was carried out in February and March 2018 and 43 people (20 females and 23 males) volunteered to participate. Their age ranged from 20 to 45 years; their background was extremely various and approximately half of them were currently studying or have studied engineering, while the other ones were mainly involved in humanistic studies. All of them either were Italian mother tongue or spoke Italian at a proficient level; for this reason, all the experiments were conducted in Italian. They all lived, worked, or studied in South Tyrol, Italy, at the time of the experiment.

An identification number (*Participant_ID*) was used to feature each participant (numbers 1 to 43), which was subsequently treated as a categorical variable (Table A1).

Participants were recruited via email and they were allowed to invite other people to the experiment. The following information about the experiment was provided at the time of recruitment.

- The experiment consists in the evaluation of products with no additional specifications about the properties of these products.
- During the experiment, they must be equipped with instruments capable of measuring certain biometric parameters.
- The experiment takes place in two sessions lasting no more than 60 min each.

Therefore, they were unaware of the real objectives of the experiment and terms such as sustainability, ecology, or environmental friendliness never emerged before the end of the experiment. In addition, the environmental attitude of each participant was elicited through a preliminary questionnaire (Section 5.3.1). In this way, it was possible to characterize participants based on their attitude towards valuing environmental sustainability. Additional information about participants' spending power was extracted both in the preliminary questionnaire and at the end of the experiment. The complete participants' characterization is shown in Table A1.

5.2. Products

Each participant had to evaluate products depicted through static pictures, as aforementioned.

The whole set of products was composed of 20 product pairs (PPs) comprising a baseline product and an alternative one. In the latter, a design effort is identifiable that makes it possible to achieve a more sustainable solution while performing functions comparable to those of the baseline product. The definition of PPs started with the individuation of products that show sustainable features; the identification of the corresponding baseline (less environmental-friendly) products followed. The PPs are illustrated and described in Table A2, which clarifies the sustainability-oriented design efforts implemented by the former. The selection of products and corresponding pictures fulfilled, whenever possible, the following requirements.

- The products illustrated had to belong to the everyday life, such as in the fields of food and beverage, cleaning and personal hygiene, light and energy, furniture, transportation. On the one hand, it was supposed that participants could evaluate a large number of the proposed products. On the other hand, the variety of industrial fields aimed to minimize domain-dependent effects.
- Environmental-related features could be captured or inferred also through static pictures, i.e., sustainable advantages should not be enabled by dynamic effects.
- The pictures had to be large and in high definition and depicted with similar colors to ease the observation of the depicted products and avoid preferences depending on the image rather than on the product.
- Each PP consisted of products with the same brand (when present) to limit biases in terms of commercial preferences.
- Within each picture composing the PP, the same number of products should be presented.

After their selection, each picture was adapted to a 1280 × 720-pixel white-background image file to be shown in a full screen 23-inch LCD color monitor. These modifications aimed to further reduce presentation differences potentially affecting evaluations.

All the PPs were featured by an identification letter (*Pair_ID*), standing for a categorical variable. Within each pair, the baseline and the more sustainable products were characterized by the dummy variable (*Sustainability_ID*) by assigning them the value 0 and 1, respectively. Details are found in Table A2.

5.3. Questionnaires

Two questionnaires were developed and used during this experiment. The former (Section 5.3.1) was designed to elicit the participants' environmental attitude. The latter (Section 5.3.2), hereinafter product evaluation template, was exploited to investigate specific dimensions of CVP for each product. Both questionnaires had to be filled in through a Likert scale ranging from 0 to 5 according to the degree of agreement with the reported statements.

5.3.1. Preliminary Questionnaire

The preliminary questionnaire included 17 statements presented in a random sequence (different for all the participants). Table A3 shows an example. The scope of this questionnaire was three-fold.

- To assess the level of consistency in the use of the Likert scale by each participant. In this respect, two antithetical affirmations are proposed, both concerning the participants' reliance upon travel agencies to plan holidays. Inconsistencies were considered as a low understanding of the Likert scale; this aspect is monitored through the variable *Check_Comparison* (Table 1), while the outcomes are reported in Table A2.
- To infer the participants' decision-making power as for household expenditures through a specific question. The variable *Family_Influence* (Table 1) matches the declared level (outcomes in Table A2).
- To define the participant's environmental attitude while avoiding direct questions about this issue. Eight characterizing statements (4 in a positive and 4 in a negative form) concerning environmental issues were proposed. In the subsequent data elaboration, the answers to the 4

negative-form statements were reversed in their values to obtain 8 variables (shown in Table 1) potentially featuring people's sensibility towards environmental problems (the higher the value of the variables the higher the sensibility). Additional details are provided in Table A2.

Table 1. Relevant variables extrapolated from the preliminary questionnaire.

Variables	Meaning
Check_Comparison	Level of consistency in the use of the Likert scale
Family_Influence	Level of decision-power in the purchase of household goods
Pro-km0	Willingness to pay a higher price to get a local product
Pro-Bio_Material	Willingness to pay a higher price to get a product made of biodegradable materials
Pro-Recycling	Favorable propensity towards sorting waste
Pro-Repair	Agreement with repairing a product rather than buying a new one
Pro-Reuse	Preference in using reusable products rather than disposable ones
Pro-Rent	Attitude towards renting a product as an alternative of buying it
Pro-Public_Tansport	Willingness to use a bicycle or public transportation rather than a private car
Pro-Pay-for_Efficiency	Willingness to pay a higher price to get a product with higher energy efficiency

In addition, 6 misleading statements were proposed as catch trials to shift the participant's attention towards topics different from environmental sustainability, e.g., journeys, cinema, housekeeping, habits, online sales, and brands.

5.3.2. Product Evaluation Template

The CVP can be investigated through multiple dimensions, often elicited by Likert questionnaires [68]. The goal of the product evaluation template is to collect information for characterizing the participants' value perception concerning each product in relation to the dimensions highlighted in Section 3 in italics.

The template was provided in the form of a table to fill in, as shown in Table 2. The 8 columns featured the factors to be evaluated through the Likert scale, while the last column was used to estimate the depicted product's price. Each evaluated variable is associated with a statement or an explanation available in a guide provided to participants, who could consult it at any time during the experiment (Table 3). To associate high scores with positive values of the variables, the variable *Disadvantages* was reversed for obtaining the indicator *Absence_of_Disadvantages* in the subsequent data elaboration.

Table 2. Structure of the evaluation template to be filled.

	Knowledge	*Interest*	*Quality*	*Advantages*	*Disadvantages*	*Preference*	*Novelty_Creativity*	*Willingness_to_Pay*	*Estimated_price*
	0–5	**0–5**	**0–5**	**0–5**	**0–5**	**0–5**	**0–5**	**0–5**	**€**
Product 1									
Product 2									
. . . ..									
Product N									

Table 3. Clarification of the variables investigated through the evaluation template.

Variables	Meaning
Knowledge	Level of agreement of the participant in affirming that he/she knows this specific product, he/she uses it, he/she bought it and he/she knows similar products
Interest	Level of agreement of the participant in affirming that the aim of the product is relevant to his/her daily life, he/she is interested in this kind of products, he/she can benefit from it
Quality	Level of agreement of the participant in affirming that he/she believes that it the product is of high quality and is able to meet her/him expectations
Advantages	Level of agreement of the participant in affirming that the product has advantages if compared to similar products and it has valuable characteristics
Disadvantages (Absence_of_Disadvantages)	Level of agreement of the participant in affirming that the product has (not) disadvantages if compared to similar products
Preference	Level of agreement of the participant in affirming that the participant would likely choose this product instead of a similar one
Novelty_Creativity	Level of agreement of the participant in affirming that the product has novel or original characteristics and it proposes innovative or brilliant solutions
Willingness_to_Pay	Level of agreement of the participant in affirming that he/she considers appropriate that the depicted product is more expensive than the average in its branch of products
Estimated_price	The participant's estimated price (€) of the product. If the picture showed more than one product, he/she was asked to specify how many products (or components) the indicated price refers to

The initial variable *Estimated_price* was transformed to obtain two indicators of the value perception for each participant with respect to the sample of participants (*Price_k*) and the actual price in the market (*Price_error*).

- *Price_k*: it refers to the distribution of estimated prices for a specific product, whose average and standard deviation were calculated. The indicator is the standardized value of the original normally distributed variable *Estimated_price*. Therefore, it stands for the dimensional distance between the *Estimated_price* of the participant in question for a specific product with respect to the distribution of prices estimated by all participants.
- *Price_error*: percentage error between the *Estimated_price* indicated by the participant and the actual price of the product. The prices of the products were found on the Internet when available; otherwise, 6 wholesalers and 6 retailers, considered as experts, were asked to estimate the price of four products and the average was considered as their actual price.

For each product, the statistical description of the overall *Estimated_price*, the *Real_price* and the employed source are shown in Table A4. For both the above indicators, positive (negative) values mean that the participant overestimates (underestimates) the product's price with respect to the sample of estimations and the actual price, respectively.

5.4. Biometric Instruments

Figure 1 shows the experimental setup, including the biometric instruments used for collecting data about the human reaction and behavior during the product observation (and evaluation). The used instruments (details are below) were a remote (due to the choice of showing products as pictures on a computer screen) ET device and a Galvanic Skin Response (GSR) meter.

- Tobii X2-60Hz Compact screen-based eye tracker.
- TEA Captiv T-Sens GSR.

The former provides information about the subjects' explorative behavior and the cognitive activation, while the signals captured by the latter are proxies of individuals' emotional arousal.

In this respect, both unconscious cognitive and emotional states are explored. Undoubtedly, other instruments could have been useful to complete the investigation of participants' reactions and behavior. However, due to the expected duration of the experiment sessions, the authors decided to avoid using potentially invasive devices, such as those commonly adopted to explore neurological phenomena, e.g., an EEG headset. The detailed description of the extraction of data from biometric instruments and the subsequent building of indicators is reported in a dedicated chapter, Section 6, which explains the use of corresponding software to manage these instruments too.

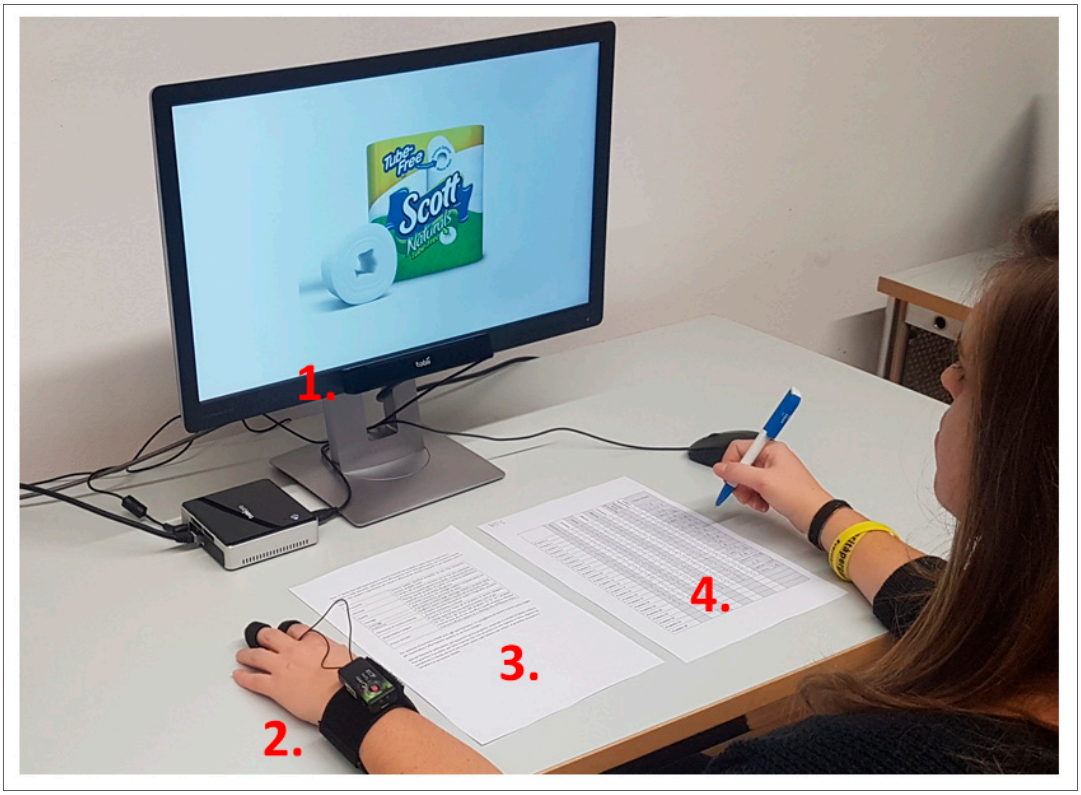

Figure 1. Experimental setup that shows the use of biometric instruments. (1.) Remote Eye Tracker, (2.) Galvanic Skin Response sensor, (3.) Task Clarification Guide, (4.) Product Evaluation Template. Disclaimer: the picture shows a reconstruction of the experimental setup only, as taking photos during the experiment would have potentially distracted participants and biased results.

5.5. Procedure

Each participant was tested singularly in two sessions, which are featured by the variable *Session* (with values 1 and 2). All the experiment sessions were conducted in the same room and in the same position inside the room. The room did not have windows and a constant artificial light prevented the need to consider the effect of different lighting conditions on participants' pupil diameters. For the same reason, participants were tested in the two sessions at similar timetables, when possible based on their availability, at least 48 hours apart to reduce the carry-over effects of the remembering of the evaluations made during the first session.

In addition, with the aim to limit the influence of the sequence of products, the followings conditions were respected.

- 20 products must be shown (randomly 10 baseline and 10 sustainable products) in each session. The sequence of illustration within each session is reflected in the variable *Order* (numeric, values 1 to 20) assigned to each illustrated product.
- No products belonging to the same PP must be shown in the same session.
- Presentation sequences for each session and for each participant are random.

At the beginning of the first session, the participant was informed that the session comprises three phases.

1. Filling in the preliminary questionnaire and contextually learning the evaluation scale to be used throughout the experiment.
2. Evaluating physical products, while they wear ET glasses (data ascribable to another experiment that does not relate to the present one).
3. Evaluating products shown on the screen, while they wear a GSR sensor and a remote ET monitors their eyes' behavior.

At the end of the second phase, the participants were invited to leave the experiment's room. During this break, an experimenter was setting the experimental environment for the third phase, while another one was helping the participants to familiarize with the product evaluation template. As for the new setting, the screen with the installed remote ET device was placed in the center of a table, in front of a stable chair. The participant was then asked to sit on the chair, in front of a monitor, where they could find a mouse, a pen, the product evaluation template and the compilation guide, as of Tables 2 and 3, respectively.

Some experiment conditions were clarified, as follows.

- All the material is available to the participant during the whole experiment phase.
- The participant can observe the product on the screen, the evaluation template, and the Supplementary Material whenever they want and in any sequence.
- The participant's task is to fill in the template by evaluating each product (featured by the numbered corresponding row) according to all the statements and factors requested.
- The participant must click the mouse when the evaluation and observation of a product is completed; the subsequent product is visualized immediately afterwards.
- If the participant has no idea as what the product is, they must strike out the entire row corresponding to the product in the product evaluation template and to skip to the subsequent product.
- The experimenters are silent during this phase and the participant must avoid any interaction with them until the text "The End" appears on the screen, as this could affect GSR data.

The GSR sensor was worn on the tips of the middle and index fingers of the hand the participant did not use to write; the participant was asked not to hit these fingers on the table, as it would have affected the reliability of extracted data. The GSR signal was managed by the Software Captiv [69] and the experimenter verifies that the sensors are well positioned. After that, the participant was asked to find the right position that allows them to fill in the questionnaire with the pen, to look at the screen and to click the mouse comfortably. To favor this operation, the screen was set and adjusted according to the participant's height. Its distance from the participant's eyes should be between 50 and 80 cm, as indicated in Tobii Studio User's Manual [70]; the projection of their eyes should be approximately at the center of the screen. This operation was assisted by Tobii Pro Studio software, which also supported the calibration of the participant's gaze behavior with the remote ET system to acquire reliable data. During the calibration, an experimenter double-checked that the synchronization of the GSR and the remote ET was successful thanks to the Captiv software.

The first product shown was a test picture (a fork), so to avoid the acquisition of data affected by probable questions asked by the participant for the sake of clarity. During the subsequent evaluations and observations, the experimenter controlled that the sequence of appearance of the pictures is the predetermined one and takes note of any event (noise, cough, interaction between participant and experimenters) that could alter the GSR signal. The presence of these events has led to the elimination of data related to GSR measurements as for the specific products per participant.

When the sentence "The End" appeared on the screen, the recording of the biometric data was manually interrupted and saved, the GSR was removed from the participant's hand, and the

completed questionnaire was archived. No information regarding the aim and scope of the experiment was provided to the participant who was asked to plan the date for the second session.

In the second session, apart from the needs of the experiment conducted in parallel, the third phase was repeated by showing the products belonging to the PPs that had not been shown in the first session. The same conditions were applied, and the main instructions were repeated. At the end of the second observation and evaluation session, the participants were asked to estimate (€) how much they spend monthly for consumer goods (*Monthly_Expenses_for_Consumer_Goods*) and for transport (*Monthly_Expenses_for_Transport*). In this way, it was possible to collect data about participants' spending power and then complete the participant's characterization (Table A1).

6. From Biometric Measurements to Indicators Featuring Unconscious Aspects

The present section presents data elaboration of biometric measures to obtain indicators describing the participants' (value) perception and behavior during the observation and/or the evaluation of each product. An overview of the variables extracted is presented in Table 4. The file includes reference procedure-related variables that have been already discussed in Section 5, namely *Participant_ID*, *Session*, *Order*, *Pair_ID* (the reference to the PP) and *Sustainability_ID*. Data were collected with a 60 Hz sampling frequency. The first 11 variables reported in Table 4 are obtained with the software Tobii Pro Studio and are extensively described in the Tobii Studio User´s Manual [70], whereas the last two ones are extracted by means of the GSR sensor.

Table 4. Explanation of the initial variables acquired through the biometric instruments.

ID	Biometrics Initial Variables	Meaning and Characteristics
1	*RecordingTimestamp*	Timestamp assigned starting from the beginning of the recording of each session (in milliseconds).
2	*MediaName*	The name of the picture shown on the screen as combination of Pair_ID and Sustainability_ID; for example, A0.JPG means that the Picture (saved in JPG format) has a Pair_ID=A and a Sustainability_ID=0. In addition, the test picture (a fork) is named Prova.JPG while the final picture is named THEEND.png
3	*StudioEvent*	Indicates the start (ImageStart) and the end (ImageEnd) of the period in which the picture of the product is exposed on screen.
4	*GazeEventType*	Type of eye-movement event classified by the applied Fixation filter, namely Fixation, Saccade, Unclassified (categorical).
5	*FixationPointX_MCSpx (FixationPointY_MCSpx)*	Horizontal (Vertical) coordinate of the fixation point on the picture (pixels in Media Coordinate System—MCSpx). The origin of the coordinate system is the top left of the product picture.
6	*SaccadicAmplitude*	Difference of eyes' orientation between the previous fixation location and the current one (degrees).
7	*GazePointLeftX_ADCSpx (GazePointLeftY_ADCSpx)*	Horizontal (vertical) coordinate of the unprocessed gaze point for the left eye on the screen (Active Display Coordinate System pixels—ADCSpx). The origin of the coordinate system is the top left of the screen.
8	*GazePointRightX_ADCSpx (GazePointRightY_ADCSpx)*	Horizontal (vertical) coordinate of the unprocessed gaze point for the right eye on the screen (ADCSpx).
9	*GazePointX_MCSpx (GazePointY_MCSpx)*	Horizontal (vertical) coordinate of the averaged left and right eye gaze point on the media element (MCSpx).
10	*PupilLeft (PupilRight)*	Size of the left (right) eye pupil (millimeters).
11	*ValidityLeft (ValidityRight)*	Confidence level as that the left (right) eye has been correctly identified. The values range from 0 (high confidence) to 4 (eye not found).
12	*GSR*	Skin conductance (micro-Siemens) detected on the participant's fingertips by the GSR sensor.
13	*Emotion_5*	5 levels of arousal (low, mid-, mid, mid+, high) obtained from the GSR data computed and provided by the Captiv software.

A specific MATLAB code was developed to transform the collected biometric data into indicators, which are grouped into the following categories and are extensively described in the corresponding subsections that follow. These indicators, together with the answers of the evaluation template, are collected in the file Participants_Products_Indicators.xlsx (linked Supplementary Material).

- Participants' approach for products' observation and evaluation (Group A, Table 5).
- Eye movements in terms of fixations, saccades and blinks during products' observation (Group B, Table 5).
- Pupillometry in terms of pupils' size, dilations and constrictions (Group C, Table 5).
- Arousal in terms of the participant's emotional involvement (Group D, Table 5).

The last column of Table 5 documents which initial variables were exploited to compute the indicators, whose description and meaning are provided in the penultimate column.

Table 5. Indicators extracted from the biometrics initial variables (Table 4.) and collected in Participants_Products_Indicators.xls.

Group	Indicators	Unit of Measure	Meaning	ID of Initial Variables Exploited (as of Table 4)
A	*Overall_involvment_time*	ms	Duration of the time interval in which the picture of the product is exposed on screen	1, 2, 3
A	*Exploring_num*	no.	Number of times the participant looks at the product picture (Exploring situation)	4, 9, 11
A	*Exploring_dur*	ms	Total duration of all the Exploring situations	1, 4, 9, 11
A	*Exploring_maxdur*	ms	Maximum duration of an Exploring situation	1, 4, 9, 11
A	*Answering_num*	no.	Number of times the participant is in the Answering situation	1, 4, 7, 8, 9, 11
A	*Answering_dur*	ms	Total duration of all the Answering situations	1, 4, 7, 8, 9, 11
A	*Answering_maxdur*	ms	Maximum duration of an Answering situation	1, 4, 7, 8, 9, 11
A	*Reflecting_num*	no.	Number of times a Reflecting situation takes place	4, 7, 8, 9
A	*Reflecting_dur*	ms	Total duration of all the Reflecting situations	1, 4, 7, 8, 9
B	*Fixationl_num*	no.	Number of fixations	4, 5, 9
B	*Fixation_dur*	ms	Total duration of fixations	1, 4, 5, 9
B	*Fixation_maxdur*	ms	Maximum duration of a fixation	1, 4, 5, 9
B	*Saccade_num*	no.	Number of relevant saccades	4, 9
B	*Saccade_dur*	ms	Total duration of the saccades	1, 4, 9
B	*Saccade_maxdur*	ms	Maximum duration of a saccade	1, 4, 9
B	*Saccade_avangle*	deg	Average angle of the saccades	1, 4, 6, 9
B	*Saccade_maxangle*	deg	Maximum angle of a saccade	1, 4, 6, 9
B	*Saccade_avespeed*	deg/s	Average angular speed of the saccades	1, 4, 6, 9
B	*Saccade_maxspeed*	deg/s	Maximum angular speed of saccades	1, 4, 6, 9
B	*Blink_num*	no.	Number of blinks	1, 4, 7, 8, 11
B	*Blink_dur*	ms	Total duration of blinks	1, 4, 7, 8, 11
C	*PD_aver*	mm	Average diameter of the pupils	9, 10
C	*PD_max*	mm	Maximum diameter of the pupils	9, 10
C	*PD_dilation_num*	no.	Number of peaks observed in the time trajectories of the pupils' diameter	9, 10

Table 5. *Cont.*

Group	Indicators	Unit of Measure	Meaning	ID of Initial Variables Exploited (as of Table 4)
C	*PD_constriction_num*	no.	Number of valleys observed in the time trajectories of the pupils' diameter	9, 10
C	*PD_dilation_dur*	ms	Total duration of the intervals in which the pupils' diameter increases	1, 9, 10
C	*PD_constriction_dur*	ms	Total duration of the intervals in which the pupils' diameter is decreases	1, 9, 10
C	*PD_dilation_avespeed*	mm/s	Average speed of the pupils' dilation	1, 9, 10
C	*PD_constriction_avespeed*	mm/s	Average speed of the pupils' constriction	1, 9, 10
C	*PD_dilation_maxspeed*	mm/s	Maximum speed recoded during the pupils' dilation	1, 9, 10
C	*PD_constriction_maxspeed*	mm/s	Maximum speed recoded during the pupils' constriction	1, 9, 10
D	*GSR_E5_high_num*	no.	Number of times a high level in Emotion_5 has been reached	13
D	*GSR_E5_medplus_num*	no.	Number of times a mid+ level in Emotion_5 has been reached	13
D	*GSR_E5_med_num*	no.	Number of times a mid level in Emotion_5 has been reached	13
D	*GSR_E5_medless_num*	no.	Number of times a mid- level in Emotion_5 has been reached	13
D	*GSR_E5_low_num*	no.	Number of times a low level in Emotion_5 has been reached	13
D	*GSR_E5_high_dur*	s	Total duration of the time intervals marked by a high level in Emotion_5	1, 13
D	*GSR_E5_medplus_dur*	s	Total duration of the time intervals marked by a mid+ level in Emotion_5	1, 13
D	*GSR_E5_med_dur*	s	Total duration of the time intervals marked by a mid level in Emotion_5	1, 13
D	*GSR_E5_medless_dur*	s	Total duration of the time intervals marked by a mid- level in Emotion_5	1, 13
D	*GSR_E5_low_dur*	s	Total duration of the time intervals marked by a low level in Emotion_5	1, 13
D	*GSR_E5_high_maxdur*	s	Maximum duration of a time interval marked by a high level in Emotion_5	1, 13
D	*GSR_E5_medplus_maxdur*	s	Maximum duration of a time interval marked by a mid+ level in Emotion_5	1, 13
D	*GSR_E5_med_maxdur*	s	Maximum duration of a time interval marked by a mid level in Emotion_5	1, 13
D	*GSR_E5_medless_maxdur*	s	Maximum duration of a time interval marked by a mid- level in Emotion_5	1, 13
D	*GSR_E5_low_maxdur*	s	Maximum duration of a time interval marked by a low level in Emotion_5	1, 13
D	*GSR_Peaks_1plus*	no.	Number of positive peaks in the phasic level of the GSR signal with standardized value of the original normally distributed variable higher than 1	12

Table 5. *Cont.*

Group	Indicators	Unit of Measure	Meaning	ID of Initial Variables Exploited (as of Table 4)
D	*GSR_Peaks_1less*	no.	Number of positive peaks in the phasic level of the GSR signal with standardized value of the original normally distributed variable lower than −1	12
D	*GSR_Peaks_2plus*	no.	Number of positive peaks in the phasic level of the GSR signal with standardized value of the original normally distributed variable higher than 2	12
D	*GSR_Peaks_2less*	no.	Number of positive peaks in the phasic level of the GSR signal with standardized value of the original normally distributed variable lower than −2	12
D	*GSR_Peaks_3plus*	no.	Number of positive peaks in the phasic level of the GSR signal with standardized value of the original normally distributed variable higher than 3	12
D	*GSR_Peaks_3less*	no.	Number of positive peaks in the phasic level of the GSR signal with standardized value of the original normally distributed variable lower than −3	12

6.1. Variables of Group A: Participants' Approach to Perform the Assigned Task

The evaluation task based on the participant's value perception can be considered as a process. In particular, the participant observes the product's picture collecting information. The information acquired is cognitively elaborated and organized to construct a clear value perception of the product in the participant's mind; an example of the procedure, used to collect information from participants, could be found in [71]. Eventually, the value perception of the product is expressed in terms of scores in the evaluation template.

This subsection introduces classifiers that feature time and iterations of the described process and that will be subsequently capitalized on to build indicators. More specifically, through the coordinates of visual attention (Table 4), it was possible to recognize three different situations characterizing the participant's behavior.

1. Exploring: the participant is looking at the product's picture.
2. Answering: the participant's eyes are not detected for more than 1500 milliseconds. It means that the participant is not looking at the screen and they are probably filling the evaluation template or reflecting on how to fill it.
3. Reflecting: the participant is looking at the screen (or close to the screen), but not at the product picture. Supposedly, the participant is reflecting or distracted.

The indicators (Group A, Table 5), which were then extracted, refer to each participant and product and describe the task execution approach.

To obtain these indicators, the MATLAB code individuates the occurrence of blinks (as explained in the following subsection), which need to be considered to prevent the above variables from being biased by this involuntary phenomenon.

On the one hand, the time spent in an Exploring situation can be representative of the quantity of information (required by the participant) for completing the evaluation template. Otherwise, it can be ascribable to the curiosity that the product evokes in the participant. However, fragmented Exploring situations can be an index of the complexity to find relationships between product's features and what was asked in the evaluation template. If the Exploring situation has a short duration, the participant could have good knowledge of the product. If the Exploring situation is particularly long, this can be related to the capability of the product of capturing attention and/or providing much information influencing the CVP.

On the other hand, a long (short) time spent for an Answering situation can be related to the difficulty (ease) of the task and/or the need to remember previous experiences for the scopes of the evaluation. In addition, the attitude of the participant to reflect on what they saw without looking at neither the picture nor the evaluation template can be featured as a Reflecting situation [72,73].

6.2. Variables of Group B: Eye Movement

This subsection collects indicators about the voluntary or involuntary eye movements recorded during the Exploring situations, namely:

- Fixation: the keeping of the visual gaze on a single location.
- Saccade: the eye movement between two fixations.
- Blink: the phenomenon that includes the closing and reopening of the eyelids.

The above-mentioned MATLAB code recognizes time intervals corresponding to the typical duration of a blink (75–475 ms) [74,75], in which the acquisition of ocular parameters does not occur. More specifically, blinks can be characterized by an absence of pupils' data (when the eyes are closed) and a series of saccades and fixations out of the product picture (Reflecting situation) due to the reopening of the eyelids and their repositioning in the previous (or in a different) point of the picture [74].

Fixation indicators, in terms of duration and number, were obtained by elaborating *GazeEventType* data.

Saccade indicators were obtained by elaborating both *GazeEventType* and *SaccadicAmplitude* data. Interesting saccades for the scope of the experiment were those recorded on the product picture and capable of being characterized in terms of number, duration, angle (of the eyes) and speed. Therefore, all the saccades that did not take place between two fixations on the picture have been excluded by the elaboration. In addition, all the saccades adjacent to an unclassified gaze event or a fixation out of the product picture were not considered as well.

As a result, of the described elaboration, the indicators (Group B, Table 5), per participant and product, describe the eye-movement behavior during the Exploring situation.

Many studies link the fixations to the object's capability of attracting the participant's attention [34,66,76,77]. Antes [78] found that when subjects look at a picture, their eye gaze position concentrates on informative areas. Duchowski [79] and Nakatani and Leeuwen [80] highlighted that a simpler cognitive process involves fewer fixation points, whereas more fixation points feature high-level cognitive processes. Saccadic movements are related to product's complexity and exploration, while their speed is an index of attention or tiredness. Finally, blinks are ascribable to stress and tiredness.

6.3. Variables of Group C: Pupillometry

The ET software provides data about both pupils' diameter (Table 4). Therefore, it was possible to obtain data about pupils' average and maximum size and to study the dilation-constriction phenomena in a dynamic perspective in terms of number, duration, and speed. The indicators (Group C, Table 5), all of them ascribable to the Exploring situation, were then extracted. The pupils' diameters and their dynamics are proxies of information acquisition and elaboration, as well as attention and complexity [81,82].

6.4. Variables of Group D: Arousal

GSR outcomes (the last two rows of Table 4) were elaborated to assess participants' involvement. Since the GSR signal was acquired during all the situations (differently than the ET), all the phases were considered relevant for the characterization of products. The elaboration removes the tonic level (which is unrelated to arousal) to isolate the phasic level [83,84]. This enabled the identification of positive and negative peaks in the phasic level of the GSR signal, which were categorized based on the standardized value of the original normally distributed variable in the phasic level. More specifically,

the number was individuated of positive and negative peaks whose absolute values exceed the values 1, 2, and 3. The indicators (Group D, Table 5) were then extracted; they are representative of the participant's emotional involvement during the observation and evaluation of the product. The set of indicators to be used is not standard and authors' choice was based on best practices; in this respect, the authors built indicators based on the recalled guide [84].

7. Statistical Elaboration of the Indicators and Results

7.1. Phenomena Involved in Products' Observation and Evaluation

As the *Check_Comparison* variable showed consistent evaluations for all the participants, all of them were included in the sample of data to be elaborated, available in Participants_Products_Indicators.xlsx (Supplementary Material).

Then, all statistical analyses were performed through the free statistical software R [85]. Data were first screened through a series of bivariate Spearman correlations involving the whole sample of extracted indicators. When two indicators were showing correlations greater than 0.8, interpretable as almost perfect agreement according to the rule of thumb introduced by Landis and Koch [86], one of the two was discarded to facilitate following statistical processes. Such levels of agreement featured just indicators emerging from biometric data. The simplification process led to keep 35 indicators (out of 93); their list is available in Table 6, first column. Priority for keeping variables were:

- Major reliability of the data, as some of them might be affected by measurement errors and further elaborations with different degrees of robustness.
- Reference to longer time intervals, e.g., indicators relevant to the whole process have been prioritized with respect to those concerning single situations as of Section 6.1.
- Greater capability of characterizing the phenomena involved in the interaction process and participants' behavior.

The Bartlett's test was used to identify the presence of multicollinearity in the matrix of data. Given that the Bartlett's test achieved a significant value, $\chi^2(595) = 19050.42$, $p < 0.001$, variables' reduction was considered appropriate.

A Principal Component Analysis (PCA) was then performed on the 35 indicators to produce a smaller set of uncorrelated variables able to evidence the dimensions of the CVP phenomenon that could be identified in the present study. The "principal" function in R was used for the PCA, which included the whole dataset. The application of the Kaiser's criterion (keeping factors obtaining eigenvalues higher than 1.0) produced ten components. The total variance explained by the ten components was 0.68 (see Table 6). The overall data elaboration process starting with the gathering of initial variables is graphically described in Figure 2. According to indicators' loadings on the Principal Components (PCs), reported in Table 6, the PCs were interpreted as follows.

- PC1 was thought to relate to a voluntary wide exploration (VWE), given that the variables could explain the typical behavior occurring when eyes were pointing to different targets.
- PC2 identified innovative value (IV) of the products; beyond quality-related aspects and preferences, this component is characterized by the perceived presence of novel or creative aspects.
- PC3 was related to those processes occurring while consciously approaching the task (CAT).
- Curiosity- and exploration-related factors (CE) appear as determinants of PC4.
- PC5 described implicit task effort (ITE), being related to the activation of the autonomous nervous system.
- The phenomenon known as information foraging (IF) was thought to apply to PC6.
- PC7 was deemed as a descriptor of phenomena involving large pupil dilation (PD).
- PC8 was interpreted as ordinary value (OV), as opposed to PC2, which features the perceived values of products deemed original; here, indeed, knowledge and interest dimensions are fundamental dimensions for this component.

- Price overestimation (PO) was found as the main phenomenon describing PC9.
- The major factors affecting PC10 regard emotional arousal and, therefore this component was considered as Level of arousal (LA).

Table 6. Results of the PCA of indicators; the rows present the indicators and their loading to the PCs, where their absolute values are greater than 0.4; the second to the last columns present the PCs; eigenvalues and proportions of explained variance are at the bottom of the table.

Names of Principal Components →	**VWE**	**IV**	**CAT**	**CE**	**ITE**	**IF**	**PD**	**OV**	**PO**	**LA**
Indicators ↓	**PC1**	**PC2**	**PC3**	**PC4**	**PC5**	**PC6**	**PC7**	**PC8**	**PC9**	**PC10**
Saccade_avangle	1									
Saccade_avespeed	0.95									
Saccade_maxangle	0.78									
Saccade_maxspeed	0.76									
Willingness_to_Pay		0.83								
Advantages		0.80								
Preference		0.80								
Quality		0.60						0.41		
Exploring_num			0.87							
Reflecting_dur			0.79							
Blink_num			0.74							
Answering_maxdur			−0.71							
Saccade_maxdur				0.83						
Saccade_dur				0.71						
PD_dilation_maxspeed				0.68						
PD_costriction_maxspeed				−0.56						
GSR_Peaks_3plus					0.83					
GSR_Peaks_1plus					0.77					
GSR_E5_med_num					0.53					
GSR_E5_medless_num					0.49					0.42
Overall_Involvment_time					0.40					
Fixation_num						0.78				
PD_dilation_avespeed				0.58		−0.70				
Fixation_maxdur	0.48					0.54				
PD_aver							0.82			
PD_max							0.75			
Knowledge								0.72		
Novelty_Creativity		0.56						−0.63		
Absence_of_disadvantages								0.59		
Interest								0.53		
Price_error									0.88	
Price_k									0.87	
GSR_E5_low_num										0.65
GSR_E5_high_num										−0.54
GSR_E5_medplus_num										−0.49
Eigenvalues	3.73	2.86	2.96	2.9	2.36	2.24	1.97	1.85	1.59	1.51
Proportion of variance	0.11	0.08	0.08	0.08	0.07	0.06	0.06	0.05	0.05	0.04
Cumulative variance	0.11	0.19	0.27	0.36	0.42	0.48	0.54	0.59	0.64	0.68

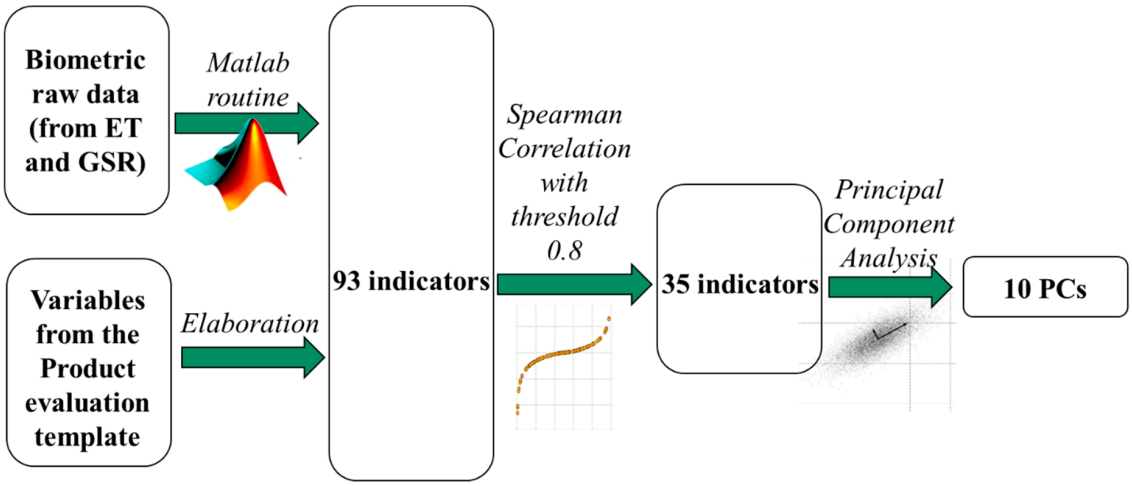

Figure 2. Simplification process leading from the gathering of results to indicators and then to PCs to characterize the phenomena underlying the CVP of GPs in the present study.

7.2. Addressing the First Research Question: Effects of Eco-design Efforts on Products' Value Perception

The set of values obtained through the PCA was collapsed into the within-subject variable named PC. Then, a mixed-effects regression model [87], fit by means of the lme4 package [88], was used to identify predictors of participants' performance. With respect to traditional regressions, mixed-effect regressions allow an evaluation of the whole structure of data in the same model. Through this analysis, it was possible to evaluate both factors of interest, as in Analysis of Variance (ANOVA), and several other continuous predictors such as either fixed or random effects, thus ensuring higher statistical power than ANOVAs and regressions. Indeed, given that standard regressions include only fixed effects, they cannot remove the amount of variance associated with random variables.

In the present mixed model fitted on data, the scaled values obtained from the PCA were used as dependent variables. The three fixed effects considered were:

- *Sustainability_ID* as a two-level factor (*Sustainability_ID1* = more sustainable product, *Sustainability_ID0* = baseline product).
- PC as a ten-level factor (the ten PCs found with the PCA).
- *Sustainability_ID* × PC interaction.

The random effects considered in the model were *Pair_ID* (to evaluate the contribution of the various families of products presented), *Order*, *Participant_ID* and *Session*.

Fixed effect parameters were interpreted as the effects of traditional regressions. The influence of every fixed effect was calculated excluding the influence of the other significant fixed effects. By following standard procedures in regressions, a main effect was kept in the analysis regardless of its significance if it was part of a significant interaction. In a pre-screening of the PC variables, the level LA was the one showing the closest values between its two levels of *Sustainability_ID* and the 0: for this reason, it was chosen for the reference estimation of the model and it appears first in Figure 3.

Consistently, the mixed-effect model performed on the components (Table 7) did not show a significant effect of GPs for the LA level. Other levels of PC differed significantly from the reference LA when keeping *Sustainability_ID* = 0: IV was lower, while OV and PO were significantly higher than LA. The interaction between PC and *Sustainability_ID* indicated that the difference between the components IF, IV and VWE with respect to the reference LA was higher in the GPs than in the baseline products, while the opposite (baseline higher than GPs) occurred in the components OV and PO. These outcomes can be visualized graphically in Figure 3 through a violin plot, which includes the distribution of the values of the PCs for baseline products and those featured by an eco-design effort. None of the other fixed effects reached the significance threshold. Conversely, all the random factors emerged as significant, indicating that that the model's goodness of fit improved by considering these sources of

variance and eliminating their contribution from those of the fixed predictors. The R^2 explained by the model was 5.5%. Even though the model converged, the low power of the model suggests that other predictors are needed to describe the variability of results.

Table 7. The following information is provided in the table: name of the term in the regression model (first column), coefficient estimate and standard error within round brackets (second column), *t*-value associated with the term (third column), *p*-values (fourth column). The number indicated close to each Random effect indicates the number of levels for each variable. The model has been computed using all responses through this formula: lmer(value ~ PC*Sustainablility_ID + (1 | Session) + (1 | Participant) + (1 | Pair) + (1 | Order), data = dataframe).

Fixed Effect Parameters	**β (SE)**	***t***	***p***
Intercept: PC = LA, Sustainability_ID0	0.011 (0.073)	0.151	0.889
PC_IV	−0.203 (0.051)	−3.998	<0.001
PC_PO	0.128 (0.051)	2.52	0.012
PC_OV	0.195 (0.051)	3.851	<0.001
PC_IF × Sustainability_ID1	0.189 (0.072)	2.629	0.009
PC_IV × Sustainability_ID1	0.408 (0.072)	5.675	<0.001
PC_VWE × Sustainability_ID1	0.162 (0.072)	2.248	0.025
PC_PO × Sustainability_ID1	−0.257 (0.072)	−3.577	<0.001
PC_OV × Sustainability_ID1	−0.393 (0.072)	−5.467	<0.001
Random Effect Parameters	**SD**		
Random effect of Participant (43)	0.165		
Random effect of Pair (20)	0.099		
Random effect of Order (20)	0.016		
Random effect of Session (2)	0.077		
Residuals	0.975		

Given the presence of factors with several levels higher than two, paired comparisons between the levels estimated by the model were necessary. For this purpose, the function *pairs(lsmeans(dataframeestimated_model, c ("PC", "Sustainability_ID"))* was used. As input, this function accepts factors produced by an estimated model and makes it possible to obtain contrasts for comparisons between pairs of levels of the aforementioned factors. Significant ($p < 0.05$) and quasi-significant ($p < 0.1$) differences, as reflected in Figure 3, were found between baseline and more sustainable products in the components below, for which estimates, standard deviations, the value of the t-test and *p*-values are also reported. For the first two PCs below, GPs exhibit higher values than baseline products; the opposite applies to the last two PCs, as inferable from the value of the β estimate.

- IV: $\beta = -0.394 \pm 0.051$; $t = -7.745$, $p < 0.001$)
- IF tended to the significance level: $\beta = -0.176 \pm 0.051$; $t = -3.452$, $p = 0.067$
- PO ($\beta = 0.271 \pm 0.051$; $t = 5.321$, $p < 0.001$)
- OV ($\beta = 0.406 \pm 0.051$; $t = 7.981$, $p < 0.001$)

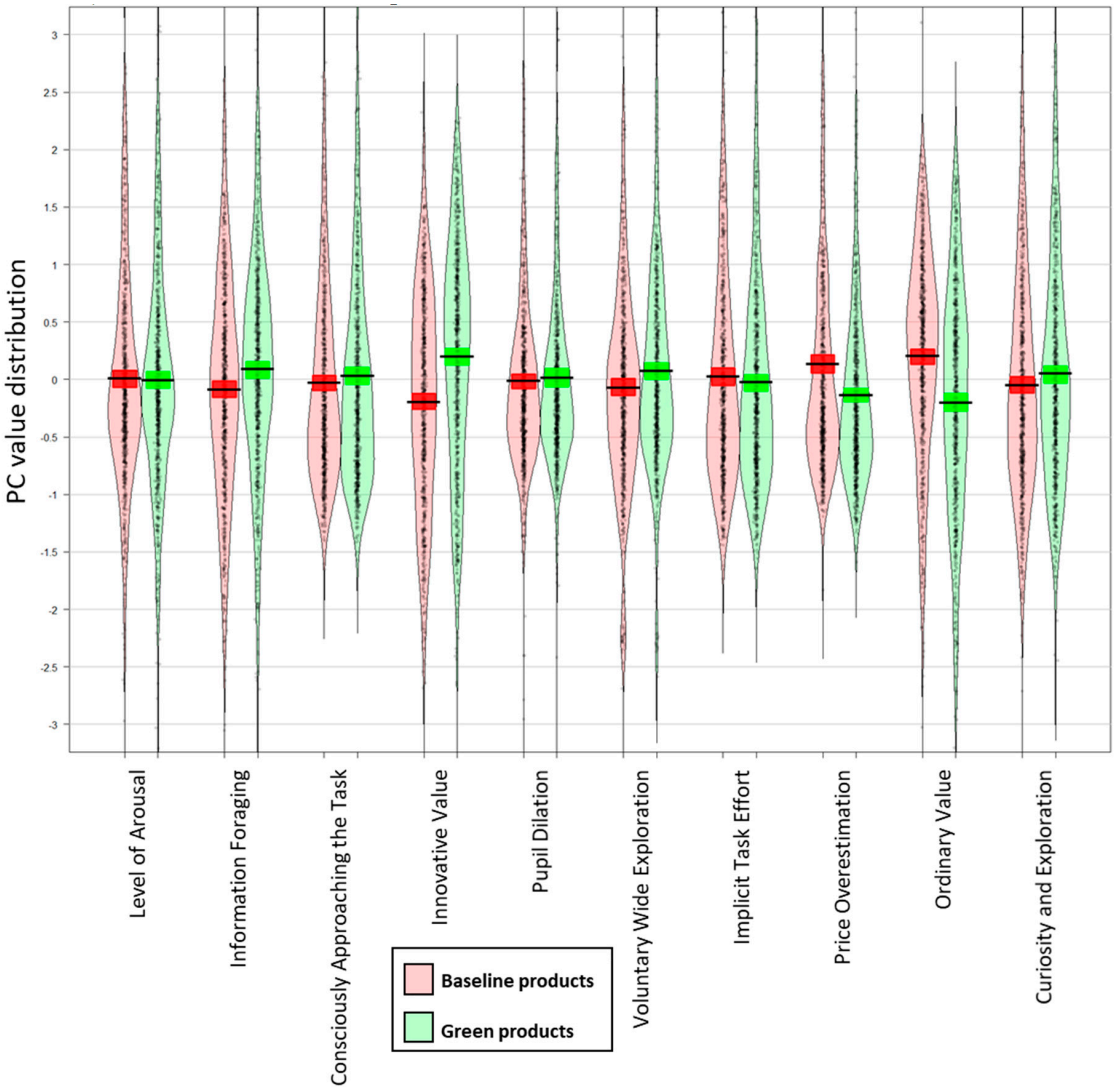

Figure 3. Scaled values estimated from the PCA, separated for the Sustainability_ID (baseline products and green products in red and green, respectively) and the PCs. Boxplots indicate median (black line) and quartiles boundaries (red and green bars). The width of the shaded area for the violin plots represents the proportion of data located there. Dots represent the values associated with each participant for each product.

7.3. Addressing the Second Research Question: Impact of Participants' Attitude Towards Sustainable Issues

The variables describing the participants' attitude to sustainability were included in the model as indicators of participants' behavior, to evaluate whether results could be influenced by the self-evaluations given by participants to several everyday situations. The data collected by the preliminary questionnaire, previously described in Section 5.3.1, and through the final questions about monthly expenditures, as in 5.5 and transformed into a variable varying from 0 to 5 consistently with the other ones, was submitted to another PCA. Its results are to be found in Table 8. The application of the Kaiser's criterion brought to the identification of five PCs, whose total variance explained is 0.70. The aim was here to disentangle the underlying predictors of sensitivity towards environmental issues from the other factors embedded in the answers. In light of this scope, the authors individuated just the first PC (*Green* hereinafter) as a potential descriptor of interest in sustainability problems—this variable somehow mirrors the concept of a higher-order factor of ecological [89] or sustainable behavior [90]. The values of this PC, which is positively correlated with almost all the variables

underlying environmental aspects, are independent from people's spending power and extent of their monthly expenditures.

Table 8. Results of the PCA of variables describing participants' attitudes; the rows present the variables and their loading to the PCs, where their absolute values are greater than 0.3; the second to the last columns present the PCs; eigenvalues and proportions of explained variance are at the bottom of the table.

Variables	PC1 (Green)	PC2	PC3	PC4	PC5
Pro-km0	0.46			0.33	
Pro-Bio_Material		−0.32	0.48		
Pro-Recycling				0.32	−0.72
Pro-Repair	0.30	−0.48			
Pro-Reuse	0.52				
Pro-Rent	0.32	0.33	0.39	−0.35	
Pro-Public_Tansport					0.60
Pro-Pay-for_Efficiency	0.44				
Family_Influence		0.40			
Monthly_Expenses_for_Consumer_Goods (transformed)		0.46		0.56	
Monthly_Expenses_for_Transport (transformed)			0.57	0.37	
Eigenvalues	2.39	1.66	1.39	1.20	1.08
Proportion of variance	0.22	0.15	0.13	0.11	0.10
Cumulative variance	0.22	0.37	0.50	0.60	0.70

Green was then chosen as a possible moderating factor in the relationship between the presence of eco-design efforts and CVP. Therefore, it was added as a continuous fixed effect to update the previous mixed-effects model. Consequently, the number of fixed predictors of the new model was six, including PC, *Sustainability_ID*, *Green*, and their interactions, while the number of random predictors remained the same as in the first model.

The second mixed-effect model (Table 9) did not show a significant effect of neither *Green* nor *Sustainability_ID* for the LA level. All random effects and the significant fixed effects for the components and the interactions found in the previous model were confirmed in the present one. In addition, a significant three-way interaction was found including Green in the IV component. Here, the slope of *Green* was positive in the GPs and negative in the baseline products (see Figure 4). The R^2 explained by the model only slightly improved with respect to the previous model, achieving a value of 5.7%. Paired comparison did not give rise to tangible differences either. The effect of green participants' attitudes had an extremely limited explanatory capability and the graphical results shown in Figure 3 do not differ perceptibly from those obtained with the new mixed model; therefore, an additional violin plot is not reported.

Table 9. The following information is provided in the table: name of the term in the regression model (first column); coefficient estimate and standard error within round brackets (second column); *t*-value associated with the term (third column); *p*-value (fourth column). The number indicated close to each Random effect indicates the number of levels for each variable. The model has been computed using all responses through this formula: lmer(value ~ PC*Sustainability_ID*Green + (1 | Session) + (1 | Participant) + (1 | Pair) + (1 | Order), data = dataframe).

Fixed Effect Parameters	**β (SD)**	***t***	***p***
Intercept: PC = LA, Sustainability_ID0, green	0.011 (0.073)	0.149	0.890
green	0.006 (0.029)	0.219	0.827
Sustainability_ID1	−0.016 (0.051)	−0.314	0.754
PC_IF	−0.094 (0.051)	−1.853	0.064
PC_IV	−0.204 (0.051)	−4.031	<0.001
PC_VWE	−0.080 (0.051)	−1.584	0.113
PC_PO	0.128 (0.051)	2.517	0.012
PC_OV	0.196 (0.051)	3.87	<0.001
PC_IF × Sustainability_ID1	0.193 (0.072)	2.681	0.007
PC_IV × Sustainability_ID1	0.413 (0.072)	5.746	<0.001
PC_VWE × Sustainability_ID1	0.162 (0.072)	2.253	0.024
PC_PO × Sustainability_ID1	−0.253 (0.072)	−3.513	<0.001
PC_OV × Sustainability_ID1	−0.389 (0.072)	−5.408	<0.001
green × PC_IV × Sustainability_ID1	0.095 (0.048)	1.995	0.046
Random Effect Parameters	**SD**		
Random effect of Participant (43)	0.166		
Random effect of Pair (20)	0.099		
Random effect of Order (20)	0.018		
Random effect of Session (2)	0.077		
Residuals	0.974		

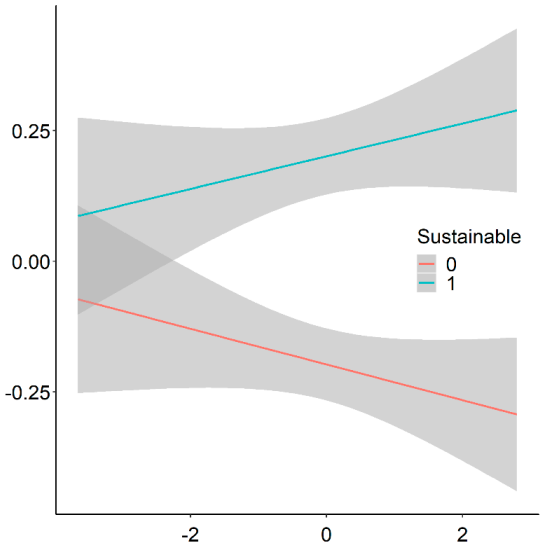

Figure 4. Estimated slopes for the PC Innovative Value (in ordinates) as predicted by Green, separated for Sustainability_ID (baseline and green products featured by the red and blue lines, respectively). The shaded areas represent the 95% confidence intervals associated with the estimated lines.

8. Discussions

8.1. Answering the First Research Question: Comments, Interpretations, and Implications

The first research question posed by the paper was intended to investigate whether eco-design efforts embodied in product affect value perception. As the experiment and subsequent data analysis have included multiple potential dimensions that characterize the CVP, the results reveal which components have been influenced by sustainable improvements.

The results demonstrate how GPs have reverse effects on different dimensions more directly ascribable to value and satisfaction, as revealed by the PCs IV and OV. According to the authors' interpretation, GPs have positively contributed to the CVP by giving rise to appreciation of aspects deemed novel and creative, but at the same time, functional, which have diffusedly resulted in preferences. In this respect, the outcomes of the study seem to confirm findings from abundant previous literature (see Section 2). However, baseline products have shown a major capability of engendering CVP by means of their acknowledged performance and absence of disadvantages; in a certain sense, they are appreciated in light of their reliability, a sort of "safe haven". It seems to emerge that many GPs have still to become established everyday objects. While they are supposedly preferred at a first instance, their choice might not be confirmed in a later stage, as remarked particularly in [33], when customers abdicate their moral responsibility and might tend to prefer common products they have already experienced and that have a satisfying quality/price ratio. Price is indeed a relevant issue emerged from the results, as participants tended to overestimate the price of baseline products rather than GPs, as revealed by the analysis of the component PO. This might imply that the knowledge of real GPs' prices could further discourage consumers from choosing the latter. As the effect of premium prices for more sustainable products has been already studied in [27], the present paper introduces further concerns, as the participants might have not sufficiently valued the environmental advantages inferable from the products' pictures.

The presence of environmental-friendly aspects in GPs has not resulted in an increased emotional involvement either based on observations on LA, PD, and CE. Indeed, despite the clear boost in IV, GPs did not induce greater curiosity and arousal than baseline products did. Previous studies reviewed in Section 2 have found how the activation of certain emotions favors the choice of GPs, e.g., [25]. This leads either to casting doubts onto previous findings or to evaluating the following competing hypotheses.

- The present experiment failed to discern the emotions taking place during products' observations. Indeed, the GSR meter enables to collect and elaborate data regarding emotional arousal but does not differentiate between pleasurable and painful emotions. In other terms, it was not possible to distinguish emotions associated with GPs and to more traditional products.
- The participants, irrespective of their orientation to sustainability issues (see the second mixed model), were not able to capture the eco-design efforts implemented in the illustrated GPs and this has prevented from strong emotional activations.

The second option individuates an open research issue, e.g., people's capability to detect sustainable advantages out of what is visible from either a real product or its picture. Previous research has found correlations between the provision of sustainability-related information and engendered emotions, e.g., [21,25]. The diverging outcomes arisen from the present study, where this information is less explicit, seem to confirm the differences caused by diverse information fashions as discussed by Du and MacDonald [66]. To investigate the ease of individuating features ascribable to eco-design, the authors plan to exploit the experiment's outputs further and analyze participants' observation of specific Areas of Interest in the pictures, which is enabled by ET results.

The presence of sustainable features resulted neutral with respect to other PCs, markedly ITE and CAT. This implies that different products have resulted in negligible differences as how participants

tackled the task they were assigned. As these components are essentially behavioral, they lend themselves to different (or complementary) interpretations:

- The products were balanced in terms of complexity, interest, or familiarity.
- The analysis of GPs did not result in changing participants' approach; the presence of (unexpected) sustainable features was not a "destabilizing" factor in participants' task.

Eventually, considerations about VWE and IF cannot be conclusive—GPs have a quasi-significant effect on the former, while they show greater values for the latter with respect to baseline products (indicatively, see Figure 3) and to the reference PC (significantly). If these effects were considered sufficiently reliable, the following implications might be derived.

- Participants have engaged in larger explorations of the pictures featuring GPs, likely due to the need to search for relevant information, to connect different pieces of information and to make sense out of them for the scopes of the experiment. This is partially in line with [33] in relation to the need to have sustainability-related information quickly to make decisions.
- GPs are characterized by a more abundant information content. Although this does not result in an increased cognitive burden, as suggested by the absence of GPs' effects on ITE and PD, the reduction of their presumable complexity might be worthwhile within CVP, especially in light of what is suggested by [24].

8.2. Answering the Second Research Question: Anything to Add to the Attitude-behavior Gap?

The second mixed model, due to the inclusion of the variable *Green*, has made it possible to explore the effects produced by individuals' sensitivity to environmental issues inferable when the use of sustainability-related terms is avoided. The mentioned attitude-behavior gap elucidates that people's interests in sustainability issues are not reflected in their consumption choices. Here, the results show how the participants' care of environmental themes has little affected their interaction with products and markedly the CVP of GPs.

The most impacted component by the presence of eco-design efforts was IV, which is a notable exception to the limited role of the *Green* variable. Significantly, "greener" participants tended to assign a larger (decreasing) innovative value to GPs (baseline products). Therefore, the association is exacerbated between sustainability aspects and value generated by original product features. Also, in light of the comments reported in Section 8.1, it emerges that some participants, though not fully capturing products' sustainability-oriented ameliorations, have greatly appreciated the benefits offered by novel aspects. Following Earl [91], this aspect is worth investigating further and seems to confirm the relationship at the personal level (and more established at the firm level) between interest in environmental problems and openness to change.

8.3. Limitations

Among the objectives of this research, great emphasis was attributed to the attempt to systematize the methodological exploration of GPs' CVP and how people's inclination for sustainable issues may affect it. In this respect, the authors' claims about the methodological limitations of previous research, highlighted in Section 2, have been overcome. This was enabled by the measures taken in the experimental design and in the subsequent statistical analysis, which was oriented to capture general phenomena taking place in people's interaction with GPs instead of focusing of few preselected ones. On the other hand, the paper's outreach was not to overcome the limitations highlighted in Section 3, namely, to present a unified theoretical framework for the systematic study of green CVP. In this sense, the presented contribution can represent an effort to facilitate the extrapolation of knowledge at the micro-level of the conceptual articulation of factors affecting the consumption of GPs presented in [92].

Other limitations follow. Although the authors strived to replicate situations people experience, this was limited to the presentation of static pictures. This choice was dictated by practical motivations

and the need to explore a large number of products and categories thereof. This has caused further limitations in terms of the selection of inducible interactions. For instance, static pictures fail to provide the full sensorial experience (tactile, olfactory and auditory) that real products do. Besides, products whose functioning and dynamic properties deliver environmental benefits could not be included in the explored sample. Experiences with services or with Product-Service Systems could not be replicated either.

As for results, data was not sufficient to clarify GPs' effects on some of the PCs, despite the extensive experiment and the time required to manage, perform it, and analyze data subsequently.

Regarding participants, the study suffers from limitations in terms of the geographic origin of involved subjects, which mirrors many of the previous studies reviewed in Section 2 and might result as a restriction for the generalizability of results.

In an eco-design perspective, results are not mature enough to elaborate guidelines for the development of products that achieve success or to support designers in the ideation of value attributes that target environmental benefits, which is not a spontaneous process [93].

9. Final Remarks, Implications, and Future Work

The paper has illustrated an experiment in which 43 participants were asked to interact with and evaluate 40 products, represented in the form of static pictures. Half of them implement eco-design principles and are here considered as a representative sample of GPs; the residual ones, indicated as baseline products, were paired to the former. The experiment gathered participants' self-assessment and measures collected through biometric instruments (a remote ET system and a GSR meter) to capture involuntary and spontaneous reactions, behaviors, and emotional activations. The design of the experiment and the subsequent data analysis targeted:

- The overall exploration of the interaction phenomenon with a particular focus on CVP.
- The understanding of the dimensions of the above phenomenon affected by the presentation of GPs.
- The understanding of the moderating role played by participants' sensitivity to environmental issues on the above relationship.

The characterization of the phenomenon captured by the experiment has been enabled by a PCA, which has elucidated the presence of ten significant and independent dimensions. Their interpretation (Section 7.1) led to the identification of different nuances of value perception, emotional, and behavioral variables. With reference to the former, value can be characterized in value for innovative solutions, value for reliable and known products, overestimated market value—these are referred to as IV, OV, and PO in the text. It emerges that while GPs engender the first nuance significantly more than baseline products, the opposite takes place for the other two dimensions. In addition, participants with a more remarked environmental sensitivity show an even greater tendency to attribute innovative value to GPs. However, this is the only significant effect played by participants' characterization in terms of interest for sustainability issues, which complements the acknowledged attitude-behavior gap. As for the behavioral characterization of the CVP phenomenon, GPs tend to make participants explore the assigned pictures more broadly. A search for information seems to take place in these circumstances and it can be inferred that the non-explicitness of information about environmental aspects resulted in a diminishment of value attributed to GPs, also in consideration of other studies in which these pieces of information were intentionally highlighted (see Section 2). This aspect has implications for product development and especially eco-design; recommendations emerge in terms of making sustainability-related information transparent and easily interpretable when designing products or their packaging. In addition, the presence of features addressing environmental benefits did not result in an increased emotional activation; this might be due to the kind of interaction that was introduced in the experiment or by participants' difficulties in capturing these features. These possible difficulties,

likely experienced also by "greener" participants, are more widely discussed in Section 8, which introduces the option of exploiting data about Areas of Interest captured by the ET system.

Other future work can be planned by the authors, based on the availability of data and further characterization of products and pictures. The following phenomena can be investigated.

- Different eco-design strategies implemented by the products might have given rise to different impacts on CVP, in line with [23]. Readers can notice that sustainable advantages exhibited by GPs (Table A2) have very different sources and motivations.
- Products can be classified in different ways, e.g. based on their reference industry, price bracket or frequency of use, and different patterns of CVP can be identified accordingly.
- Different features of the displayed products, e.g., the presence of trademarks, written information, persuasive messages, might have affected the interaction with participants as well.
- The moderating role in the creation of CVP can be studied of pictures-related aspects, e.g., presence of other objects in the background, representation of the object as in a market shelf.

Supplementary Materials: The following are available online at http://www.mdpi.com/2071-1050/11/5/1226/s1, Table: Participants_Products_Indicators.xlsx.

Author Contributions: The authors contributed equally to each one of the parts of this work

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

Appendix A

Table A1. Participants' characterization.

Participant_ID	*Gender*	*Year_of_Birth*	*Pro-km0*	*Pro-Bio_Material*	*Pro-Recycling*	*Pro-Repair*	*Pro-Reuse*	*Pro-Rent*	*Pro-Public_Tansport*	*Pro-Pay-for_Efficiency*	*Family_Luence*	*Monthly_Expenses_for_Consumer_Goods*	*Monthly_Expenses_for_Transport*	*Check_Comparison*
ID	M/F	Year	0–5	0–5	0–5	0–5	0–5	0–5	0–5	0–5	0–5	€	€	0–5
1	M	1991	0	5	4	3	5	0	0	3	1	200	150	5
2	M	1989	4	1	4	2	4	2	4	5	2	500	200	5
3	F	1983	5	0	4	4	5	2	5	4	4	400	70	5
4	M	1992	5	5	5	3	5	2	5	5	3	400	30	4
5	M	1989	3	0	2	1	4	0	3	4	3	350	100	5
6	F	1983	0	4	1	2	1	1	3	4	5	200	50	5
7	M	1977	4	0	3	3	5	2	3	5	4	750	90	5
8	F	1990	4	1	4	2	4	1	3	4	2	300	150	5

Table A1. *Cont.*

Participant_ID	*Gender*	*Year_of_Birth*	*Pro-km0*	*Pro-Bio_Material*	*Pro-Recycling*	*Pro-Repair*	*Pro-Reuse*	*Pro-Rent*	*Pro-Public_Tansport*	*Pro-Pay-for_Efficiency*	*Family_Luence*	*Monthly_Expenses_for_Consumer_Goods*	*Monthly_Expenses_for_Transport*	*Check_Comparison*
ID	M/F	Year	0–5	0–5	0–5	0–5	0–5	0–5	0–5	0–5	0–5	€	€	0–5
9	F	1985	4	5	4	3	5	3	4	4	4	350	100	5
10	M	1977	3	1	4	4	4	1	1	4	4	300	250	4
11	M	1979	4	4	3	3	5	1	5	4	3	250	40	4
12	F	1992	2	1	5	3	5	3	4	5	5	300	100	5
13	F	1997	4	1	3	3	4	3	4	5	2	80	60	4
14	M	1995	4	0	1	4	5	0	5	4	3	100	45	4
15	F	1982	0	5	2	2	4	2	5	4	5	400	200	5
16	F	1985	3	5	5	1	4	4	3	5	5	450	300	4
17	F	1987	3	2	2	3	4	1	4	4	3	250	30	4
18	M	1982	2	4	3	4	4	1	1	4	5	200	70	5
19	M	1991	2	4	3	3	4	2	4	3	1	200	35	4
20	M	1987	2	2	4	2	4	2	4	4	2	550	150	4
21	M	1977	4	4	5	3	5	2	5	5	4	280	3	4
22	M	1992	4	4	4	3	4	3	5	4	3	300	200	5
23	M	1987	4	5	2	5	5	0	5	4	0	200	180	3
24	M	1996	5	0	5	4	5	3	4	5	5	60	20	5
25	F	1996	2	0	3	1	3	1	5	4	4	500	17	4
26	M	1992	5	0	4	2	5	5	4	5	4	100	50	4
27	M	1996	4	1	5	2	3	1	1	4	3	150	40	4
28	F	1991	5	4	5	4	5	1	5	5	2	250	50	5
29	M	1982	4	3	4	1	2	2	3	3	2	300	250	5
30	M	1995	5	2	5	4	5	2	4	5	4	350	50	5
31	F	1973	4	4	3	2	4	1	4	4	4	400	350	5
32	M	1989	3	3	3	3	3	3	5	3	1	250	150	5
33	M	1993	2	3	4	3	4	1	3	2	3	150	150	5
34	F	1988	3	0	3	4	5	1	5	3	5	500	40	5
35	F	1983	1	0	5	2	1	1	5	2	5	800	70	4
36	M	1988	2	2	4	2	2	1	4	3	4	400	110	5
37	M	1994	4	1	5	4	5	1	5	4	1	600	230	3
38	F	1998	1	1	4	2	5	5	4	5	1	50	15	5
39	F	1998	3	3	4	5	4	2	2	3	3	80	15	4
40	F	1994	5	3	4	4	3	0	3	2	4	320	50	3
41	F	1998	4	3	2	4	4	4	4	5	4	200	350	4
42	F	1998	4	0	2	3	5	3	5	4	5	225	15	3
43	F	1997	3	1	5	3	5	3	4	3	3	100	200	4

Table A2. Products Pairs.

Pair_ID	Sustainability_ID		Eco-Design Effort
	0	1	
	Baseline Products	**Sustainable Products**	
A	 Disposable single-server butter	 Disposable single-server butter that includes a wooden spoon lid	The cap has been made with a less toxic and biodegradable material; its design avoids the use of an additional spoon (to be thrown away or washed).
B	 Washing-Up Liquid	 Eco-Refill for Washing-Up Liquid	With the "refill solution", 78% less plastic for the packaging is used; the solution encourages to keep the "more robust" container previously purchased, thus fostering reuse and reducing waste
C	 Liquid laundry detergent in a plastic packaging	 Concentrated washing powder in a cardboard packaging	The solid detrgent can be contained in a biodegradable cardboard package instead of a plastic one. The shape of the right-hand side product optimizes transport and storage. It contains a concentrated detergent, which reduces the use of water.
D	 Honey gift box with "excessive" use of packaging	 Honey gift box with "optimized" use of packaging	The "excessive" packaging on the left-hand side shows an abundant use of material, especially in consideration of the amount of honey contained. This has been optimized in a more sustainable solution.

Table A2. *Cont.*

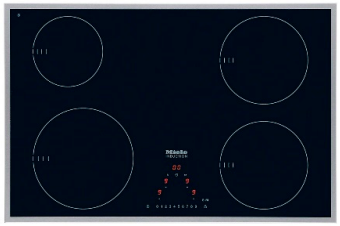
Pair_ID	Sustainability_ID		Eco-Design Effort
	0	1	
	Baseline Products	**Sustainable Products**	
E	 Liquid printing toners in plastic containers	 Solid printing toners without containers	The solid printing toner does not require packaging
F	 Toilet paper	 Toilet papers without cardboard tube	The absence of the cardboard tube reduces the amount of waste produced and material employed
G	 Disposable Razors	 Razor with interchangeable blades	Since the only part of the razor subject to wear is the blade, the right-hand side solution makes it possible to replace the blades only. This results in the diminishment of waste.
H	 Gas cooker	 Induction cooker	The induction cooker determined an improvement in terms of toxic emissions inside the kitchen.

Table A2. *Cont.*

Pair_ID	Sustainability_ID		Eco-Design Effort
	0	1	
	Baseline Products	**Sustainable Products**	
I	 Coffee cup	 Edible coffee cup	The edible product avoids waste at the end of its life and using energy and materials for washing cups.
L	 Milk produced more than 1000 km away from the place of the experiment	 Milk produced locally	Local products drastically reduce emissions for their transportation.
M	 Disposable handkerchiefs	 Washable handkerchiefs	The "Washable handkerchiefs" solution enable reuse and reduction of waste.
N	 Disposable batteries	 Rechargeable batteries	Rechargeable batteries drastically reduce the amount of toxic waste compared to disposable ones

Table A2. *Cont.*

Pair_ID	Sustainability_ID		Eco-Design Effort
	0	1	
	Baseline Products	Sustainable Products	
O	 Battery torch	 Hand-powered torch	The hand-powered torch does not require batteries and, therefore, it does not produce any toxic waste during its lifecycle.
P	 Toothbrush	 Toothbrush with interchangeable bristles	Since the only part of the toothbrush subject to wear is the bristles, the right-hand side solution makes it possible to replace the bristles only. This results in the diminishment of waste.
Q	 Gasoline car	 Electric car	Electric mobility has advantages in terms of local toxic emissions
R	 Water bottle	 Space-saving water bottle	The space-saving water bottle is made entirely with the same non-toxic material. Since the occupied space (when empty) is about half of the classic ones, this leads to an optimization during the transportation phase, which reduces the environmental impact

Table A2. *Cont.*

Pair_ID	Sustainability_ID		Eco-Design Effort
	0	1	
	Baseline Products	Sustainable Products	
S	 Liquid shampoo in a plastic container	 Solid shampoo in a paper container	Solid shampoo does not require plastic packaging. Its packaging is made of a biodegradable material
T	 Couch	 Inflatable couch	The inflatable couch minimizes the consumption of material because the padding is replaced with air. This leads to an optimization during the transportation phase, which reduces the environmental impact. The appropriate dimensioning leads to a comparable duration of the product.
U	 Hazelnut chocolate	 Hazelnut chocolate with packaging reusable as a glass	The container shaped like a glass stimulates the user to reuse it (with a different function) instead of throwing it away.
V	 Eggs in plastic packaging	 Eggs in cardboard packaging	The cardboard packaging has evident advantages in terms of environmental sustainability compared to the plastic ones.

Table A3. Preliminary questionnaire example.

Variables Investigated (Hidden in the Material Provided to Participants) with the Form of the Statement in Brackets (Where Applicable)	You Have to Answer by Marking the Level of Agreement that You Have with Each of the Following Statement	Disagreement					Agreement
Pro-Repair (Negative)	I prefer to buy a new product rather than repairing it or having it repaired	0	1	2	3	4	5
Check_Comparison	I prefer to rely on a travel agency rather than organizing holidays myself	0	1	2	3	4	5
Pro-Pay-for_Efficiency (Positive)	I am in favor of paying a higher price to get a product with better energy efficiency	0	1	2	3	4	5
Misleading Statement	I am in favor of introducing a single ticket for transport, museums, and cinema	0	1	2	3	4	5
Pro-Bio_Material (Negative)	I am against paying a premium price for using biodegradable materials	0	1	2	3	4	5
Misleading Statement	I am against paying a premium price to choose a seat on the plane	0	1	2	3	4	5
Pro-Reuse (Positive)	I prefer washable and reusable products to disposable ones	0	1	2	3	4	5
Misleading Statement	I prefer to do the housework myself rather than entrusting someone else with doing it	0	1	2	3	4	5
Pro-Recycling (Negative)	I think it is frustrating to separate waste correctly	0	1	2	3	4	5
Misleading Statement	I think it is difficult to fully adapt to local ways of living when I visit a foreign country	0	1	2	3	4	5
Pro-Public_Tansport (Positive)	For my journeys, I gladly use public transport (train, bus) or alternative means of transportation (walking, cycling) instead of the car	0	1	2	3	4	5
Family_Influence	I contribute to the choice of products purchased by the family to a considerable extent	0	1	2	3	4	5
Pro-Rent (Negative)	I prefer to own a product rather than renting it, even when there is this possibility	0	1	2	3	4	5
Misleading Statement	I prefer to buy a product online rather than buying it in the store	0	1	2	3	4	5
Pro-km0 (Positive)	I prefer to use local products (even if more expensive) than those that come from other parts of the world (even if cheaper)	0	1	2	3	4	5
Misleading Statement	I prefer products of famous brands (even if more expensive) than unknown ones (even cheaper ones)	0	1	2	3	4	5
Check_Comparison	I prefer to organize my holidays autonomously without relying on agencies	0	1	2	3	4	5

Table A4. Price Elaboration.

Pair_ID	Sustainability_ID	Real Price (€)	Average of Estimated_prices	Standard Deviation of Estimated_prices	Skewness of Estimated_prices	Kurtosis of Estimated_prices	Bias%	Web References
A	0	0.17	0.70	0.65	1.95	3.96	310.76	A0
A	1	0.95	1.19	1.64	4.20	21.53	25.53	A1
B	0	1.59	3.29	1.66	1.91	5.60	106.83	B0
B	1	2.59	3.88	1.78	1.08	1.83	49.76	B1
C	0	10.90	5.63	2.94	2.05	6.52	−48.34	C0
C	1	13.00	6.91	2.99	1.04	1.55	−46.87	C1
D	0	46.00	43.72	57.39	3.49	13.58	−4.96	D0
D	1	56.00	63.43	36.97	1.20	0.88	13.27	D1
E	0	252.00	41.83	34.97	2.61	9.44	−83.40	E0
E	1	426.00	53.45	49.67	1.69	2.98	−87.45	E1
F	0	1.50	3.35	1.18	0.65	−0.19	123.30	F0
F	1	3.26	3.04	1.25	0.87	1.54	−6.68	F1
G	0	1.99	2.17	1.30	2.63	10.99	8.83	G0
G	1	17.46	7.54	5.48	2.13	6.07	−56.79	G1
H	0	629.00	391.43	426.66	3.49	15.03	−37.77	H0
H	1	1399	506.07	526.09	3.05	11.69	−63.83	H1
I	0	2.40	1.60	1.17	2.14	3.49	−33.54	I0
I	1	1.80	1.57	0.99	0.69	0.36	−12.78	I1
L	0	0.50	1.32	0.63	0.81	0.64	163.49	L0
L	1	1.40	1.48	0.57	2.23	8.20	5.78	L1
M	0	3.25	4.71	5.38	2.94	11.12	44.83	M0
M	1	3.30	3.15	2.84	2.26	6.87	−4.58	M1
N	0	2.80	4.96	1.96	0.73	0.66	77.31	N0
N	1	12.19	7.77	4.40	1.47	2.28	−36.29	N1
O	0	14.99	10.86	8.96	2.54	8.19	−27.57	O0
O	1	6.99	8.96	11.08	4.45	22.94	28.24	O1
P	0	8.80	3.45	7.42	6.15	39.22	−60.79	P0
P	1	10.50	7.13	5.61	1.28	0.74	−32.11	P1
Q	0	26000	24284	18431	3.66	17.87	−6.60	Q0
Q	1	40100	28057	11371	0.22	−0.87	−30.03	Q1
R	0	1.98	4.36	3.00	1.48	3.02	120.39	R0
R	1	10.95	4.66	3.81	1.87	5.09	−57.41	R1
S	0	15.80	5.99	3.91	1.39	1.21	−62.08	S0
S	1	9.95	5.27	2.44	0.53	−0.75	−47.08	S1
T	0	2000	534.76	487.90	2.58	8.36	−73.26	T0
T	1	91.00	101.07	159.98	4.72	25.87	11.07	T1
U	0	5.19	3.99	1.37	0.53	0.75	−23.12	U0
U	1	2.59	3.12	1.11	1.65	4.62	20.49	U1
V	0	1.19	2.78	2.26	4.12	21.28	133.63	V0
V	1	2.50	2.50	1.03	1.10	2.08	0.07	V1

Table A4. *Cont.*

Product	Web Reference
A0	https://www.menz-gasser.it/product/burro-darachidi/
A1	http://www.yankodesign.com/2010/10/29/four-flavored-butter-spoon/
B0	https://ipersoap-online.com/detergente-piatti-lime-e-fiori-di-mela.html?gclid=CjwKCAjwkMbaBRBAEiwAlH5v_v55dpRsWZNVI_MblYyClzAMX7adgziul2HRAGEqFT6riAhBUk0dYBoCvoYQAvD_BwE
B1	https://www.ecomarket.bio/winni-s-winnis-detersivo-piatti-lime-fiori-mela-ecoricarica.html
C0	http://shop.vjsm.com.mt/fabric-care/dash/liquids/dash-liquid-regular-50-washes-3-25l/
C1	https://www.amazon.it/Actilift-Polvere-Detersivo-Lavatrice-Bucato/dp/B07BYR84NC/ref=sr_1_10?ie=UTF8&qid=1532094348&sr=8-10&keywords=dash+actilift
D0	https://competition.adesignaward.com/design.php?ID=53557
D1	https://www.behance.net/gallery/11750165/Hexagon-Honey
E0	https://www.lelong.com.my/fuji-xerox-docuprint-1190-cmyk-color-toner-cartridge-refill-wanyang-I1267620-2007-01-Sale-I.htm
E1	https://www.amazon.com/Xerox-108R00926-108R00927-108R00928-
F0	https://www.amazon.com/Scott-Naturals-Bath-Tissue-Rolls/dp/B008O2TONK
F1	https://www.walmart.com/ip/Scott-Tube-Free-Unscented-Bathroom-Tissue-4-Rolls/28201249
G0	https://www.amazon.it/GILLETTE-MACH3-USA-GETTA-3PZ/dp/B001ULCU6K
G1	https://www.amazon.it/Gillette-Mach3-Turbo-uomini-Rasoio-lamette/dp/B0000TZA2E
H0	https://shop.miele.it/piani-cottura-km-2010-7111110/
H1	https://shop.miele.it/piani-cottura-km-6118-7768020/
I0	https://capsulecaffe.netsons.org/p/tazzine-caffe-lavazza-in-porcellana-12pz/
I1	https://www.greenme.it/mangiare/altri-alimenti/8322-cookie-cup-le-tazzine-commestibili-di-lavazza
L0	https://irp-cdn.multiscreensite.com/a1808cc2/files/uploaded/18E12P%20%283%29.pdf
L1	http://www.lafontesnc.it/latte/213-latte-mila-intero-1-litro.html
M0	http://www.ilpapiroweb.it/?art=12-055086
M1	https://www.colombomilano1911.com/shop/accessori-moda-classici/fazzoletti-di-stoffa-da-uomo/cervinia-rigato-fazzoletti-con-righe-sfumate/
N0	https://www.buttasu.com/batterie-monouso/21-batterie-monouso-duracell-plus-power-ministilo-aaa-alkaline-1-blister-da-4-batterie-5000394038141-5000394038141.html
N1	https://www.amazon.it/Duracell-Rechargeable-Battery-Batteries-81364750/dp/B003B00484
O0	https://www.amazon.fr/Duracell-CMP-6C-Lampe-Torche-LED/dp/B00TU34MFM
O1	https://www.decathlon.it/lampada-torcia-dynamo-100-id_8204085.html
P0	https://it.aliexpress.com/item/Crest-Sensitive-Gum-Care-Toothbrush-Complete-Deep-Clean-Soft-Bristles-Tooth-Brushes-Twin-Pack-Teeth-brush/32692601388.html
P1	https://www.amazon.it/Silver-Care-NERO-antibatterico-intercambiabile/dp/B073B8JHMS/ref=sr_1_3?ie=UTF8&qid=1531751325&sr=8-3&keywords=silver+care+on
Q0	https://www.motortrend.com/cars/volkswagen/gti/2010/2010-volkswagen-gti-first-drive/
Q1	https://www.quattroruote.it/listino/volkswagen/e-golf
R0	https://www.bsigadget.com/product/54N1439-borraccia_sportiva___iskan.html
R1	https://www.squeasy.es/producto/botella-de-agua-personalizable/
S0	https://www.lushusa.com/hair/shampoo/rehab/02010.html
S1	https://it.lush.com/products/shampoo-solidi/new
T0	http://catalogo.living.corriere.it/catalogo/prodotti/E-De-Padova/Yuva.shtml
T1	https://www.ebay.it/itm/Vango-Inflatable-Settee-Camping-Furniture/292082845881?hash=item44017e88b9:g:7FUAAOSwuLZY7MFP

Table A4. *Cont.*

Product	Web Reference
U0	https://www.prontospesa.it/negozio/prodotto.asp?CodProd=41668&Menu=Dispensa&IdCat=30
U1	https://www.prontospesa.it/negozio/prodotto.asp?CodProd=252&Menu=Dispensa&IdCat=30
V0	https://www.quiconviene.it/spesa-consegna-domicilio/98121/uova_161?sort=asc
V1	https://www.luovo.bio/le-nostre-uova/

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