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Do Consumers Really Want to Reduce Plastic Usage? Exploring the Determinants of Plastic Avoidance in Food-Related Consumption Decisions

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Abstract: The mass production and use of plastics over the past decades is now posing a threat to the environment due to increasing pollution. The industrial transition towards more sustainable plastic alternatives has already started, but the process will require years to become truly feasible from an industrial and economic standpoint. In the meantime, a significant contribution to limit plastic-related environmental impact could arise from consumers' daily consumption choices. This study aims at investigating the determinants of consumers' decision to avoid purchasing single-use plastic eating utensils, food products with multiple plastic packaging, and plastic water bottles while grocery shopping. The results of the Structural Equation Model reveal that environment- and health-related concerns associated with plastics are key drivers of plastic avoidance. Instead, subjective knowledge and the importance attached to the commitment of third parties for tackling the plastic issue only indirectly affect consumer behaviors with regard to plastic avoidance.

Keywords: plastic pollution; food packaging; water bottles; consumer behavior; Structural Equation Model; environmental concern; subjective knowledge; pro-environmental behaviors

1. Introduction

Over the last seventy years, plastic production has constantly increased [1]. Because of their low cost, durability, ductility, and the possibility of being easily added with other elements to enhance their properties, plastic materials currently find application in a wide range of industries. Plastics are now everywhere and constitute objects that are massively used in our everyday life [2]. Despite their anticipated benefits, the mass use of plastics is now posing a threat to the environment [3,4]. Geyer et al. (2017) reported that, as of 2015, only a limited share of all plastic waste has been recycled or incinerated, while nearly 80% has been disposed in landfills or accumulated in the natural environment [5].

Currently, the packaging industry represents the first industry of destination for plastic materials, absorbing about one-third of the worldwide plastic production [1]. Of this, the packaging destined to the food system represents a sizable share [6]. Plastic food packaging is suitable to preserve foods from deterioration, maintaining their properties and quality, while also extending the product shelf life [7]. In the past years, some health concerns related to the possibility that plastics may release residuals in food have been raised both from consumers and from the scientific world. The case of Bisphenol A represents a well-known example [7]. However, the use of these components is strictly disciplined at the EU level and the allowed residual levels in food products amply guarantee public safety [8]. As such, plastic materials are safely used for food packing, and the projections suggest that their usage is expected to quadruplicate within the next 30 years [6]. Plastic materials are extensively used in the food context also for the production of single-use cutlery, dishes, cups (referred to as plastic eating

utensils in the following pages), and water bottles [9]. To date, because of their widespread usage and their inadequate disposal, these objects represent almost 50% of the European litter in coastal areas [10].

In recognition of the negative impact of plastic contamination on the environment, the European Union started making some steps forward for improving plastic management through the adoption of targeted policy guidelines and measures. A first concrete step in this direction was undertaken in 2015 with the EU Circular Economy Action Plan, including the guidelines for "adopting a material-specific lifecycle approach to integrate circular design, use, reuse, and recycling activities into plastics value chains". The Circular Economy Action Plan laid the foundation for the subsequent EU Strategy for Plastics (2018) [10,11]. The latter, representing the first European plastic-specific policy, stressed the need for innovation in plastic production. The Strategy for Plastics highlighted the urgency to boost research developments in bioplastics and proposed a multi-stakeholder engagement, inviting producers for voluntary pledges geared at improving plastics management [10]. More recently, the Directive (EU) 2019/904 of the European Parliament and of the Council "on the reduction of the impact of certain plastic products on the environment" [12] signed a further step forward for tackling the plastic issue. The directive established that single-use plastic objects made with certain pollutant plastic materials must be banned from the market by 2021 [12], thus pushing the industry towards their substitution with more sustainable materials. In this regard, firms have already started exploring possible alternatives to petroleum-based plastics. Of these, biopolymers (i.e., bioplastics) probably represent the most promising materials, some of which are already available on the market. However, their mass production and use will require years to become truly feasible from an industrial and economic point of view [6,13,14]. In essence, the EU policies have laid the groundwork for a more stainable usage of plastic materials, but the transition process will require a long time.

In the meantime, a significant contribution could arise from consumers' daily consumption choices. If people diminish their purchase and usage of plastic objects, they could partly alleviate plastic-related environmental pressure, accompanying the industrial transition without producing further pollution. This can be done, for instance, by replacing single-use plastic objects with reusable ones, avoiding purchasing products with multiple packaging, or choosing items with no packaging at all. Consumers' decision to limit their purchase and use of plastics can be described as a pro-environmental behavior (PEB), that is a voluntary action geared at contributing to environmental preservation and/or conservation [15]. Many studies in the past have investigated the determinants of consumers' decision to engage in various PEBs, such as recycling [16], energy conservation [17], and organic food consumption [18]. However, to date, very few have specifically focused on consumers' avoidance of plastic objects, especially in the food context.

This paper attempted to fill this gap by exploring the drivers that lead consumers to avoid plastics while grocery shopping. In detail, building on past literature on PEBs, we conducted an exploratory analysis based on a Structural Equation Modeling approach to investigate whether plastic-related concern, knowledge, and the importance attached to the commitment of third parties for tackling plastic-related environmental impact can affect the extent to which people avoid purchasing single-use plastic eating utensils, foods with multiple plastic packaging, and plastic water bottles. The focus on these objects was motivated at least by two main reasons. Firstly, as mentioned above, these objects currently represent the main sources of plastic leakage in the environment. In such context, plastic water bottles represent the most ubiquitous items. Their market is growing faster than ever and the projections indicate that it will further expand in the future [19], which makes them a key target to hit. Secondly, food is purchased with daily frequency. This implies that consumers' avoidance of plastics while grocery shopping could significantly contribute to reducing plastic leakage and its related impact.

The results of the present study provided useful insights for future consumer-based studies on plastics and offer cues for reflection for developing effective communication strategies and policies geared at redirecting consumer behaviors towards a more thoughtful and less impacting use of plastics, at least in the food context.

The present paper is structured as follows: Paragraph 1.1 describes the literature background for the study and the hypotheses development, Section 2 illustrates materials and methods used for the study, Section 3 shows the results obtained, and Section 4 provides with the discussion of results.

Literature Background and Hypotheses Development

Consumer decision to avoid plastic objects, which was the target behavior of this paper, can be conceptualized as a PEB. This term refers to any practice (such as purchasing, use, post-use, management, activism behaviors) that consciously seeks to limit the impact of human activities on the environment [20–22]. Pro-environmental behaviors involve a number of different targets, such as reducing greenhouse gas emission, reducing water and energy consumption, recycling, therein including the reduction of plastic use. Accordingly, the hypotheses to be tested in this paper were developed within the PEBs framework.

Many studies in the past have investigated the reasons why people engage (or do not) in several PEBs, approaching this issue from different perspectives. For instance, previous studies in the psychology field focused on the role of individual altruism [22]. Other studies recognized individual love of nature, beliefs and attitudes, childhood experience, lifestyles and habits as possible drivers of PEBs [22–26]. Among others, consumers' environmental and health-related concerns have emerged as key factors in influencing PEBs. Environmental concern relates to the extent to which consumers worry about the possible negative consequences that unsustainable consumption patterns can exert on the environment [22,27,28]. Health concern, instead, relates to possible negative effects for human health. As reported in previous studies, both environmental and health concern are associated with plastic usage. Indeed, consumers perceive plastic litter, waste, and pollution as problematic and threatening both for the terrestrial and the marine environment [29–31]. At the same time, plastic pollution is perceived as risky for human health due to possible contamination of air, water, and also food [32–34]. In this regard, past findings demonstrated that consumers worry that plastics may release contaminants in food. When so, the perceived quality of the product is reduced and health-related risk perception increases [34–38]. Overall, the results of these studies indicated that the higher the concern, the higher the likelihood of actively engaging in sustainability-oriented behaviors [23,39–41]. Based on such evidence, the first hypothesis of the study was formulated as follows:

Hypothesis 1 (H1). *The higher the consumer plastic-related concern, the higher the probability that they avoid purchasing single-use plastic eating utensils, plastic water bottles, and food with multiple plastic packaging.*

Alongside environmental and health concern, also knowledge plays an important role in driving individual behaviors. Most of past studies on PEBs specifically focused on environmental knowledge (i.e., how much people are knowledgeable about specific environmental issues) and highlighted that it is positively associated with the extent to which people engage in PEBs [16,22,23,39–41]. Their findings indicated that when consumers are knowledgeable about a specific environmental problem, they are also more likely to behave sustainably in that specific regard [21,42].

When dealing with the role of knowledge in driving behaviors it is common to refer to two different constructs, namely the objective knowledge and the subjective knowledge. The former reflects the extent to which an individual accurately and objectively knows the specificities of a certain issue, while the latter represents how much he/she thinks to know about that topic. There is still debate in the literature on whether objective or subjective knowledge mostly affect PEBs [16,43,44]. However, several studies suggested that subjective knowledge is a better predictor of both pro-environmental intentions and behaviors. Such evidence emerged in past research involving different PEBs such as recycling behavior [16], energy conservation behaviors [17], and organic food consumption [18]. On these grounds, the second hypothesis of this work was formulated as follows:

Hypothesis 2-1 (H2-1). *The higher the consumers' subjective knowledge about plastic-related issues, the higher the probability that they avoid purchasing single-use plastic eating utensils, plastic water bottles, and food with multiple plastic packaging.*

As for the role of knowledge, there is another aspect to highlight. While some studies considered environmental knowledge as a pre-requisite for engaging in PEBs [45], others described it as a necessary but not-sufficient condition "per se" to behave sustainably [42]. At present, this latter approach is increasingly accepted. In fact, evidence demonstrate that in many cases environmental knowledge does not directly increase PEBs. Instead, it positively affects the extent to which individuals act sustainably by influencing other variables, such as emotional engagement, values, attitudes, awareness, as well as concern [17,18,21,46].

Based on such evidence, and following the rationale of H1, it was hypothesized that:

Hypothesis 2-2 (H2-2). *The higher the subjective knowledge about plastic-related issues, the higher the plastic-related concern.*

A further peculiar characteristic of PEBs is that they are not just related to an individual dimension, but they are also strongly associated with a social dimension. Firstly, environmental sustainability can only be achieved as the result of a common commitment involving the society at different levels [10]. Not only citizens are called to do their part, but also scientist, policy makers, and industries. For instance, with specific regard to plastics, policy makers are called to set the guidelines and rules for a more sustainable production and consumption system [47–49], while consumers should act together in a sustainability-oriented manner with their daily behaviors and consumption decisions. At the same time, the industrial sector must reduce plastic use and provide consumers with innovative products and tools, which can enable them to behave sustainably in their everyday life [47]. In fact, the actions of a single individual can only have a very limited impact in increasing environmental sustainability. Instead, they assume an essential role when other members of the society act in the same direction and share the same commitment for the environmental cause [50]. When so, the collective effort is rewarded with increased social welfare, because the benefits deriving from sustainability-oriented behaviors are shifted on the society as a whole [48]. In such context, the extent to which individuals engage in PEBs is strongly affected by what others do [50–53]. Past studies demonstrated that people may lose their motivation to engage in PEBs when they perceive that they are the only that behave sustainably. In other words, "Why should I if no-one else does?". The latter motivation has been reported by Prabawa-Sear and Baudains (2011) as a key discouraging factor for undertaking PEBs [54].

Building on such evidence, the following was hypothesized:

Hypothesis 3 (H3). *The importance attributed to the commitment of third parties for tackling plastic-related environmental impact affects the extent to which individuals avoid purchasing single-use plastic eating utensils, plastic water bottles, and food with multiple plastic packaging.*

2. Materials and Methods

2.1. Data Collection

The data for the analysis were collected by means of a consumer survey carried out in the metropolitan area of Milan (northern Italy) during spring 2019. Before collecting the data, a pilot study was conducted on a small sample of 40 respondents in order to test the appropriateness of the questions and the length of the survey. Consumers were approached face-to-face by the researchers following a random sampling approach. They were verbally informed about the aim of the survey and then invited to respond to the questionnaire. All invited respondents were informed that the questionnaire was anonymous and that the data were used exclusively for research purposes. After agreeing to

participate, they received from the researchers a brief explanation about the type of questions involved and the related response scales. Respondents were then allowed to fill the questionnaire autonomously and to deliver it to the researcher after responding. Only people older than 18 years old (i.e., the legal age in Italy) were considered eligible for the survey. Totally, 520 adult consumers were approached. The final sample resulted in 441 complete questionnaires, after screening for incomplete answers. The ad hoc questionnaire formulated for this study was composed by five sections, respectively aimed at investigating plastic-related behaviors and at eliciting respondents' plastic-related concern, subjective knowledge, the importance attributed to the commitment of third parties for tackling the plastic issues. One additional section was dedicated to the main sociodemographic and economic variables. The order of presentation of the sections was randomized to overcome potential ordering bias (integral version of the questionnaire available upon request.).

2.2. Analytical Approach

A Structural Equation Modeling (SEM) approach was used to test the hypotheses described in Section 1. The SEM is a multivariate statistical method that is based on the combination of factor analysis and multiple regression analysis. It is extensively applied in many social, educational, and behavioral research fields to simultaneously analyze structural relationships (i) among exogenous measured variables (i.e., indicators) and the related endogenous latent constructs (i.e., variables that do not have observed/manifest realization in the sample population), as well as (ii) among the latent constructs and the dependent variable in the model [55–57].

The SEM can be described as in Equation (1):

$$\eta = B\eta + \Gamma\xi + \zeta \quad (1)$$

where ξ is a column vector of n exogenous latent variables, and η is a column vector of m latent (endogenous) variables. B is a matrix of coefficients associated with the latent constructs, and ζ the remaining error terms associated with them. The measurement equations take the following form:

$$y = \Lambda y\, \eta + \varepsilon \quad (2)$$

$$x = \Lambda x\, \xi + \delta \quad (3)$$

where $y_{(p\times1)}$ and $x_{(q\times1)}$ are the column vectors of the p-measured endogenous variables and q-measured exogenous variables, Λy and Λx are the associated factor loadings matrices, and ε and δ are the remaining uncorrelated error terms.

Subsequent analytical steps were followed to perform the SEM. The first step consisted in defining the latent constructs to be included in the model. Each latent construct was expressed by a set of related measured variables (or indicators). To define each latent, a factor analysis was performed on the related measured variables. Then, a confirmatory factor analysis was used to select the indicators that better expressed the latent construct. The relationship between the aforementioned constructs was then explored through a mediation analysis aimed at unveiling possible indirect relationship across the latent constructs. The final SEM was performed by taking into account the mediation results.

2.3. Measures

The questionnaire used for the data collection was developed to measure the latent constructs included in the model, named PL_BEHAV, representing the dependent variable of the SEM, PL_CON, SUBJ_KN, and SHRD_COMM. The questionnaire also included questions to elicit the sociodemographic and economic characteristics of the sample. The latter are reported in Table 1, in comparison with the available sociodemographic data of the Milan population, as provided by the Italian Institute of Statistics (2019) [58]. As illustrated, while the distribution by gender of the sample population reflects the Milan population data, some differences emerge with regard to age. The age class

25–34 years old was overrepresented in our sample, while people older than 65 years old were remarkably underrepresented.

Table 1. Sociodemographic characteristics of the sample.

Variable		% of the Sample	% of Milan Population
Gender	Men	44.9	47.99
	Women	55.1	52.01
Age	18–24	10.2	7.74
	25–34	39.7	13.25
	35–44	12.5	16.31
	45–54	14.7	19.86
	55–64	18.1	15.86
	65+	4.8	26.98
Education	Elementary school	1.6	-
	Middle school	13.6	-
	High school	40.4	-
	University graduate	39.2	-
	Higher	5.2	-
Monthly family income *	less than 800€	6.3	-
	800–1500€	16.3	-
	1500–3000€	38.5	-
	3000–5000€	21.3	-
	more than 5000€	6.8	-

* 10.7% of our respondents refused to disclose this information.

All the latent constructs were measured by means of multiple items taken or adapted from previous studies with validated scales. The explanatory factor analysis was performed on all these items and the Kaiser-Meyer-Olkin (KMO) and Bartlett's sphere test was used to test the reliability of the results. The coefficients showed that the indicators of the latent constructs were unrelated and, therefore, suitable to describe our model (KMO = 0.756; significance of Bartlett's test = 0.000). Afterwards, the confirmatory factor analysis was performed in order to test the goodness of the constructs. The resulting model fit were slightly below the acceptable values. Thus, the worst-performing items were dropped in a second CFA, and this resulted in a better model with largely acceptable fitting measures (χ^2/df < 3; TLI > 0.9; CFI > 0.9; RMSEA< 0.08) [59].

The dependent variable (PL_BEHAV) aimed at capturing the the extent to which respondents consciously avoid plastics while grocery shopping, with a focus on food and drink packaging. In detail, the dependent variable in the model was represented by an index resulting from the summation of the scores assigned to three questions. The latter asked respondents whether they generally avoid purchasing (i) single-use plastic eating utensils (e.g., plastic cutlery, plates, cups, etc.), (ii) food products with multiple plastic packaging, and (iii) plastic water bottles. These objects were chosen as they represent the most ubiquitous plastic objects in the environment, they are massively used and easily discarded in incorrect manners, and their market is expected to remain stable or even to grow in the next years [6,10]. Questions were reported in the form "When you go get groceries, do you generally avoid buying . . . ?" with "Yes/No" dummy response alternatives. These three items were formulated based on a group of questions included in the Special Eurobarometer 468 on the "Attitude of European citizens towards the environment" [60]. The resulting index ranged from 0 to 3, with higher scores associated with more sustainable behaviors (i.e., higher plastic avoidance).

In order to test the hypotheses formulated with regard to the effect of individual plastic-related concern, subjective knowledge, and the importance attached to the commitment of third parties for tackling plastic issues, the following exogenous latent constructs were considered. The first latent variable (PL_CON) aimed at reflecting consumers' level of concern about the effects of plastic contamination on the environment as well as on health. While past studies on PEBs have focused exclusively on environmental concern, this study also considered the health dimension. Indeed, as explained in Section 2, when plastic packaging is put in contact with food consumers might worry about the release of possible contaminants in the product. Hence, PL_CON was expressed by three items, measured on a scale ranging from 1 (= strongly disagree), to 7 (= strongly agree), adapted from

the Eurobarometer 468 survey [60]. Furthermore, when dealing with the role of environmental concern on PEBs, most of past studies used unspecific measures to be associated with specific behaviors [61–63]. This approach implies not accounting for some peculiar determinants that can be strictly related to the specific behavior under study, and not with others. Bamberg (2003) discussed this issue, suggesting that context-specific measures of environmental concern that closely relate to the PEB under study could provide more accurate results [64]. In fact, it is quite frequent to observe inconsistency between individual self-reported environmental concern and concrete behaviors. This can be, at least in part, attributed to the way in which environmental concern is elicited [21,23]. For this reason, in this paper the latent PL_CON was measured with indicators that are directly associated with plastics.

The second latent construct in the model (SUBJ_KN) was expressed by three items adapted from Pieniak et al. (2010) [18]. The items aimed at eliciting respondents' subjective knowledge about plastic materials, their usage and sorting, and at capturing individual perceived level of plastic-related subjective knowledge with respect to other people's [18]. Also in this case, respondents stated their level of agreement to each item on a Likert scale from 1 (strongly disagree) to 7 (strongly agree).

The latent construct SHRD_COMM represents the importance attached by consumers to the commitment of third parties for tackling the plastic issue. This latent was expressed by means of four items adapted from the Eurobarometer 468 (2017) [60]. Such items aimed at measuring the importance that respondents attributed to the actions of producers, authorities, and other citizens for tackling the plastic environmental issue (on a Likert scale from 1 = not at all important, to 5 = very important). All latent constructs as well as their indicators are illustrated in Table 2.

Table 2. Latent variables and items.

Latent Construct	Acronym of the Latent Variable	Scale	Indicator	Acronym of the Indicator
Plastic purchasing behavior	PL_BEHAV	Yes/No	When you go get groceries, do you generally avoid buying single-use plastic goods (e.g., plastic cutlery, cups, plates, etc.)?	BEHAV1
			When you go get groceries, do you generally avoid buying products with multiple plastic packaging?	BEHAV2
			Do you generally avoid buying plastic water bottles?	BEHAV3
Plastic-related concern	PL_CON	7-points Likert scale	Environmental problems caused by plastics affect my everyday life and my health	CON1
			I am worried about the impact on my health of everyday objects made of plastics	CON2
			I am worried about the impact on the environment of everyday objects made of plastics	CON3
Subjective knowledge	SUBJ_KN	7-points Likert scale	I have good knowledge on the different types of plastics used to bottle water	SKN1
			Compared with other people I have good knowledge on how to sort plastic wastes	SKN2
			Compared with other people I have good knowledge on what to throw away in the plastic sorting	SKN3
Importance of third party commitment	SHRD_COMM	5-points Likert scale	Products should be designed in a way that facilitates the recycling of plastic	COMM1
			Industries and retailers should make an effort to reduce plastic packaging	COMM2
			Local authorities should provide more and better collection facilities for plastic waste	COMM3
			People should inquire on how to reduce their plastic waste	COMM4

3. Results

3.1. Reliability and Validity of the Model

The validity of the constructs was investigated through the values of Composite Reliability (CR), Cronbach's Alpha, and Average Variance Extracted (AVE) [57]. Results are showed in Table 3.

Table 3. Validity and reliability of latent constructs.

Latent Variable	Item	Loadings	CR	Cronbach's Alpha	AVE
Plastic-related concern	CON1	0.732	0.83	0.82	0.62
	CON2	0.822			
	CON3	0.797			
Subjective knowledge	SKN1	0.42	0.80	0.75	0.58
	SKN2	0.849			
	SKN3	0.923			
Importance of third party commitment	COMM1	0.593	0.70	0.70	0.36
	COMM2	0.68			
	COMM3	0.563			
	COMM4	0.579			

CR = Composite Reliability; AVE = Average Variance Extracted.

Almost all constructs measures fitted the required levels (CR > 0.7; Cronbach's Alpha > 0.7; AVE > 0.5), indicating an overall good convergence validity [62]. The low AVE value associated with the shared commitment latent variable could be expected, as this issue is relatively new in the literature. However, we retained the latent variable because of the overall good fitting of other measurements and of the whole CFA [65]. Moreover, the overall goodness-of-fit measures of the model were highly acceptable, thus suggesting that the relationships tested were significant and well explain our dependent variable.

3.2. Mediation Analysis

The mediation analysis was conducted to unveil possible indirect relationship across the latent constructs. Indeed, past evidence showed that concern, knowledge and the commitment of third parties for the environmental cause, can have an indirect effect on PEBs [21,28,40,46,66]. The mediation analysis was conducted following the procedure proposed by Baron and Kenny (1986) and further adopted also in Elgaaied (2012) [67,68]. The resulting paths and coefficients of the model are reported in Figures 1 and 2.

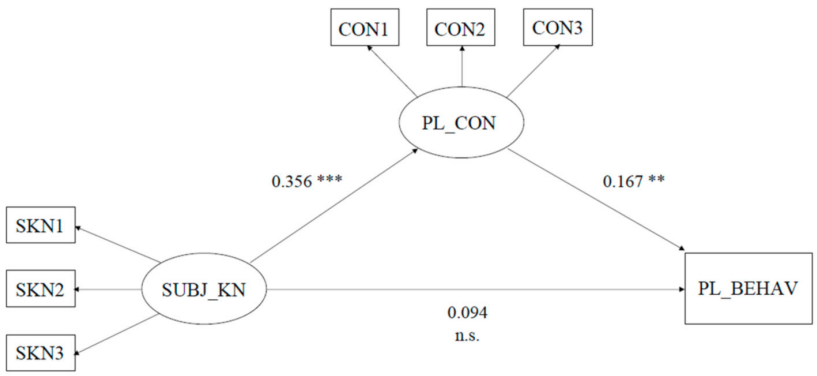

Figure 1. Test for the mediating role of PL_CON on SUBJ_KN. Notes: n.s. = non-significant; significance at ** $p < 0.01$, and *** $p < 0.001$.

The results in Figure 1 show that the relationship between plastic-related SUBJ_KNOW and PL_BEHAV was fully mediated by PL_CON. This is in line with past findings indicating that knowledge does not directly affect PEBs, but positively influences the extent to which consumers engage in environmentally friendly behavior by increasing concern [21,46]. Similarly, and in line with past literature [28,66], the results in Figure 2 show that also SHRD_COMM did not directly increase the extent to which consumers consciously avoid plastics while grocery shopping, Instead, it indirectly affected PL_BEHAV by increasing PL_CON. As such, the results of the mediation analysis indicated that H2-1 (i.e., the higher the consumers' subjective knowledge about plastic-related issues, the higher the probability that they avoid purchasing single-use plastic eating utensils, plastic water bottles, and food with plastic packaging) was rejected, while H2-2 (i.e., the higher the subjective knowledge about plastic-related issues, the higher the plastic-related concern) was confirmed.

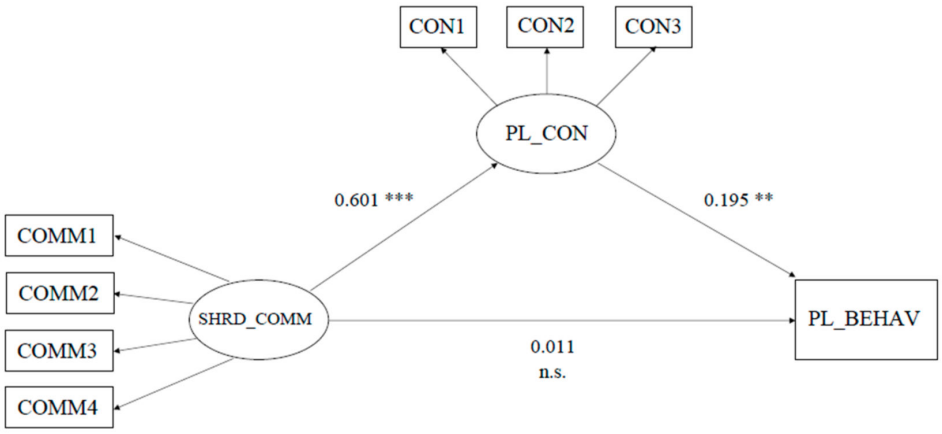

Figure 2. Test for the mediating role of PL_CON on SHRD_COMM. * SHRD_COMM. Notes: n.s. = non-significant; significance at ** $p < 0.01$, and *** $p < 0.001$.

3.3. Structural Equation Model

Accounting for the results of the mediation analysis the Structural Equation Model was performed as described in Figure 3. The resulting coefficients and goodness-of-fit indices are displayed in Table 4.

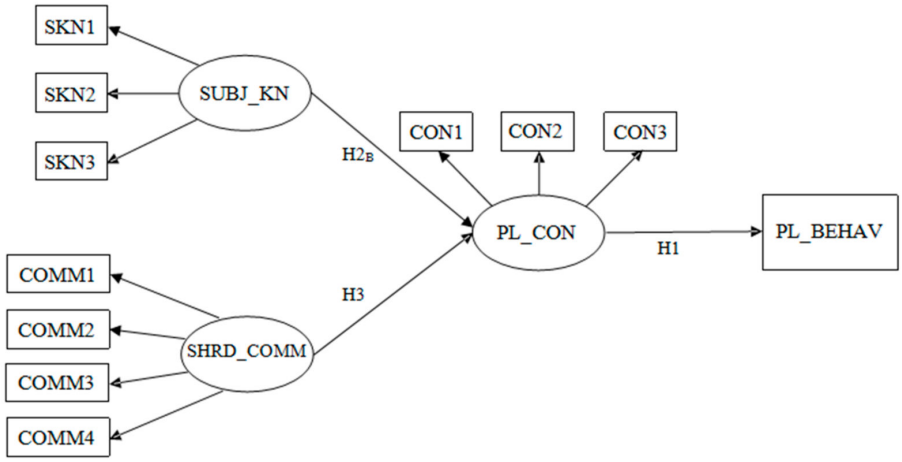

Figure 3. Structural Equation Model.

The results showed a positive and significant association between PL_CON and PL_BEHAV ($\beta = 0.212$, $p < 0.001$). To explain, this positive relationship indicates that when consumers are concerned about the possible negative effects of plastic contamination on the environment as well as on their health, they are more likely to avoid purchasing single-use plastic objects, plastic water bottles,

and products with multiple plastic packaging. This evidence confirmed H1, that is the higher the environmental concern, the higher the probability to avoid purchasing single-use plastic objects while grocery shopping.

The coefficients obtained also showed a positive relationship between SUBJ_KN and PL_CON ($\beta = 0.253$, $p < 0.001$). Indeed, this result reveals that consumers exhibiting a higher level of subjective knowledge on the issue of plastic pollution and on how to act to diminish the impact of plastics on the environment were also more concerned about the negative consequences of plastics on the environment and on human health. This outcome of the model fully confirmed H2-2, which stated that the higher the subjective knowledge about plastic-related issues, the higher the level of plastic-related concern.

Lastly, the relationship between SHRD_COMM and PL_CON resulted to be positive (0.553) and significant ($p < 0.001$). This finding reveals that consumers who attributed more importance to the collective commitment against plastic pollution (with other citizens, with the firms, and the policy makers) were also more concerned about the adverse effects of plastic over-use. This latter evidence partly confirmed H3. In fact individual perception of others' commitment in reducing the environmental impact of plastic only indirectly affected the probability that consumers avoid purchasing single-use plastic eating utensils, plastic water bottles and food with plastic packaging, by increasing plastic-related concern.

Table 4. Model's results and goodness-of-fit measures.

Path	Coefficient	Significance	Hypothesis	Result
PL_CON –> PL_BEHAV	0.212	***	H1	Fully confirmed
SUBJ_KN –> PL_BEHAV	0.094	n.s.	H2-1	Rejected
SUBJ_KN –> PL_CON	0.253	***	H2-2	Fully confirmed
SHRD_COMM –> PL_CON	0.553	***	H3	Partly confirmed
Significance: $p < 0.001$ ***				
Goodness of fit	χ^2/df	TLI	CFI	RMSEA
Values	2.31	0.95	0.96	0.055
Acceptable values	<3	>0.90	>0.90	<0.08

Notes: n.s. = non-significant; significance at *** $p < 0.001$.

4. Discussion

This paper aimed at investigating which could be the drivers of consumers' decision to avoid plastic usage with a specific focus on the food context. Using a Structural Equation Modeling approach, we explored the role of plastic-related concern, subjective knowledge, and the importance attributed to the commitment of third parties for tackling plastic environmental issues as possible drivers of plastics avoidance. In detail, the interest was centered on consumers' decision to avoid purchasing single-use plastic eating utensils, food with multiple plastic packaging, and plastic water bottles while grocery shopping.

Overall, the results highlighted that all the latent constructs included in the analysis affected consumers' plastic avoidance, at least in the specific context of our analysis. In detail, plastic-related concern was found to directly drive plastic avoidance, which confirmed the first hypothesis of the study. This result is in line with past literature showing that environmental concern is a key behavioral determinant of many PEBs [29–31]. In this regard, our results contributed to extend current evidence by also considering health-related concern. In fact, consumers sometimes associate plastic materials with potential health risks. This is due to the possibility that plastics may release chemical contaminants in the environment or the product that they are in contact with [34–36]. Such concern is especially high when plastics are in direct contact with food [37]. Our findings suggested that both environmental and health related concerns should be accounted for when analyzing consumer plastic-related behaviors.

The results indicated that also plastic-related subjective knowledge (i.e., subjective knowledge about plastic materials and their recycling) was able to influence the extent to which consumers avoid purchasing plastic items while grocery shopping, although indirectly. Indeed, the observed relationship between subjective knowledge and plastic avoidance was fully mediated by plastic concern. In other words, high plastic-related subjective knowledge increased plastic concern (both environment- and health-related), which in turn increased the probability that consumers avoided plastic items. This finding is in line with previous research stressing that environmental knowledge does not directly increase PEBs, but contributes to drive sustainability-oriented behaviors by influencing other variables, including concern [17,18,21,46]. This approach has become increasingly accepted in the literature on PEBs [23,50] and was further confirmed by the evidence of this study. Another key finding of this paper regards the importance that consumers attributed to others' commitment for tackling plastic-related environmental issues (i.e., shared commitment). Similar to subjective knowledge, shared commitment did not directly drive plastic behaviors, but influenced the extent to which consumers avoid plastic food packaging, single-use eating utensils, and water bottles by increasing concern. This result remarks that studies on PEBs, including plastic avoidance, should not limit the analysis to the individual behaviors. As suggested in previous studies, the extent to which consumers decide to behave sustainably is strongly affected by what others do in the same regard [50–53]. If people perceive that the environmental cause is not shared by the other members of the society, they may feel like their efforts are useless, thus losing their motivation to engage in PEBs [51]. Our analysis highlighted that, with specific regard to plastics, consumers attach high importance not only to other citizens' behaviors, but also to what the firms and the politics do.

It must be acknowledged that our study suffered from some limitations. Firstly, the survey was based on stated data, and it is possible that participants over/underestimated their responses. Secondly, the data might have been affected by social-desirability bias. However, given that respondents were asked to autonomously fill the questionnaire, we expect this bias to be limited. The third limitation regards the distribution of the sociodemographic variables in our sample, especially with regard to age. Indeed, while the age class 25–34 was overrepresented in our sample, the age class of people older than 65 years old was remarkably underrepresented. To some extent, this might have affected the results. Indeed, young adults are known to be more sensitive to the environmental sustainability, while older consumers are typically less attentive towards this issue [69,70]. Furthermore, the distribution of age classes in our sample did not reflect the Milan population, which implies that the results cannot be generalized.

Although these limitations did not allow us to derive definitive conclusions and to provide robust policy implications, we believe that this study offers some useful hints for developing future consumer-based studies on plastics. Essentially, the results stressed that plastic-related PEBs are mainly and directly driven by environmental and health concern. Therefore, future studies should further investigate which variables can determine an increase/decrease in consumers' concern with regard to plastic issues. Moreover, the results seem to indicate that policy measures geared at increasing the extent to which consumers worry about the consequences of plastic contamination (e.g., by increasing plastic specific knowledge) might be effective in leveraging a sustainability-oriented behavioral change.

Our findings indicated that also plastic-related subjective knowledge and shared commitment play a role in this regard. However, their effect seems weaker and strictly related to other variables. Future studies should broaden the scope of our analysis in order to clarify how and to what extent these factors are associated with concern, eventually considering other individual characteristics and behavioral determinants.

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References

1. PlasticsEurope. Plastics—The Facts 2016. *Plast. Facts.* Available online: https://www.plasticseurope.org/en/resources/publications/3-plastics-facts-2016 (accessed on 5 August 2019).
2. Syberg, K.; Hanses, S.F.; Christensen, T.B.; Khan, F.R. Risk Perception of Plastic Pollution: Importance of Stakeholder Involvement and Citizen Science. In *Handbook of Environmental Chemistry*; Wagner, M., Lambert, S., Eds.; Springer: Cham, Switzerland, 2018; pp. 203–221. ISBN 9783319616148.
3. Baztan, J.; Carrasco, A.; Chouinard, O.; Cleaud, M.; Gabaldon, J.E.; Huck, T.; Jaffrès, L.; Jorgensen, B.; Miguelez, A.; Paillard, C.; et al. Protected areas in the Atlantic facing the hazards of micro-plastic pollution: First diagnosis of three islands in the Canary Current. *Mar. Pollut. Bull.* **2014**, *80*, 302–311. [CrossRef] [PubMed]
4. Eriksen, M.; Maximenko, N.; Thiel, M.; Cummins, A.; Lattin, G.; Wilson, S.; Hafner, J.; Zellers, A.; Rifman, S. Plastic pollution in the South Pacific subtropical gyre. *Mar. Pollut. Bull.* **2013**, *68*, 71–76. [CrossRef] [PubMed]
5. Geyer, R.; Jambeck, J.R.; Law, K.L. Production, use, and fate of all plastics ever made. *Sci. Adv.* **2017**, *3*, 25–29. [CrossRef]
6. World Economic Forum; Ellen MacArthur Foundation; McKinsey & Company. The New Plastics Economy—Rethinking the Future of Plastics. Available online: https://www.ellenmacarthurfoundation.org/publications (accessed on 11 November 2019).
7. Marsh, K.; Bugusu, B. Food packaging—Roles, materials, and environmental issues: Scientific status summary. *J. Food Sci.* **2007**, *72*, R39–R55. [CrossRef] [PubMed]
8. European Commission. Commission Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food. *Off. J. Eur. Union* **2011**, *12*, 1–89.
9. Carpenter, E.; Wolverton, S. Plastic litter in streams: The behavioral archaeology of a pervasive environmental problem. *Appl. Geogr.* **2017**, *84*, 93–101. [CrossRef]
10. European Commission. *A European Strategy for Plastics in a Circular Economy*; European Commission: Brussels, Belgium, 2018.
11. European Commission. *Closing the Loop—An EU Action Plan for the Circular Economy*; European Commission: Luxembourg, 2015.
12. European Commission. *DIRECTIVE (EU) 2019/904 on the Reduction of the Impact of Certain Plastic Products on the Environment*; European Commission: Luxembourg, 2019.
13. Da Cruz, N.F.; Simões, P.; Marques, R.C. Economic cost recovery in the recycling of packaging waste: The case of Portugal. *J. Clean. Prod.* **2012**, *37*, 8–18. [CrossRef]
14. Lettner, M.; Schöggl, J.P.; Stern, T. Factors influencing the market diffusion of bio-based plastics: Results of four comparative scenario analyses. *J. Clean. Prod.* **2017**, *157*, 289–298. [CrossRef]
15. Axelrod, L.J.; Lehman, D.R. Responding to environmental concerns: What factors guide individual action? *J. Environ. Psychol.* **1993**, *13*, 149–159. [CrossRef]
16. Ellen, P.S. Do we know what we need to know? Objective and subjective knowledge effects on pro-ecological behaviors. *J. Bus. Res.* **1994**, *30*, 43–52. [CrossRef]
17. Dursun, İ.; Tümer Kabadayı, E.; Tuğer, A.T. Overcoming the psychological barriers to energy conservation behaviour: The influence of objective and subjective environmental knowledge. *Int. J. Consum. Stud.* **2019**, *43*, 402–416. [CrossRef]
18. Pieniak, Z.; Aertsens, J.; Verbeke, W. Subjective and objective knowledge as determinants of organic vegetables consumption. *Food Qual. Prefer.* **2010**, *21*, 581–588. [CrossRef]
19. Etale, A.; Jobin, M.; Siegrist, M. Tap versus bottled water consumption: The influence of social norms, affect and image on consumer choice. *Appetite* **2018**, *121*, 138–146. [CrossRef] [PubMed]
20. Jensen, B.B. Knowledge, action and pro-environmental behaviour. *Environ. Educ. Res.* **2002**, *8*, 325–334. [CrossRef]
21. Kollmuss, A.; Agyeman, J. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ. Educ. Res.* **2002**, *8*, 239–260. [CrossRef]

22. Peattie, K. Green Consumption: Behavior and Norms. *Annu. Rev. Environ. Resour.* **2010**, *35*, 195–228. [CrossRef]
23. Gifford, R.; Nilsson, A. Personal and social factors that influence pro-environmental concern and behaviour: A review. *Int. J. Psychol.* **2014**, *49*, 141–157. [CrossRef]
24. Joshi, Y.; Rahman, Z. Investigating the determinants of consumers' sustainable purchase behaviour. *Sustain. Prod. Consum.* **2017**, *10*, 110–120. [CrossRef]
25. Moon, S.J.; Costello, J.P.; Koo, D.M. The impact of consumer confusion from eco-labels on negative WOM, distrust, and dissatisfaction. *Int. J. Advert.* **2017**, *36*, 246–271. [CrossRef]
26. Geng, L.; Xu, J.; Ye, L.; Zhou, W.; Zhou, K. Connections with nature and environmental behaviors. *PLoS ONE* **2015**, *10*, e0127247. [CrossRef]
27. Kilbourne, W.; Pickett, G. How materialism affects environmental beliefs, concern, and environmentally responsible behavior. *J. Bus. Res.* **2008**, *61*, 885–893. [CrossRef]
28. Coelho, F.; Pereira, M.C.; Cruz, L.; Simões, P.; Barata, E. Affect and the adoption of pro-environmental behaviour: A structural model. *J. Environ. Psychol.* **2017**, *54*, 127–138. [CrossRef]
29. Barnett, A.J.; Wiber, M.G.; Rooney, M.P.; Curtis Maillet, D.G. The role of public participation GIS (PPGIS) and fishermen's perceptions of risk in marine debris mitigation in the Bay of Fundy, Canada. *Ocean Coast. Manag.* **2016**, *133*, 85–94. [CrossRef]
30. Adane, L.; Muleta, D. Survey on the usage of plastic bags, their disposal and adverse impacts on environment: A case study in Jimma City, Southwestern Ethiopia. *J. Toxicol. Environ. Health* **2011**, *3*, 234–248. [CrossRef]
31. Otsyina, H.R.; Nguhiu-Mwangi, J.; Mogoa, E.G.M.; Mbuthia, P.G.; Ogara, W.O. Knowledge, attitude, and practices on usage, disposal, and effect of plastic bags on sheep and goats. *Trop. Anim. Health Prod.* **2018**, *50*, 997–1003. [CrossRef]
32. Tudor, D.T.; Williams, A.T. Public Perception and Opinion of Visible Beach Aesthetic Pollution: The Utilisation of Photography. *J. Coast. Res.* **2003**, *19*, 1104–1115.
33. Kiessling, T.; Salas, S.; Mutafoglu, K.; Thiel, M. Who cares about dirty beaches? Evaluating environmental awareness and action on coastal litter in Chile. *Ocean Coast. Manag.* **2017**, *137*, 82–95. [CrossRef]
34. Joseph, N.; Kumar, A.; Majgi, S.M.; Kumar, G.S.; Prahalad, R.B.Y. Usage of plastic bags and health hazards: A study to assess awareness level and perception about legislation among a small population of Mangalore city. *J. Clin. Diagn. Res.* **2016**, *10*, LM01–LM04. [CrossRef]
35. Aday, M.S.; Yener, U. Understanding the buying behaviour of young consumers regarding packaging attributes and labels. *Int. J. Consum. Stud.* **2014**, *38*, 385–393. [CrossRef]
36. Fernqvist, F.; Olsson, A.; Spendrup, S. What's in it for me? Food packaging and consumer responses, a focus group study. *Br. Food J.* **2015**, *117*, 1122–1135. [CrossRef]
37. Omari, R.; Frempong, G. Food safety concerns of fast food consumers in urban Ghana. *Appetite* **2016**, *98*, 49–54. [CrossRef] [PubMed]
38. Omari, R.; Frempong, G.K.; Arthur, W. Public perceptions and worry about food safety hazards and risks in Ghana. *Food Control* **2018**, *93*, 76–82. [CrossRef]
39. Hines, J.M.; Hungerford, H.R.; Tomera, A.N. Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *J. Environ. Educ.* **1987**, *18*, 1–8. [CrossRef]
40. Bamberg, S.; Möser, G. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.* **2007**, *27*, 14–25. [CrossRef]
41. Kaiser, F.G.; Ranney, M.; Hartig, T.; Bowler, P.A. Ecological Behavior, Environmental Attitude, and Feelings of Responsibility for the Environment. *Eur. Psychol.* **1999**, *4*, 59–74. [CrossRef]
42. Kaiser, F.G.; Fuhrer, U. Ecological Behavior's Dependency on Different Forms of Knowledge. *Appl. Psychol.* **2003**, *52*, 598–613. [CrossRef]
43. Park, C.W.; Mothersbaugh, D.L.; Feick, L. Consumer Knowledge Assessment. *J. Consum. Res.* **1994**, *21*, 71. [CrossRef]
44. Radecki, C.M.; Jaccard, J. Perceptions of knowledge, actual knowledge, and information search behavior. *J. Exp. Soc. Psychol.* **1995**, *31*, 107–138. [CrossRef]
45. Wiek, A.; Withycombe, L.; Redman, C.L. Key competencies in sustainability: A reference framework for academic program development. *Sustain. Sci.* **2011**, *6*, 203–218. [CrossRef]
46. Carmi, N.; Arnon, S.; Orion, N. Transforming Environmental Knowledge into Behavior: The Mediating Role of Environmental Emotions. *J. Environ. Educ.* **2015**, *46*, 183–201. [CrossRef]

47. Dilkes-Hoffman, L.S.; Pratt, S.; Laycock, B.; Ashworth, P.; Lant, P.A. Public attitudes towards plastics. *Resour. Conserv. Recycl.* **2019**, *147*, 227–235. [CrossRef]
48. Heidbreder, L.M.; Steinhorst, J.; Schmitt, M. Plastic-free July: An experimental study of limiting and promoting factors in encouraging a reduction of single-use plastic consumption. *Sustainability* **2020**, *12*, 4698. [CrossRef]
49. Luís, S.; Roseta-Palma, C.; Matos, M.; Lima, M.L.; Sousa, C. Psychosocial and economic impacts of a charge in lightweight plastic carrier bags in Portugal: Keep calm and carry on? *Resour. Conserv. Recycl.* **2020**, *161*, 104962. [CrossRef]
50. Kurisu, K. *Pro-Environmental Behaviors*; Springer: Tokyo, Japan, 2015; ISBN 9784431558323.
51. Borg, K.; Curtis, J.; Lindsay, J. Social norms and plastic avoidance: Testing the theory of normative social behaviour on an environmental behaviour. *J. Consum. Behav.* **2020**, 1–14. [CrossRef]
52. Ellen, P.S.; Wiener, J.L.; Cobb-Walgren, C. The Role of Perceived Consumer Effectiveness in Motivating Environmentally Conscious Behaviors. *J. Public Policy Mark.* **1991**, *10*, 102–117. [CrossRef]
53. Pieters, R.G.M. Changing Garbage Disposal Patterns of Consumers: Motivation, Ability, and Performance. *J. Public Policy Mark.* **1991**, *10*, 59–76. [CrossRef]
54. Prabawa-Sear, K.; Baudains, C. Asking the participants: Students' views on their environmental attitudes, behaviours, motivators and barriers. *Aust. J. Environ. Educ.* **2011**, *27*, 219–228. [CrossRef]
55. Henseler, J.; Ringle, C.M.; Sinkovics, R.R. The use of partial least squares path modeling in international marketing. *Adv. Int. Mark.* **2009**, *20*, 277–319. [CrossRef]
56. Christ, S.L.; Lee, D.J.; Lam, B.L.; Zheng, D.D. Structural equation modeling: A framework for ocular and other medical sciences research. *Ophthalmic Epidemiol.* **2014**, *21*, 1–13. [CrossRef]
57. Tan, X.; Wang, X.; Zaidi, S.H.A. What drives public willingness to participate in the voluntary personal carbon-trading scheme? A case study of Guangzhou Pilot, China. *Ecol. Econ.* **2019**, *165*, 106389. [CrossRef]
58. ISTAT. Demographic Data of the Metropolitan City of Milan. 2019. Available online: http://dati.istat.it/Index.aspx?DataSetCode=DCIS_POPRES1# (accessed on 31 October 2020).
59. Marsh, H.W.; Hau, K.-T.; Wen, Z. In Search of Golden Rules: Comment on Hypothesis-Testing Approaches to Setting Cutoff Values for Fit Indexes and Dangers in Overgeneralizing Hu and Bentler's (1999) Findings. *Struct. Equ. Model.* **2004**, *11*, 452–483. [CrossRef]
60. European Commission. *Special Eurobarometer 468—Report Attitudes of European Citizens Towards the Environment*; European Commission: Luxembourg, 2017.
61. Bang, H.K.; Ellinger, A.E.; Hadjimarcou, J.; Traichal, P.A. Consumer concern, knowledge, belief, and attitude toward renewable energy: An application of the reasoned action theory. *Psychol. Mark.* **2000**, *17*, 449–468. [CrossRef]
62. Li, G.; Li, W.; Jin, Z.; Wang, Z. Influence of environmental concern and knowledge on households' willingness to purchase energy-efficient appliances: A case study in Shanxi, China. *Sustainability* **2019**, *11*, 1073. [CrossRef]
63. Maichum, K.; Parichatnon, S.; Peng, K.-C. The Influence of Environmental Concern and Environmental Attitude on Purchase Intention towards Green Products: A Case Study of Young Consumers in Thailand. *Int. J. Bus. Mark. Manag.* **2017**, *2*, 2456–4559.
64. Bamberg, S. How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. *J. Environ. Psychol.* **2003**, *23*, 21–32. [CrossRef]
65. Fornell, C.; Larcker, D.F. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *J. Mark. Res.* **1981**, *18*, 39. [CrossRef]
66. Lee, Y.-K.; Kim, S.; Kim, M.-S.; Choi, J.-G. Antecedents and interrelationships of three types of pro-environmental behavior. *J. Bus. Res.* **2014**, *67*, 2097–2105. [CrossRef]
67. Baron, R.M.; Kenny, D.A. The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *J. Pers. Soc. Psychol.* **1986**, *51*, 1173–1182. [CrossRef]
68. Elgaaied, L. Exploring the role of anticipated guilt on pro-environmental behavior—A suggested typology of residents in France based on their recycling patterns. *J. Consum. Mark.* **2012**, *29*, 369–377. [CrossRef]
69. Lozano, R.; Lukman, R.; Lozano, F.J.; Huisingh, D.; Lambrechts, W. Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system. *J. Clean. Prod.* **2013**, *48*, 10–19. [CrossRef]

70. Vicente-Molina, M.A.; Fernández-Sáinz, A.; Izagirre-Olaizola, J. Environmental knowledge and other variables affecting pro-environmenta behaviour: Comparison of university students from emerging and advanced countries. *J. Clean. Prod.* **2013**, *61*, 130–138. [CrossRef]