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Influences on purchase intention for bioplastic products and consumer preferences for bio-based apparel in Germany

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Summary

This dissertation investigates the influence of psychographic characteristics of consumers on the purchase intention of bioplastic products as well as their preferences for certain product attributes and price preferences for bio-based products. The target variables purchase intention, preferences for certain product attributes and price preferences are investigated and published in three papers in the context of this dissertation. Possible influencing factors are identified in a comprehensive literature search, whereby the results of previous scientific studies in this field are reviewed. So far, there are only very few studies on the consumption of bio-based apparel and the associated consumer preferences. In 2016, the "*BiNa*"[1] project conducted the largest study to date on consumer preferences, attitudes and perceptions of bioplastics in Germany. The present dissertation and the published studies are based on parts of the data from this survey. The sample of 1,673 participants is representative of the German population and includes citizens aged 16 and over who are surveyed via an online access panel.

In the first paper, a logistic regression analysis is performed, combining the purchase intention for bioplastic products as a dependent variable with 12 independent variables derived from the literature review. Significant and comparatively high influences on purchase intention are found in relation to the variables attitudes towards bioplastics, green consumer values, product experience and interest in information about bioplastics. Policy makers and economic actors who promote marketing and information activities related to bioplastic products can benefit from the results of this study.

In the second study, a choice based conjoint analysis (CBC) for a bio-based rain jacket is performed and psychographic indicators in the form of covariates are included in the statistical estimation of the participants' preferences for the analyzed bio-based rain jacket. The results show the high importance of previous product experiences, green consumer values and attitudes towards bioplastics for the selection of bio-based apparel and thus provide first insights into the influence of psychographic characteristics of consumers when choosing bio-based apparel.

Based on a CBC experiment for a functional bio-based rain jacket, a latent class cluster analysis for the segmentation of consumers of green bioplastic apparel is performed in the third manuscript. Psychographic factors are identified that play a significant role in distinguishing between consumer groups of bio-based apparel with a "preference for a low price" and those that show "acceptance for a moderate price". The strongest distinguishing variables found by discriminant analysis are purchase intention for bio-based apparel, followed by GCV and subjective norms for bio-based apparel. This study helps to better illuminate the heterogeneity of consumer preferences for bio-based apparel.

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[1] BiNa = Biokunststoffe Nachhaltig (engl.: Bioplastics sustainable)
    ProjectLink: http://www.biokunststoffe-nachhaltig.de/index.php/startseite.html

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Abbreviations	Meaning
BiNa (acronym)	Biokunststoffe Nachhaltig (engl. bioplastics sustainable)
CAIC	Correct Akaike information criterion
CBC	Choice based conjoint analysis
GCV	Green consumer values
HB	Hierarchical Bayes
OAP	Online access panel
PICB	Perceived influential communication behavior
PKB	Perceived knowledge about bioplastics
WPC	Wood plastic composite
WTP	Willingness to pay

Influences on purchase intention for bioplastic products and consumer preferences for bio-based apparel in Germany

1 Introduction

The global use of crude oil is increasingly enriching emitted carbon dioxide in the atmosphere. Plastic products made of crude oil have become important consumer goods in almost all branches of industry worldwide in recent decades. Since the accumulation of fossil carbon dioxide in the atmosphere is mainly responsible for climate change, a rethinking is taking place in societies. The use of biomass as renewable resource for the production of plastics is one pathway for transformation of economies in future. Renewable raw materials are intended to be increasingly used for the production of bio-based plastics. Bioplastics can be produced from biogenic raw materials and thus the accumulation of fossil carbon in the atmosphere can be reduced. In addition, carbon dioxide is bound in the bioplastics and is therefore not climatically effective. In 2019, bioplastic products are still a niche product and account for a 6 % share of the world market ("Old and new economy" according to figure 1), but a further increase in market share is expected (IfBB 2019). However, the potential to replace plastics is much greater considering that the substitutes made from biogenic raw materials have identical technical properties compared to conventional plastics (Endres 2019; Pilla 2011; Endres and Siebert-Raths 2011). For several conventional plastic materials, there are bioplastics as substitutes (the so-called "drop-ins") (Endres 2019; Endres and Siebert-Raths 2011). In addition, there are further possibilities through "novel bioplastics", which differ from conventional plastics chemically and in their properties (such as e.g. PLA, PHA, or PEF according to figure 1) (Endres and Siebert-Raths 2011). In this thesis bio-based products, whose raw material basis is renewable biomass, are investigated.
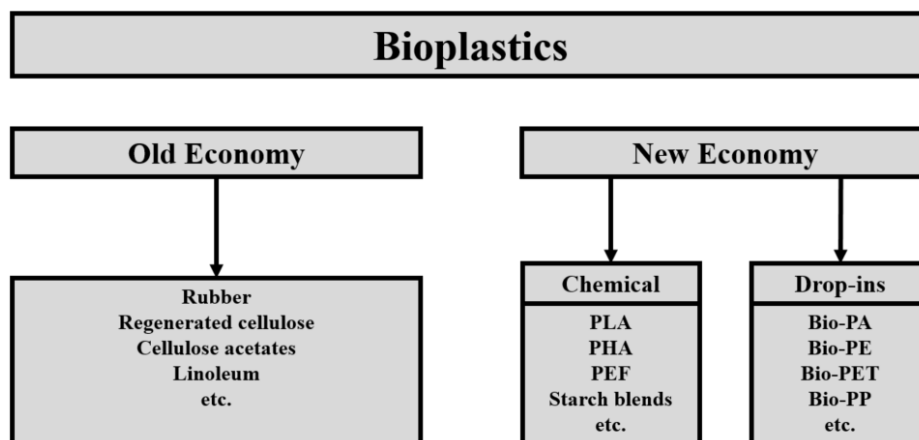

Figure 1: Bioplastics, figure according to IfBB (2019)

The framework conditions for the markets of bio-based products are mainly determined by politics, and industry and retail react on this by offering related products and services, but finally the consumer decides on the choice of a product. Therefore, it is essential to investigate the relevant factors that influence consumer decisions and consumer behavior with regard to bioplastic products as one way of green consumerism. Recent studies have looked at various factors that influence consumer behavior in this field.

Kurka (2012) examines the willingness of the test persons to pay for certain bio-based products and the factors that influence the increased willingness to pay (WTP). He finds that a positive environmental attitude, a positive attitude towards health and existing product experience are significant factors influencing an increased WTP for bio-based product. Furthermore, Kurka (2012) investigates which product attributes are preferred in particular related to specific consumer segments and identifies the so-called "LOHAS" (Lifestyles of Health and Sustainability) as consumer segment that had the highest WTP for bio-based product attributes. Overall, he concludes that the increased WTP across groups is mainly product-dependent and attribute-dependent (Kurka 2012). Kainz (2016) and Kainz et al. (2013) investigate consumers' knowledge about bioplastics in Germany and their information requirements. In addition, Kainz (2016) uses an auction experiment to investigate how information, knowledge and attitudes towards sustainable consumption affect the WTP for bio-based products and reveals that green attitudes have strong influence on the WTP of such products. Additionally, she shows that information about bio-based products in combination with a label lead to higher WTPs (Kainz 2016). Rumm (2016) shows in a choice based conjoint analysis (CBC) experiment that the benefits of the bio-based product attributes increase with increasing proportion of bioplastic and existence of a corresponding label, while high prices of bioplastic products decrease consumers' benefits. In addition, she finds that buyers of bioplastic products have a more positive attitude towards bioplastic products (Rumm 2016). Scherer et al. (2017, 2018a, 2018b) examine consumer preferences and their predictors for sand toys and sports equipment as well as the factors influencing the segmentation of interested and less interested consumer groups of bio-based sports equipment. These studies show that consumers prefer bio-based products over conventional plastic products and that the strongest influences are identified from environmental attitudes and health-related aspects (Scherer et al. 2017, 2018a, 2018b). Yue et al. (2010) show a higher WTP for biodegradable containers in their study through hypothetical conjoint analysis and non-hypothetical experimental auctions. In their consumer study, Osburg et al. (2016) investigate the acceptance of wood plastic composites (WPCs) that contain a high proportion of wood by-products or wood waste. This study suggests that the purchase intention for WPCs is placed between that of solid wood and solid plastic substitutes, and that consumer segments with a high level of environmental awareness and innovativeness rate WPCs better than others (Osburg et al. 2016). Lynch et al. (2017) examines the arguments of Dutch citizens for and against bioplastics and show that the participants support the contribution of bio-based innovations to economic growth and sustainability, while higher costs, food scarcity or deforestation associated with bio-based innovations are criticized. The study

further shows an increase in acceptance and support for bio-based innovations if the test persons recognize a direct personal benefit (Lynch et al. 2017). Kozar and Connell (2013) examine the correlations between knowledge about social and environmental responsibility as well as attitudes and purchase behavior in connection with apparel consumption. They find that participants have greater knowledge about the environmental aspects related to the production of apparel compared to related social aspects. And although participants of the study show little overall interest in socially and environmentally responsible apparel purchasing behavior, knowledge and attitudes related to social and environmental issues are important predictors of socially and environmentally responsible apparel purchasing behavior (Kozar and Connell 2013). Reinders et al. (2017) find that brands using 100% bio-based materials are rated best by consumers, and that the effect on purchase intention among environmentally conscious consumers is mediated by brand attitude and brand emotions. Chekima et al. (2016) investigate explanations for consumers' intention towards purchasing green products by applying the theory of planned behavior. They find that cultural value, attitude and eco-label are important motivational drivers for the intention to purchase green products (Chekima et al. 2016).

The studies presented above show that there is already a wide range of findings in the field of green consumerism. However, these studies also show different consumer choice behavior and preferences between the different product types, also dependent on the mode how the more environment-friendly character of a specific product can be achieved. Therefore, consumer preferences and their influencing factors for specific product attributes must always be investigated specifically adapted to product groups or single products. Although various authors already published several consumer studies related to bioplastic products in recent years (Scherer et al. 2017, 2018a, 2018b; Sijtsema et al. 2016; Kurka 2012; Kainz 2016; Rumm 2016; Lynch et al. 2017; Reinders et al. 2017; Eckmann 2019), there is hardly any knowledge available in the area of consumer reactions related to bio-based apparel. As the global apparel market has an enormous volume with growing tendencies, and offers a wide range of options for improvements with regard to the environmental aspects in production and used raw materials, the question arises, what are the behaviors, intentions and motivations of consumers regarding their consumption of bio-based apparel? What preferences do consumers have for specific attributes of bio-based apparel? These and other questions have not yet been discussed in connection with bio-based apparel and will be examined in this thesis.

Additionally, there have been no studies in the scientific literature on the purchase intention for bioplastic products and the factors influencing this intention in Germany, although several bio-based product-specific studies have been conducted in this country in recent years. Hence, the first manuscript of this thesis investigates the influencing factors on the purchase intention for bioplastic products in Germany. The core research questions are in this context:

-   Do consumers intend to buy bioplastic products in Germany?

-   What factors influence consumers' intention to buy bioplastic products?

The first study shows which factors influence the purchase intention for bioplastic products, which product characteristics play an important role for the consumer in the purchase decision for bio-based apparel and how the consumer-related factors found influence this purchase decision. Thus, the second study examines the influence of identified psychographic features on the purchase decision for bio-based apparel and selected product features in the context of a CBC. The core research questions are:

-   Which characteristics of bio-based apparel are relevant for consumer preferences?
-   Which psychographic factors have an influence on consumers' choice for certain characteristics of bio-based apparel?
-   How strong are the influences of certain psychographic factors on consumer choices?

These questions are answered by the results of the CBC and the estimation of covariates using a hierarchical Bayesian estimation algorithm. The results provide information on the consumers' preference for various product attributes of bio-based apparel and on the influence of psychographic characteristics of consumers on the preference of certain product attributes. The data analysis for the second manuscript raises the question of the heterogeneity of consumer groups of bio-based apparel and the differentiation between them. Therefore, consumer segments based on the CBC for bio-based apparel are examined in the third study with a specific focus on their price preferences. The research questions of the third study are:

-   Which consumer segments with a focus on product pricing can be identified for bio-based apparel?
-   What are the factors that influence consumer pricing preferences for different bio-based garments and that play a role in differentiating between different consumer groups?

Following this introduction, the study approach and research focus are presented in section 2 of this thesis. Subsequently, the identified target variables and the influencing factors, i.e. the independent variables, are presented. In section 3, the data collection, the scales and items used in the survey and the statistical methods used in the studies are explained. Finally, section 4 presents the publications and results in compact form. In the concluding section 5, the results are discussed in terms of content and methodology and evaluated in a final chapter on possible effects.

2 Study approach and theoretical framework

2.1 Study approach

The aim of the thesis is to work less theory-based (not least due to lack of an existing theory capturing the fields of investigation of this thesis) and instead to focus on actual and relevant issues related to consumer estimations of bioplastic products in Germany. This focus is based on outcomes of previous scientific studies carried out in this field, but also on discussions within the interdisciplinary research project "*BiNa-Biokunststoffe Nachhaltig*" (bioplastics sustainable: "New pathways, strategies, business and communication models for bioplastics as a building block of a sustainable economy", IfBB Hannover 2014-2020) in which the author of this thesis has been actively involved. Thus, the chosen study approach of this thesis arose in the scientific discourse within the "*BiNa*" project and on the basis of its empirical results. In addition, previous studies on the topic of consumers and bioplastics are reviewed and their findings are used to identify relevant issues and reveal research gaps. Therefore, the ultimate goal is to identify the factors, i.e. psychographic characteristics or other consumer-related factors, that influence consumers when choosing or buying bioplastics products. This is analyzed at three different levels and with a focus on specific issues.

- consumers' purchase intention with regard to bioplastic products in general
- the product selection in connection with bio-based products, especially apparel
- the consumer preference of defined price levels in connection with bio-based products, especially apparel

Prior to the analysis of these questions, the relevant scientific literature was examined for suitable study designs, methods and procedures. It turned out that no specific theoretical model is able to cover all the questions to be investigated. Earlier results, however, suggest that various factors potentially contribute to answering the raised research questions. Therefore, it was decided to specifically identify these influencing factors, which are relevant for the specific study areas, by means of literature research and subsequent empirical tests with the data of an online survey.

The chronology of the studies follows a logical approach (Figure 2). The identified target variables are directly related to each other, because the purchase or in this case the replacement of the actual action, the choice for a product is preceded by the intention of the purchase (Ajzen 1991; Ajzen and Fishbein 1980). The measurement of price preferences and their influencing factors is a target variable that represents a more in-depth analysis of choice behavior. More information on the background of the target variables and their use in this study follows in section 2.2.1.
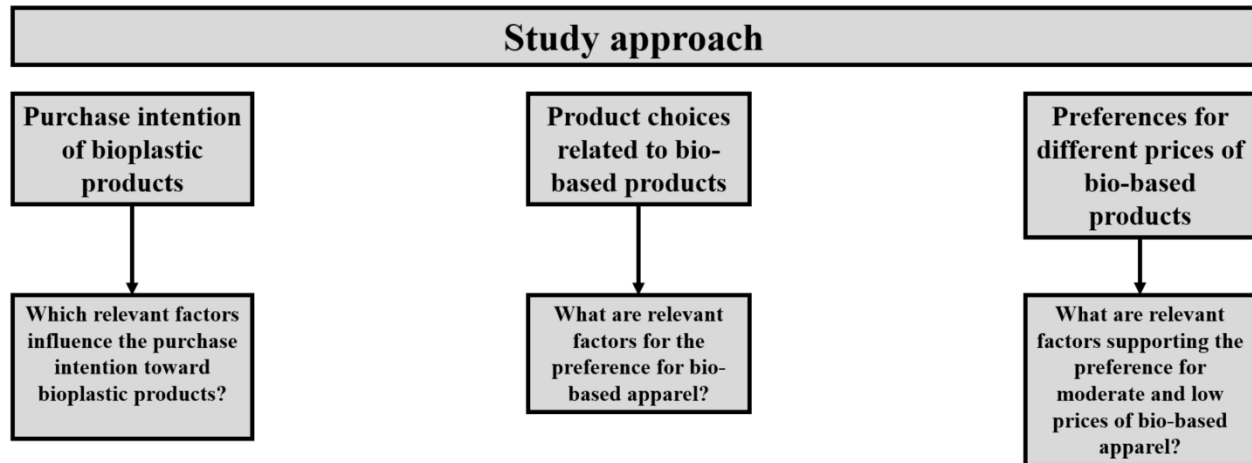
Figure 2: Study approach with key research questions

2.2 Identified target variables and influencing factors

One main aim of the study is the measuring of the influence of relevant factors on intention and behavior, measured in each case by purchase intention and choice behavior. The intention to buy precedes the purchase, and purchasing activities can be simulated by means of choice behavior experiments. Both target variables can be influenced by various factors that have been identified in a literature review. Furthermore, due to the heterogeneity of the preferences of the participants, clusters are created and classified into 2 groups, differing in their part worth utilities for price preferences for bio-based products. Thereupon the factors that contribute to the separation of the classes are measured. The second focus of the study is on identifying important factors influencing the target variables purchase intention and the preferences for specific characteristics of bio-based products analyzed with the help of a CBC. The most important influencing factors should be as universally valid as possible and should fit perfectly to the attributes of bioplastic products. Since attributes are mainly product-dependent, this part is analyzed focusing on bio-based apparel. In the following, the relevance of the target variables is explained and their interrelation is outlined.

2.2.1 Dependent variables

Why are the chosen target variables relevant for analyzing consumer aspects related to bioplastic products in this study? It is not so much a technical question whether bioplastics are relevant as an alternative to conventional plastics, this relevance is determined by the consumer. Up to now, consumers are hardly convinced to prefer bioplastics over conventional plastics, moreover, bioplastics are sometimes perceived very critically, as Blesin et al. (2017) also find out for Germany. This can have various reasons, for example the unclear disposal of bioplastic products in the end-of-use phase, the confusing German wording of the syllables "*Bio*" and "*Plastik*" or "*Kunststoff*", the lack of standards and the many different types of bioplastic

types, which laypersons cannot differentiate and many other challenges, see Blesin et al. (2017) and also Scherer et al. (2020). Hence, this thesis focuses on the three key questions: when consumers intend to buy bio-based apparel or bioplastic products in general, what are the preferred features on them and what influences the choice of bioplastic products. In addition, as I have seen during my studies, there is a heterogeneous group of consumers in terms of price, namely consumers with a preference for low prices and those with an acceptance of moderate prices. This leads to the third key question: what factors are relevant to distinguish between these two groups? Thus, the three target variables purchase intention, choice behavior and differences in price preferences are explained in more detail below.

Purchase intention towards bioplastic products

The intention to purchase a product is seen as a form of behavioral intention influenced by attitudes (Ajzen and Fishbein 1980). Furthermore, Morrison (1979) shows that purchase intention predicts actual purchase behavior. In addition, green consumption is already measured in earlier studies by the intention to purchase and also the associated influencing factors (Laroche et al. 2001; Nam et al. 2017; Kaufmann et al. 2012; Kim and Choi 2005). This leads to the assumption that purchase intention is a strong indicator for measuring green consumption and that the effect of influencing factors on it allows comparisons with existing studies on the one hand and is a well-established variable for analysis on the other.

Preferences for bio-based apparel, CBC

According to Ajzen (1991), the behavioral intention is followed by the behavior or transferred to consumption, this means that the intention to purchase is followed by the purchase. The purchase intention and its influencing factors are measured with the first target variable. Measuring purchasing behavior requires very complex procedures, so this is substituted by measuring consumer choice. Louviere and Woodworth (1983) show that consumer choice behavior corresponds to actual purchasing behavior. The measurement of consumer choice is therefore a simple and cost-effective way to measure consumer behavior in a simulated buying situation (Louviere et al. 2000). In particular, the individual attributes of a product can be recorded in terms of their value for the consumers (McFadden 1986). When designing a choice set, any product attributes can be taken into account. In this work, however, a product concept as close to the market as possible is designed. In addition, the connection of individual attributes to the influencing variables/covariates also play a role in attribute selection, such as the product attribute certificate for fair production and the measurement of the influencing factor altruism. The preferences for individual product attributes and their characteristics are then recorded using the utility function. This utility function contributes to predict purchase decisions and is therefore relevant for product management or for pricing (Eggers and Sattler 2011).

Classification of consumer groups with preferences for low prices and those with an acceptance of moderate prices

None of the most recent studies have examined the factors that influence differences in price preference for bio-based apparel (Scherer et al. 2018b; Hustvedt and Dickson 2009; Hustvedt and Bernard 2010, 2008; Austgulen 2016; Nam et al. 2017; Koszewska 2013). However, price is an attribute with high relevance when buying or choosing bio-based apparel. It is therefore important to identify those factors that contribute to distinguish between heterogeneous consumer groups showing different preferences for price variants of bio-based apparel. Therefore, the present study investigates which consumer segments with a focus on product pricing can be identified for bio-based apparel and which factors influence consumer price preferences for bio-based apparel. In addition, the psychographic factors that play an important role in the classification of the investigated consumer groups of bio-based apparel are also examined. In the present study, the consumer groups examined are those with a "preference for a low price" and those with an "acceptance of a moderate price".

2.2.2 Independent variables

In a further step, the factors influencing the target variables are identified in an extensive analysis of previous scientific studies. A large number of previous studies analyzing consumer aspects related to bio-based products or related fields of research are analyzed and the relevant factors influencing the three target variables are extracted. The factors identified are shown in the following.

Sociodemographic variables: age, gender & education

Sociodemographic characteristics are often investigated in consumer research studies, but their influence on green consumption tends to be small (Diamantopoulos et al. 2003; Casimir and Dutilh 2003; Straughan and Roberts 1999; Tanner and Wölfing Kast 2003; Hess et al. 2013). Based on the results of the previous studies, it is also postulated in the present study that the socio-demographic characteristics age, gender and education have no influences on the purchase intention towards bioplastics or preferences for bio-based apparel.

Green Consumer Values

Haws et al. (2014) examine a range of environmental attitudes and values and develop a scale to measure the relationship between an individual's green values and their environmentally friendly purchasing decisions, the Green Consumer Values (GCV). In addition, Haws et al. (2014) find a relationship between GCV and consumers' purchasing intentions for green products, which is also reported by Kurka (2012) and Scherer et al. (2017) for bio-based products. In the present study, the influences of GCV on purchase intention of bioplastic products and preferences for bio-based apparel are analyzed.

Altruism

Several studies indicate that altruistic behavior according to Batson and Powell (2003) is related to environmentally friendly consumption (Straughan and Roberts 1999; Stern et al. 1993; Lusk et al. 2007; Teng et al. 2015). Hefner (2013) also identifies altruism as a driver of environmentally friendly behavior. Pfattheicher et al. (2016) and Teng et al. (2015) find that altruism correlates with the intention to purchase environmentally friendly products. Therefore, influences of a person's altruism on their purchase intention of bioplastic products and their preferences for bio-based apparel are measured in the present study.

Attitude towards bioplastics

Studies by Kurka (2012), Rumm (2016) and Scherer et al. (2017) find a correlation between attitudes of the test persons related to bioplastics and their choice based behavior with regard to bio-based products. They find that the study participants with positive attitudes towards bioplastics also show a higher interest in bioplastic products. Hartmann and Apaolaza-Ibáñez (2012) and Teng et al. (2015) also show that consumer concern for the environment has a positive effect on their intention to buy green products. Therefore, this study assumes that a positive attitude towards bioplastics influences the willingness of consumers to accept moderate prices for bio-based apparel. Additionally, this study measures the influence of a person's attitude towards bioplastics on their intention to purchase bioplastic products and their preferences for bio-based apparel.

Subjective norm towards bioplastics

Individuals tend to behave in a certain way when they believe that certain people expect them to. These subjective norms are an element of the theory of reasoned action of Ajzen and Fishbein (1980). Subjective norms are known to influence environmentally friendly behavior, for example Teng et al. (2015) find a positive influence of subjective norms on the purchase intentions for green products. Several other studies also find influences of subjective norms on green consumption (Untaru et al. 2016; Tarkiainen and Sundqvist 2005; Mishra et al. 2014; Hefner 2013). Nam et al. (2017) reveal a positive influence of subjective norms on the purchase intention for sustainable sportswear. This study investigates the influence of subjective norms for bioplastics on the purchase intention of bioplastics and the contribution to the separation of the classes of price preferences.

Innovativeness & innovation-friendly

Consumer attitudes towards innovation are an important driver for the introduction of environmentally friendly product innovations (Tellis et al. 2009; Englis and Phillips 2013; Jansson 2011). Scherer et al. (2017) find that ecologically sensitive consumers are more innovative than consumers of conventional plastics. Additionally, Osburg et al. (2016) find that the probability that a consumer chooses wood-plastic

composites over conventional plastics correlates with the consumer's innovative power. Therefore, the individual's attitude towards innovation seems to have a positive effect on his or her choice of environmentally friendly apparel. This study investigates whether a higher degree of an individual's innovativeness increases the intention to purchase and whether it leads to a higher acceptance of a moderate price for bio-based apparel. In addition, the influence of the subjects' innovation friendliness on the proportion of bioplastics in textiles is investigated in the CBC.

Product experience with bioplastics

Young (2000) and Lee et al. (1995) show that past recycling behavior transforms into future recycling behavior. Young et al. (2010) show that previous product experience with green products has a positive influence on the intention to buy green products. Blesin et al. (2017) show that past product experience with bioplastics leads to an increased intention to buy bio-based products. Therefore, this study investigates how product experience affects purchase intention and product choice and whether product experience contributes to the classification of price preference groups.

Purchase intention towards bioplastic products

The consumption of environmentally friendly products has been analyzed in previous studies on the basis of purchase intention (Laroche et al. 2001; Nam et al. 2017; Hartmann and Apaolaza-Ibáñez 2012). In addition, Morrison (1979) shows that purchase intentions predict purchase behavior. In agreement with the previous studies, this study investigates whether the intention to purchase bioplastic products is a relevant factor for the acceptance of moderate prices for bio-based apparel.

Trust

Trust, as defined by Beierlein et al. (2012) and Rammstedt et al. (2013) is an indicator of a person's ability to trust the actions of others. In addition, previous studies measure scales for green trust as predictors of green consumption, because consumers who trust green products are more likely to consume them (Atkinson and Rosenthal 2014; Young et al. 2010; Chen and Chang 2013a, 2013b; Thøgersen 2002; Sammer and Wüstenhagen 2006; Nuttavuthisit and Thøgersen 2017). Furthermore, trust in green products is positively influenced by an eco-label and the argumentation specificity of the product (Atkinson and Rosenthal 2014). In addition, a possible influence of "general" trust as an indicator for the purchase intention of green products is discussed by Atkinson and Rosenthal (2014) and Young et al. (2010). Therefore, this study investigates trust as a factor influencing preferences for bio-based apparel. Consumer trust is directed towards the actors of a manufacturing company and thus also towards the actions or products of these actors. It is assumed that labels are seen as an effort by the manufacturer to gain consumer trust, and that consumer trust in manufacturers can be linked to trust in the perceived authenticity of product labels for bio-based

apparel (Hamzaoui Essoussi and Zahaf 2008; Padel and Foster 2005). Therefore, this study investigates whether trust influences consumer preferences for certification of bio-based apparel. Furthermore, Fandos Herrera and Flavián Blanco (2011) and Jiménez and San Martín (2010) find that consumers need to trust the products they buy and that this is related to the familiarity of the products and their origin. Therefore, this study examines whether a lower level of trust increases the preference for bio-based apparel with a biomass source produced at national level.

Interest in information about bioplastics & interest in bioplastics

McDonald et al. (2009) find that environmentally conscious consumers seek information about green products. In addition, Rumm et al. (2013) and Schleenbecker and Hamm (2013) find that the decision to buy environmentally friendly products is positively influenced by product and resource information about green products. This study investigates whether the specific interest in information about bioplastics has a positive influence on the decision to buy bioplastics products. In addition, it is investigated whether the interest in bioplastics contributes to the classification of the price preference groups and whether consumers with a higher interest accept a higher price of bio-based apparel.

Perceived knowledge about bioplastics (PKB)

Kaiser and Fuhrer (2003) designate specific knowledge as a predictor of environmentally friendly behavior. Jaiswal and Kant (2018) also find a significant effect of consumers' perceived environmental knowledge on purchasing decisions for green products. Therefore, this study investigates whether the perceived knowledge influences the purchase intention for bioplastic products.

Perceived influential communication behavior (PICB)

When it comes to communication in diffusion processes, opinion leaders often play an important role as change agents and can moderate and accelerate the adoption of innovations in their social environment (Valente and Davis 1999). According to Boster et al. (2011), opinion leaders have the three important characteristics that firstly, they have a high level of expertise in the knowledge field of their opinion expression, secondly, they are socially well networked and thirdly, they have a high perceived influential communication strength. The present study focuses on the third characteristic of opinion leaders. Bioplastics have hitherto appeared as a barely relevant social issue and previous surveys by Kurka (2012), Scherer et al. (2017) and Rumm (2016) reveal a low level of consumer knowledge about bioplastics. The present study investigates whether people who consider themselves to be particularly communicative consume an innovative product or material, in this case bioplastic products, against the background of gathering this experience and strengthening their position as opinion leaders within a group. Therefore, the influence of the PICB on the purchase intention of bioplastic products is investigated.

Table 1: Assignment of identified independent variables to dependent variables

Independent variable	Purchase intention	Choice behavior	Price preference
Sociodemographic variables, age, gender and education	X	-	X
Green Consumer Values	X	X	X
Altruism	X	X	X
Attitude towards bioplastics	X	X	X
Trust	-	X	-
Subjective norm towards bioplastics	X	-	X
Innovativeness and innovation-friendly	X	X	X
Interest in information about bioplastics	X	-	-
Interest in bioplastics	-	-	X
Product experience with bioplastics	X	X	X
Purchase intention towards bioplastic products	-	-	X
Perceived knowledge about bioplastics	X	-	-
Perceived influential communication behavior	X	-	-
X = used as independent variable/covariate			

3 Data and statistical methods

3.1 Data collection via online survey

In an extensive literature research, the target variables are therefore related to influencing factors or indicators. A measurement of actual behavior is very costly and complex. In addition, Morwitz and Fitzsimons (2004), among others, show that the measurement of behavior can also influence this, so that such a measurement does not necessarily has to be free of biases. For this reason, an online survey is methodically preferred. This online survey has the advantage that many respondents can be interviewed quickly and economically (Callegaro et al. 2014). Data of the study was collected through an online access panel in June 2016. For that purpose, a market research company was subcontracted to recruit the respondents. The participants received pre-determined incentives for completing the full survey. Online surveys are less costly and allow data to be collected quickly (Evans and Mathur 2005). The target group is the German population aged 16 or older. In order to get a representative view about their perception, attitude and behavior towards bioplastic products, a sample of 1,500 to 2,000 people was selected using specific sociodemographic characteristics based on the German sample census (=“Microzensus 2015”) (German Federal Statistical Office 2015). Quotas are set on gender, age, education and number of inhabitants in the town of residence (Table 8). The independent variables derived from the literature review as well as the operationalization of the dependent variable purchase intention are listed in (Table 5), as well as the wording of the statements, the answering scales and the sources used for elaborating the statements of the different variables (Table 5). Additionally, Cronbach's Alpha is added for variables with more than one statement to show the reliability-value of the item-scales.

3.2 Data cleaning

The data has subsequently been cleaned to remove answers that are not feasible (straight-liners, Christmas-tree-behavior, conflicting answers, wrongly answered test-questions, etc.), finally leaving 1,673 respondents for the statistical analysis. Data cleaning was performed using Microsoft Excel (Microsoft Corporation 2016) and SPSS 23 (IBM Corp. 2015). In a first step a rough cleanup of the data to remove obviously poor interviews was done, proceeding as following: Firstly all 2,036 incomplete surveys were removed, secondly 145 interviews conducted in a time below 478 seconds, which is half of the median-time, were cleaned of, thirdly 4 interviews with several days response time were cleaned of and fourthly 2 interviews with 100% straight-line-answers were removed. The total n before the first data cleaning contained 3,966 interviews and the n after the first data cleaning left 1,779 respondents. In the second and more precise adjustment of the data, I recorded additional straight-liners, determined very short response times for key questions (here a certain minimum time spent on the questionnaire page is assumed, orientation is provided by the median) and found "Christmas-tree-behavior" and most likely inconsistent answers. For this purpose, I have assigned

points, i.e.: if a respondent collects many points in all areas, he will achieve a high total score and will be deleted from the data set. So the question arises when the score is high enough to remove an interview from the data set. For this decision I have looked at the distribution of the points awarded and used a Gaussian distribution as a reference. Then I removed all data to the right of the +2 sigma interval from the data set. The total n before the second data cleaning contained 1,779 interviews and the n after the second data cleaning left 1,673 respondents.

3.3 Scales of dependent and independent variables

The dependent variable "purchase intention" is measured with the two items "I will consciously pay attention to bioplastic products made of biogenic resources in future purchase decisions" and "When I have the choice between a conventional plastic product and one made of renewable raw materials, I will choose the one made of biogenic raw materials in the future" using a 5-point-Likert-scale. Afterwards this scale is substituted using a dichotomous dummy-variable to form the binary variable needed for the binary logistic regression. Answers from 1 to 3 are coded as 0, which is "no purchase intention" and answers from 4 to 5 are coded as 1, which is "purchase intention". The answer 3 ("maybe") of the Likert-scale is added to "no purchase intention" in order to avoid over-interpretation of this position. To apply the derived independent variables in the logistic regression model, the means of each scale are calculated for each respondent and used as input-variables. The construct validities of the defined independent variables used in the present studies are verified by means of factor analyses, which are included in the appendix (Table 6 and Table 7). The derivation and reasons for selecting the independent variables have already been described in detail in section 2.2.2. The independent variables are operationalized as shown in Table 5. These items and scales have already been tested and validated in previous studies, which increases the comparability of the results of this study. Likert scales with five possible answers are used for all independent variables with the exception of product experience, which is collected dichotomously, and socio-demographic characteristics, where several answering options are available.

3.4 Applied methods of statistical data analysis

An overview of the statistical methods applied in the studies is displayed in Table 3. Data analysis was performed using Sawtooth 8 (Sawtooth 2015) and SPSS 23 (IBM Corp. 2015).

Factor analysis

The explorative factor analysis can be used to identify structures in data sets as well as to reduce sets of variables and to standardize the variables (Backhaus et al. 2016b). In this study, items are checked for construct validity in a factor analysis and non-correlating items are removed. The highly correlating items are used to form factors. In addition, factorization or standardization is performed in the CBC analysis, since

factorized variables, i.e. 0-standardized variables, are used as covariates in the hierarchical Bayes estimation.

Binary logistic regression

The binary logistic regression is applied to a dichotomous expression of the dependent variable, and the identified predictor variables contribute to the calculation of the binary expression (Backhaus et al. 2016c). The logit model is then used to calculate the logarithmized probability of the occurrence of an event, in this study the purchase intention of bio-based products. In a further step, the odds for the target variable can be calculated from this. This means the chance for the occurrence or increase of the purchase intention by the identified predictor variables.

Choice based conjoint analysis with hierarchical Bayes estimation

Choice based conjoint analysis (CBC) is a well-known and valid method of examining preferences for innovation or existing products (Eggers and Sattler 2011; Louviere and Woodworth 1983). Although the measured choice decisions do not necessarily lead to purchasing behavior, they do provide information about the motivation to buy certain products, e.g. about important attributes that consumer products offer or about their WTP. The preferences of a respondent are estimated based on the chosen product concepts of the CBC. Therefore, a set of attributes with realistic and existing occurrences (levels) must be selected. Table 2 shows the attributes and levels that have been used for the CBC experiment with the bio-based rain jacket in this study. The product concepts are randomly constructed (random tasks) and chosen selectively (fixed tasks). The defined tasks are part of the validation of the method. By choosing the depicted product concepts, the respondents rate each attribute level. The utility function can be used to translate the decisions made into the consumer's perceived preferences and to predict buying decisions (Eggers and Sattler 2011).

Table 2: Attributes and levels of the CBC for the analyzed bio-based rain jacket

Attributes	Levels
Percentage of bioplastic in fabric	100%
	50%
	20%
Biogenic resource	potatoes
	chipped wood
	Sugar cane
	corn
Origin of resource	South America
	European Union
	United States of America

	Asia	
Product certificate	Free of pollutants	
	Climate protection	
	Fair production	
	Without certificate	
Price	349.- €	
	239.- €	
	109.- €	
	69.- €	

Latent class analysis

A latent class analysis, based on a maximum likelihood estimation, is performed with Sawtooth 8 to calculate clusters within the sample to divide consumers into heterogeneous classes based on their preferences for the analyzed product attributes of the bio-based rain jacket (Sawtooth Software 2004). At the beginning of the estimation, the utility values for each segment are determined randomly. Subsequently, the data of each respondent is compared with the utility values of each segment and the probabilities of each respondent belonging to each segment are calculated, while utility values and group affiliations are iteratively improved. The clustering is estimated with differing group solutions. The best group solution is chosen by a fitting consistent Akaike information criterion (CAIC) and an appropriate relative Chi-square. Additionally, group size and coherence are considered (Sawtooth Software 2004).

Discriminant analysis

The discriminant analysis is a method for classification through influencing variables. As displayed above, discriminant analysis allows the investigation of two or more groups (Backhaus et al. 2016a). In this study, those influencing factors are identified that differentiate between respondent groups showing either a preference for a low price for bio-based apparel or the acceptance of a moderate price for such a product.

Table 3: Statistical methods used in the studies

Dependent variable	Independent variables	Statistical analysis	Tool/Software
Purchase intention for bioplastic products			
	10 factors: Sociodemographic characteristics, GCV, altruism, innovativeness, subjective norm towards bioplastics, attitude towards bioplastics, product experience with bioplastics, interest in information about bioplastics, perceived knowledge about bioplastics, perceived influential communication behavior	Factor analysis	SPSS 23
Purchase intention for bioplastic products	10 factors: Sociodemographic characteristics, GCV, altruism, innovativeness, subjective norm towards	Binary logistic regression	SPSS 23

	bioplastics, attitude towards bioplastics, product experience with bioplastics, interest in information about bioplastics, perceived knowledge about bioplastics, perceived influential communication behavior		
Preferences for bio-based apparel			
	5 factors: GCV, altruism, innovativeness/innovation-friendly, attitude towards bioplastics, trust	Factor analysis	SPSS 23
Relative importance and part worth utilities	6 covariates: product experience with bioplastics, GCV, altruism, innovativeness/innovation-friendly, attitude towards bioplastics, trust Attributes and levels of the simulated product (Table 2)	CBC/HB-estimation	Sawtooth 8
Segmentation and influencing factors for the classification of the price utilities related to bio-based apparel			
6 cluster: Relative importance and part worth utilities	Attributes and levels of the simulated product (Table 2)	Segmentation through latent class analysis	Sawtooth 8
2 classes: Preference for low prices, acceptance of a moderate price	9 factors: Sociodemographic characteristics, product experience with bioplastics, GCV, altruism, innovativeness, attitude towards bioplastics, subjective norm towards bioplastics, purchase intention, interest in bioplastics	Classification through discriminant analysis	SPSS 23

4 Results

In this chapter, the publications and submitted papers are presented in summary form and the specific research question is explained in each case. The full outcome of the research results can be found in the appendices (Appendix B: Publications & manuscript).

4.1 Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany

This chapter summarizes the paper "Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany" written by Florian Felix Klein, Agnes Emberger-Klein, Klaus Menrad, Wiebke Möhring, and Julia-Maria Blesin. This paper is published in the Journal Sustainable Production and Consumption in 2019. The doctoral candidate is the primary author of the paper and is responsible for data collection, data analysis, writing of the manuscript, and editing of the text in agreement with co-authors.

Consumers can hardly distinguish bioplastic products from conventional plastic products in a buying situation, considering that there are usually no external and obvious distinguishing features apart from labels. For various applications of plastic products, bioplastics may be an environmentally friendly substitute. Also in the course of the constant carbonization of the earth's atmosphere through the use of fossil oil, bioplastics are an alternative made of renewable raw materials. However, the purchase and use of such product alternatives is decided by consumers themselves. So far, little is known about the specific factors that influence consumers' purchasing decisions regarding bioplastic products. However, bioplastic products differ in their characteristics, as do consumers' evaluations and personal benefits of a product, as well as the attitudes on the sustainability or other psychographic parameters of a product. Previous consumer studies on bioplastic products have mainly focused on consumer perception and choice behavior, segmentation of bioplastic consumers or their WTP. None of these studies specifically analyze consumers' purchasing intentions for bioplastic products. According to Ajzen's theory of reasoned action, purchase intention serves as a strong predictor for actual purchasing behavior (Ajzen and Fishbein 1980). This research gap reveals two key questions, firstly: do consumers intend to buy bioplastic products? and secondly: what factors influence their buying intention? In this study we investigate the purchase intention for bioplastic products and the factors that influence the purchase intention for bioplastic products on the German market. For this purpose, an extensive literature review is conducted and relevant factors are identified. On this basis, a comprehensive questionnaire is drawn up. In an online access panel, 1673 interviews representative of the German population older than 16 years are collected after data cleaning. The quota of the participants is based on the characteristics age, gender, education and number of inhabitants of the place of residence.

Hypotheses postulating an influence on the purchase intention for bioplastic products are derived from the findings on corresponding factors related to the purchase intention of green and bio-based products found in previous studies. Subsequently, the influences of the analyzed factors on the purchase intention are measured in a binary logistic regression. The strongest influences pro purchase intention for bioplastic products are shown by the Green Consumer Values, followed by the prior product experience with bioplastic products. The variables interest in information about bioplastics and attitude towards bioplastics also show a stronger positive influence. Significant moderate influences are shown by the variables subjective norm towards bioplastics, altruism, perceived influential communication behavior and innovativeness. The socio-demographic variables age, gender and education do not show significant influences on the purchase intention for bioplastic products, nor does the perceived knowledge related to such products.

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Klein, Florian; Emberger-Klein, Agnes; Menrad, Klaus; Möhring, Wiebke; Blesin, Julia-Maria (2019): Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany. In Sustainable Production and Consumption 19, pp. 33-43. DOI: 10.1016/j.spc.2019.01.004.

4.2 Indicators of consumers' preferences for bio-based apparel: a German case study with a functional rain jacket made of bioplastic

This chapter summarizes the paper "Indicators of consumers' preferences for bio-based apparel: a German case study with a functional rain jacket made of bioplastic" written by Florian Felix Klein, Agnes Emberger-Klein, Klaus Menrad. This paper is published in the journal Sustainability in 2020. The doctoral candidate is the primary author of the paper and is responsible for data collection, data analysis, writing of the manuscript, and editing of the text in agreement with co-authors.

The apparel industry has steadily increased its production volume in recent years and products of the fast-fashion division are nowadays market-determining. In addition, modern clothing is often made of synthetic fibers, especially functional apparel. The majority of synthetic fibers are nowadays made from crude oil. This fossil raw material is largely responsible for the carbonization of the earth's atmosphere. Bioplastics made from renewable raw materials offer an alternative. The technical feasibility is undisputed, but do consumers even intend to buy bio-based apparel? And what are the potential driving forces behind the choice of bio-based apparel?

So far, the driving forces and factors that influence consumers' choices for bio-based apparel are hardly known. Few studies have been conducted in this area and none of these studies analyzed consumers' choices in relation to bio-based apparel. In order to close this open research question, this research paper focuses on

the psychographic factors that influence consumers' choices of bio-based functional apparel. A choice based conjoint experiment (CBC) is conducted to analyze the consumers' choice decisions. In order to consider the influence of psychographic drivers, these variables are considered as factorized covariates in the Hierarchical Bayes estimation of the preferences. Thus, this study provides first insights into the influence of psychographic characteristics of consumers linked to the selection of bio-based functional apparel. The relevant psychographic influencing factors are identified through an extensive literature review, with the focus of the research being on previous studies on green apparel, bio-based products and green products. Taking into account the influences found, hypotheses are derived and the direction of influence of the psychographic characteristics on the participants' preference for a specific product attribute is tested. The three key research questions of this study are firstly "Which attributes of bio-based apparel are relevant for consumers' preferences?", secondly "Which covariates have an influence on consumers' assessment of certain attributes of bio-based apparel?" and thirdly "How strong are the influences of certain covariates on consumer choices?" These questions are answered by the results of the CBC and the estimation of the covariates using a hierarchical Bayes estimation algorithm.

On the first research question: The attributes price and product certificate show the highest average importance of all attributes of the analyzed bio-based rain jacket. The highest marginal utilities of the price attribute are found within the lower price levels and the utilities of the certificate attribute indicate that a product without certificate has a high negative benefit for consumers. Within the attribute percentage of bioplastic in fabric, the level 100% bioplastic in the fabric is the one with the highest utility value. The origin of the raw materials also plays a role for consumers of bio-based apparel, as the EU as origin of resource shows a higher utility value compared to the overseas regions.

On the second and third research question: Consumers without product experience with bio-based apparel are likely to have a lower preference for bio-based apparel. Participants with high GCV are more likely to have a preference for bio-based apparel and, in addition, low prices are less relevant for these subjects. Similarly, when a high degree of altruism is observed, low prices for bio-based apparel are less relevant to the respondents. A higher altruism as well as a higher attitude towards bioplastics increases the probability of preferring a certification of bio-based apparel. The covariate trust shows little to no influence on the attributes certification and origin of raw materials, therefore, none of the hypotheses related to trust can be fully confirmed. In addition, a more innovation-friendly consumer has a stronger preference for a high percentage of bioplastic in the fabric of bio-based apparel.

4.3 Consumer preferences in Germany for bio-based apparel with low and moderate prices, and the influence of specific factors in distinguishing these groups

This chapter summarizes the manuscript "Consumer preferences in Germany for bio-based apparel with low and moderate prices, and the influence of specific factors in distinguishing these groups" submitted by Florian Felix Stahl, Agnes Emberger-Klein, and Klaus Menrad to the Journal Business Strategy and the Environment. The doctoral candidate is the primary author of the paper and is responsible for data collection, data analysis, writing of the manuscript, and editing of the text in agreement with co-authors.

Bioplastics are a potential alternative to conventional plastics in order to stop the use of the fossil resource crude oil and as carbon storage. There are very few studies on the consumption of bio-based apparel and consumer preferences for it. In 2016 we have conducted the largest study to date on consumer preferences, attitudes and perceptions of bioplastics in Germany. Our sample of 1,673 participants is representative of the German population, including citizens over the age of 16 who have been surveyed via an online access panel. We have conducted a choice based conjoint analysis for a functional rain jacket. On this basis, we perform a latent class cluster analysis to segment consumers of green bioplastics apparel. Through consumer segmentation, the difference in the price preference of certain cluster groups becomes apparent. In order to examine heterogeneity between these cluster groups more closely, we look for important influencing factors with respect to their price orientation. Therefore, we identify psychographic factors that significantly contribute to the differentiation between consumer groups of bio-based apparel with "preference for a low price" and "acceptance of a moderate price". For further analysis and classification of the two found cluster groups, we perform a discriminant analysis, which allows us to determine the contribution of each factor to the separation of the two price-preference classes.

The socio-demographic variables show no contribution to discrimination, while all other variables are relevant to the differentiation between the two groups of price preferences. Purchase intention for bio-based apparel is the strongest dividing variable, followed by GCV and subjective norms for bio-based apparel. This study has shown that socio-demographic characteristics have no relevance in the separation of the defined consumer price preference groups and it contributes to better illuminate the heterogeneity of consumer preferences for bio-based apparel. Additionally, this study supports the development of new green garments based on consumer preferences (e.g. type and content of fibers, origin of biomass, certificates) and in particular the pricing of bio-based garments. It shows that almost 40% of German consumers compromise on the price of bio-based apparel. It is highly relevant that the marketing of such products also takes into account factors that support allocation to price preference groups.

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5 Discussion

In this chapter, the most important results of the three papers are discussed in summary form, with the key findings of the studies being evaluated from a superordinate perspective. First, the focus is on a discussion of the results in terms of content, followed by a methodological discussion in which the limitations of the work are also addressed.

5.1 Thematic discussion

In the following the most important results and effects of the influencing factors towards the dependent variables are discussed and compared with the work of other authors, first in relationship to the three papers underlying this thesis and second in a cross comparison.

Factors influencing the purchase intention of bioplastic products

GCV shows the strongest influence on the purchase intention for bioplastic products in our study, which is also shown by other authors (Scherer et al. 2017; Haws et al. 2014; Hartmann and Apaolaza-Ibáñez 2012). The previous product experiences with bioplastic products is measured with a high influence on the purchase intention. Thus, our results are in line with previous studies (Chiu et al. 2012; Young 2000; Reinders et al. 2017; Lin 2010; Lee et al. 1995). The variables related to bioplastics, namely interest in information about bioplastics and attitude towards bioplastics both show a strong positive influence on the purchase intention towards bioplastic products, which is also found by McDonald et al. (2009) and Rumm (2016) related to the interest in information and Hartmann and Apaolaza-Ibáñez (2012) and Scherer et al. (2017) related to the attitude. Significant moderate influences are shown by the variables subjective norm towards bioplastics, which is in line with previous studies (Teng et al. 2015; Mishra et al. 2014), altruism, shown by previous studies (Teng et al. 2015; Lusk et al. 2007; Pfattheicher et al. 2016), perceived influential communication behavior, shown by Boster et al. (2011), and innovativeness, consistent with studies of Osburg et al. (2016) and Jansson (2011). The socio-demographic variables age, gender and education do not show significant influences on the purchase intention for bioplastic products, nor does perceived knowledge. From a broader perspective, four variables that are specifically related to bioplastic products (i.e. interest in information about bioplastics, attitude towards bioplastics, former product experience with bioplastics and subjective norm towards bioplastics) all show significant influence on the purchase intention, in contrast to the factor perceived knowledge about bioplastics.

Covariates influencing the choice behavior related to a bio-based rain jacket

The attributes price and product certificate show the highest average importance of all attributes of the analyzed bio-based rain jacket. The highest marginal benefits of the attribute price are found within the lower price levels and the benefits of the attribute certificate indicate that a product without certificate has

a high negative benefit for consumers. Within the attribute percentage of the bioplastics in the fabric, the level 100% bioplastics in the fabric is the one with the highest marginal utility value, also shown by Sijtsema et al. (2016). The origin of the raw materials also plays a role for consumers of bio-based apparel, as the EU as the origin of the resource has a higher utility value compared to overseas regions (Scherer et al. 2017). Consumers without product experience with bio-based apparel are also likely to have a lower preference for bio-based apparel, this is also shown in previous studies (Cowan and Kinley 2014; Khare and Sadachar 2017; Nam et al. 2017; Lee et al. 1995). Participants with high GCV show a higher preference for bio-based apparel, and in addition, low prices are less relevant for them, which is consistent with studies of Haws et al. (2014) and Scherer et al. (2017, 2018b). If a high degree of altruism is observed, low prices for bio-based apparel are also less relevant to respondents, which is also shown by Scherer et al. (2017) and Stern et al. (1993). A higher degree of altruism as well as a higher attitude towards bioplastics increases the likelihood of preferring certification of bio-based garments. Similar findings are reported in previous studies (Lusk et al. 2007; Grolleau et al. 2009). Furthermore, a more innovative consumer has a stronger preference for a high proportion of bioplastics in the fabric of bio-based apparel, which is consistent with the results of previous studies (Scherer et al. 2017; Tellis et al. 2009; Osburg et al. 2016). These results primarily show a significant positive influence of the green attitudinal factors, altruism and the specific variables related to bioplastics on the choice behavior of certain attribute levels of the analyzed bio-based rain jacket that the respondents might value as being more environmental friendly or sustainable. These specific product characteristics of the rain jacket are mainly a high percentage of bioplastics, production of the plant-based raw materials in the EU and green certification labels for bio-based apparel.

Specific factors distinguishing preference groups for low and moderate prices of a bio-based rain jacket

All factors separating the two respondent classes "preference for a low price" and "acceptance of a moderate price" for the analyzed bio-based rain jacket are significant, apart from socio-demographic characteristics, which is in line with previous studies (Tanner and Wölfing Kast 2003; Hess et al. 2013; Diamantopoulos et al. 2003). The variables that contributes most to the separation of the classes are purchase intention for bio-based products, GCV and subjective norm of bio-based apparel. Scherer et al. (2018b) also show that GCV contributes to the classification into interested and uninterested consumers of bioplastic products.

Effect tendencies of the five matching dependent variables on the three target variables

The sets of variables, whose influence on the dependent variables is measured, are composed differently in the three studies (Table 1). For this reason, the effects of the influencing factors can only be compared if they are included in the studies on the three target variables. The influence of the different independent

variables on the three dependent target variables is discussed in the following based on the overview given in Table 4.

The influence of the variable GCV on the target variable is significant in all three studies and is one of the stronger influences in each case. A higher GCV is positively influencing the "acceptance of a moderate price" for bio-based clothing and a higher purchase intention. Furthermore, GCV is associated with a preference for a high proportion of bioplastics in textiles. Similarly, the variable altruism is also associated with a significant influence on the purchase intention of bioplastic products and on the "acceptance of a moderate price" for bio-based apparel. In addition, consumers with higher altruism are more likely to prefer the certification of bio-based garments. Positive assessment of the different attitudes towards bioplastics is also associated with a significant influence on the purchase intention of bioplastic products and on the "acceptance of a moderate price" for bio-based apparel. In addition, consumers with a higher attitude towards bioplastics are more likely to prefer a high proportion of bioplastics in textiles of bio-based apparel and green label certification for climate protection or fair production processes. Previous product experiences with bioplastics have a positive influence on the purchase intention for bioplastic products. In the CBC, test persons with product experience show increased preferences for a high proportion of bioplastics in textiles, production within the EU and certificates for climate protection or non-polluting textiles. Although the variable contributes to separate the classes "preference for a low price" and "acceptance of a moderate price", the CBC participants with prior product experience prefer low prices for bio-based apparel. Participants with a high level of innovativeness show a higher purchase intention for bioplastic products. In addition, participants with a high level of innovativeness prefer a bio-based jacket over the "none" option. They are also prepared to pay higher prices for the bio-based rain jacket, with at the same time preferring a high proportion of bioplastics in the fabric and a certificate for fair production. Innovativeness of consumers contributes to separate the two classes "preference for a low price" and "acceptance of a moderate price". Overall, it can be assumed that consumers who show an "acceptance of a moderate price" for bio-based apparel, which is associated with a high GCV, altruism or innovativeness of such consumers, are likely to be particularly different from those types of consumers who prefer conventional products over green products, as is found in previous studies (Haws et al. 2014; Nam et al. 2017; Rezai et al. 2012; Teng et al. 2015; Thøgersen 2002; Brosdahl and Carpenter 2010; Cowan and Kinley 2014; Hustvedt and Bernard 2008; Rahman et al. 2014; Wiederhold and Martinez 2018; Scherer et al. 2018b), or are very price sensitive also in relation to bio-based products (Scherer et al. 2018b). The specific factors attitudes towards bioplastics and previous product experience with bioplastics also show a high influencing effect on the measured targets and should be considered in future studies in this field.

Table 4: Influence of independent variables on the three target variables

Independent variable	Match[1,2]	Significance[3] for the purchase intention	Significance[3] for the choice behavior	Significance[3] for the classification of the price preference
Sociodemographic variables, age, gender and education	-	No influence on the purchase intention for bioplastic products	-	Not significant for the separation of the price preference groups
Green Consumer Values	X	Positively influencing the purchase intention for bioplastic products (***)	Positively influencing the choice for price (***) and percentage of bioplastic (***)	Significant for the separation of the price preference groups (***)
Altruism	X	Positively influencing the purchase intention for bioplastic products (**)	Positively influencing the choice for price (***) and product certificate (**)	Significant for the separation of the price preference groups (***)
Attitude towards bioplastics	X	Positively influencing the purchase intention for bioplastic products (***)	Positively influencing the choice for bio-based apparel (***), product certificate(***) and percentage of bioplastic (***)	Significant for the separation of the price preference groups (***)
Trust	-	-	Partially positively influencing the choice for product certificate (**)	-
Subjective norm towards bioplastics	-	Positively influencing the purchase intention for bioplastic products (***)	-	Significant for the separation of the price preference groups (***)
Innovativeness and innovation-friendly	X	Positively influencing the purchase intention for bioplastic products (*)	Positively influencing the choice for percentage of bioplastic (***)	Significant for the separation of the price preference groups (***)
Interest in information about bioplastics	-	Positively influencing the purchase intention for bioplastic products (***)	-	-
Interest in bioplastics	-	-	-	Significant for the separation of the price preference groups (***)
Product experience with bioplastics	X	Positively influencing the purchase intention for bioplastic products (***)	Positively influencing the choice for bio-based apparel (***)	Significant for the separation of the price preference groups (***)
Purchase intention towards bioplastic products	-	-	-	Significant for the separation of the price preference groups (***)
Perceived knowledge about bioplastics	-	No influence on the purchase intention for bioplastic products	-	-
Perceived influential communication behavior	-	Positively influencing the purchase intention for bioplastic products (**)	-	-

([1]) X = Independent variables measured in the different studies showing similar influences on the dependent variables

([2]) - = not analyzed, no match

([3]) All shown influences are measured statistically significant on the statistical levels: (*) significant at the 0.05 level, (**) significant at the 0.01 level, (***) significant at the 0.001 level

5.2 Methodical discussion

When investigating the factors influencing the target variables and the overall question related to purchase intention of bioplastics and selection behavior for bio-based apparel, research methods should be chosen that take into account a comprehensive and uniform analysis of all relevant factors. The survey with the participants has been realized in an OAP. The data set and the relationships between the factors are analyzed exclusively quantitatively using multivariate statistics. The adjusted data set with an n of 1,673 participants ensures a valid representativeness for the cited population groups in Germany due to the size of the sample.

Advantages and disadvantages of Web Surveys in OAP in this study

The measurement in an OAP has advantages and disadvantages. On the one hand, the survey of the test persons is carried out very specifically according to the given quota and very fast and demand-oriented. Therefore, many participants can be interviewed quickly and very specifically. The disadvantage is that a limited response quality such as straight-lining, Christmas tree-behavior, conflicting answers and the like has to be detected in a rather high number of participants which results in removal of several answers during data cleaning (see section 3.2). It is also conceivable and difficult to filter that participants with above-average interest prefer to take part in the survey. The participation of semi-professional survey participants can also cause another possible distortion. In conclusion, it can be said that web surveys are a cost-effective and time-efficient survey method in which the response behavior should be examined more closely to avoid distortions.

Target group of the survey

The target group of the survey in this thesis is the population in Germany aged 16 years and older, aiming that the sample should represent the socio-demographic structure of the population as far as possible. The quota of participants is based on the socio-demographic characteristics of age, gender, education and size of residence. The target ratios are based on the German "Mikrozensus". In the end, the set quota is achieved and there are only small deviations, which are not statistically significant. Any kind of a possible selection error of the participants cannot be completely excluded by the set quotas, such as participants with above-average interest or semi-professional survey participants. However, due to the use of an OAP, this procedure is necessary to ensure representativeness with respect to the chosen socio-demographic characteristics.

Selection of influencing factors and unexplained part in analysis

As in all studies, the target variables cannot be fully explained with the chosen independent variables. This is partly due to general limitations concerning the research on possible influencing factors and partly to the methods and procedures used in this study. One reason for not explaining the overall proportion of the variance in the different target variables in the present thesis, is the procedure aiming to identify and test

existing influencing factors from previous scientific studies. Other possible factors that have not yet been measured and require new research and design are therefore not analyzed in this study. The non-explanatory part of the study is also evident in the choice experiment, as the construction of a product concept is limited to a rather small set of product attributes and levels of bio-based products in order not to overstrain the response capacities of survey participants. Therefore the consumer preferences obtained from the CBC experiments are always linked to specific attributes, and these again are linked with the product concept. For this reason, relevant attributes are researched and implemented into the CBC product design of the analyzed functional rain jacket. The factors, products and product attributes not considered can be investigated in future studies in the field of consumers and bioplastics. The recurring indecisive attitude of the test persons towards bioplastic products is striking in the present as well as in previous studies. This is presumably due to the low level of experience of the test persons with bioplastics, which is also evident in previous studies (Rumm 2016; Kurka 2012; Kainz 2016) as well as a limited consumer knowledge related to this subject in Germany (Blesin et al. 2017; Blesin et al. 2020). This is presumably no longer a factor in scientific studies in case bio-based products have become more widely known and are more adopted by consumers.

What about the bias caused by social desirability?

In particular, surveys aimed at self-reported environmental attitudes often assume a certain social desirability (Grimm 2010). However, Milfont (2009) and Kaiser et al. (1999) find that this influence is marginal and that the scales therefore do not lose validity in their basic statement and direction of effect. Therefore, social desirability can be given the same consideration as in all studies measuring environmental behavior. In this study, the social desirability both in the construction of the survey scales and in the statistical analysis, is assumed to be marginal and therefore no error calculation is made in this respect.

Why is no behavior related to bio-based products investigated?

The intention to carry out an action does not necessarily mean that the intention also leads to the proclaimed action (Morrison 1979; Kalwani and Silk 1982). For this reason, in an additional step, the choice behavior related to bio-based products is investigated in this thesis, thereby taking into account the role of selected independent variables in the form of covariates. However, a CBC is also a simulated purchase situation and the choice behavior of the respondents can be different in a real purchase situation. But McFadden (1986) finds out, that the product choices in a CBC also represent valid results of actual buying behavior. Therefore, valid and transferable choice results are assumed in this study as well. However, product concepts in a CBC are linked to the attributes used and their levels. When choosing the attributes, the researcher makes a decision about the importance of individual attributes in relation to others and attributes are therefore in principle also to be considered as hyper parameters. In this study, the attributes and levels of the analyzed

bio-based apparel are selected carefully. Currently available products are compared and frequently matching characteristics are considered for the selection of attributes. Thus, the product attributes represent a market-driven situation of current bio-based outdoor rainwear. Nevertheless, not all attributes and their characteristics can be considered and it is conceivable that certain consumers take missing attributes more into account when choosing an outdoor rain jacket. For this reason, CBCs with new bio-based product concepts should be created in the future and consumer preferences for specific product attributes should be specifically investigated. However, no direct behavioral measurements are made in this study. Data collection for behavioral measurements are very complex and also prone to errors as previous studies showed (Barker et al. 1994; Morwitz and Fitzsimons 2004; Morwitz 2012). In addition, they are very costly and often require established consumer panels. Additionally, the tested products have to be already introduced in the market or they must be available at least as prototypes so that they can be sold to consumers for research purposes. But the least requirement is not fulfilled for the analyzed rain jacket. Nevertheless, with the development of more bio-based products in the coming years, real purchase situations can be observed and correlations with influencing factors, such as those in this study, can be investigated in future studies. One example in this respect represents the study of Scherer et al. (2020) who questions customers of an online shop about the purchase of bio-based products in Germany.

Transferability of the results to other products and international comparability

The first study of this thesis analyzes the purchase intentions for bioplastic products in general in Germany. Although there are no directly comparable studies in previous scientific literature that has been carried out in other countries, the comparison of the results of this study with previous research shows that the influence of the analyzed variables is mostly in line with the outcome of other authors (see section 5.1) so that at least a partial international transferability is assumed for this part of the thesis. In the further investigations, preferences and attitudes regarding bio-based apparel are analyzed. Thereby, the results on consumer preferences are product-related, but a comparison of these results again shows at least similar results in earlier studies, which provides arguments for assuming a certain transferability of the results of this work to other bio-based product categories and also to countries outside Germany. Further studies can be based on the insights of this thesis and compare the influence of different independent variables on differing bio-based products in parallel. Additionally, such studies can be used for investigations related to the theoretical framework related to purchase intentions and actual purchase of bio-based products. It also should be noted that this study investigates the attitudes and preferences of consumers in Germany. Due to the structure and the high number of participants in the sample, the results are assumed to be representative for the analyzed target group. However, it is possible that consumers from other countries show different attitudes and preferences related to bio-based products. The international transferability of the insights of this study can

be verified by investigations in other countries. Thereby, the same scales can be used and a similar study design ensures comparability.

5.3 Future implications

Knowing which attributes are relevant for consumers of bio-based products and which attitudes they have, is an important information not only for companies actually offering or developing such products, but also for decision-makers in politics or society who want to promote transformation of the economy in direction of more sustainable products. Based on the outcome of this thesis, there are several possible levers in order to exert influence. On the one hand, there are the identified conventional plastic preferring consumers with the preference for a low price for the analyzed products, and on the other hand the more green consumers with a higher acceptance of a moderately higher price for bio-based products. The latter group will most likely buy bio-based products if they are available on the markets on a larger scale in the future, even if they are offered at moderately higher prices (Trudel 2018; Steg and Vlek 2009; Laroche et al. 2001). Conventional plastic preferring consumers, who actually show little willingness to support sustainable products and instead focus on the attribute "low price", can possibly be convinced to more sustainable consumption behavior taking into account a longer time perspective. This can be influenced, for example, through social influence, nudging in shopping situations and also through education addressing a sustainable consumption or other actions (White et al. 2019; Buerke et al. 2017; Zsóka et al. 2013; Gatersleben et al. 2002). Finally, it is important to note that bioplastics are not per se more environmentally friendly, as shown by studies of Venkatachalam et al. (2018) and Spierling et al. (2018). At this point, regional and product-specific studies are necessary to analyze the specific conditions at production sites, production methods and supply chains, etc. Nevertheless, bio-based plastics offer a great opportunity both to capture and store carbon from the atmosphere and to produce high-quality products that differ from conventional plastics, for example through biodegradability and the absence of petroleum, i.e. the use of non-fossil carbon, and thus contribute to the transformation of the economy in direction of more sustainability.

Publication bibliography

Ajzen, Icek (1991): The theory of planned behavior. In *Organizational Behavior and Human Decision Processes* 50 (2), pp. 179–211. DOI: 10.1016/0749-5978(91)90020-T.

Ajzen, Icek; Fishbein, Martin (1980): Understanding attitudes and predicting social behavior. Pbk. ed. Englewood Cliffs, N.J.: Prentice-Hall.

Atkinson, Lucy; Rosenthal, Sonny (2014): Signaling the green sell. The influence of eco-label source, argument specificity, and product involvement on consumer trust. In *Journal of Advertising* 43 (1), pp. 33–45. DOI: 10.1080/00913367.2013.834803.

Austgulen, Marthe Hårvik (2016): Environmentally Sustainable Textile Consumption—What Characterizes the Political Textile Consumers? In *Journal of Consumer Policy* 39 (4), pp. 441–466.

Backhaus, Klaus; Erichson, Bernd; Weiber, Rolf; Plinke, Wulff (2016a): Diskriminanzanalyse. In Backhaus (Ed.): Multivariate Analysemethoden. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 215–282.

Backhaus, Klaus; Erichson, Bernd; Weiber, Rolf; Plinke, Wulff (2016b): Faktorenanalyse. In Backhaus (Ed.): Multivariate Analysemethoden. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 385–452.

Backhaus, Klaus; Erichson, Bernd; Weiber, Rolf; Plinke, Wulff (2016c): Logistische regression. In : Multivariate Analysemethoden: Springer, pp. 283–356.

Barker, Kathleen; Fong, Lynda; Grossman, Samara; Quin, Colin; Reid, Rachel (1994): Comparison of self-reported recycling attitudes and behaviors with actual behavior. In *Psychological Reports* 75 (1), pp. 571–577.

Batson, C. Daniel; Powell, Adam A. (2003): Altruism and Prosocial Behavior. In John Wiley (Ed.): Handbook of Psychology, Volume 5 - Personality and Social Psychology. Hoboken, NJ, USA: Wiley & Sons, Inc., pp. 463–484. Available online at http://www.communicationcache.com/uploads/1/0/8/8/10887248/handbook_of_psychology_volume_5_personality_and_social_psychology_2003.pdf#page=485.

Beierlein, Constanze; Kemper, Christoph; Kovaleva, Anastassyia; Rammstedt, Beatrice (2012): Kurzskala zur Messung des zwischenmenschlichen Vertrauens. Die Kurzskala Interpersonales Vertrauen (KUSIV3). Edited by GESIS Leibniz-Institut für Sozialwissenschaften. GESIS Leibniz-Institut für Sozialwissenschaften. Köln, Germany (GESIS-Working papers, 22). Available online at https://nbn-resolving.org/urn:nbn:de:0168-ssoar-312126.

Blesin, J. M.; Klein, F.; Emberger-Klein, A.; Scherer, C.; Menrad, K.; Möhring, W. (2017): Bevölkerungsrepräsentative Online-Befragung in Deutschland zu Biokunststoffen. Arbeitsbericht Oktober

2017. Edited by University of Applied Sciences Hannover, University of Applied Sciences Weihenstephan-Triesdorf. University of Applied Sciences Hannover, University of Applied Sciences Weihenstephan-Triesdorf. Hannover, Germany, Straubing, Germany. Available online at http://biokunststoffe-nachhaltig.de/files/Downloads/BiNa%20Working%20Paper%20zur%20Bevoelkerungsbefragung%202016.pdf, checked on 12/25/2019.

Blesin, Julia-Maria; Möhring, Wiebke; Klein, Florian; Scherer, Christoph; Emberger-Klein, Agnes; Menrad, Klaus (2020): Biokunststoffe in der Wahrnehmung und Einschätzung der deutschen VerbraucherInnen und Bevölkerung. In Hans-Josef Endres, Marina Mudersbach, Hannah Behnsen, Sebastian Spierling (Eds.): Biokunststoffe unter dem Blickwinkel der Nachhaltigkeit und Kommunikation. Springer Vieweg, Wiesbaden.: Springer Nature 2020, pp. 127–158.

Boster, Franklin J.; Kotowski, Michael R.; Andrews, Kyle R.; Serota, Kim (2011): Identifying Influence: Development and Validation of the Connectivity, Persuasiveness, and Maven Scales. In *Journal of Communication* 61 (1), pp. 178–196. DOI: 10.1111/j.1460-2466.2010.01531.x.

Brosdahl, Deborah J. C.; Carpenter, Jason M. (2010): Consumer knowledge of the environmental impacts of textile and apparel production, concern for the environment, and environmentally friendly consumption behavior. In *Journal of textile and apparel, technology and management* 6, 4 (4). Available online at http://ojs.cnr.ncsu.edu/index.php/jtatm/article/download/854/730.

Buerke, Anja; Straatmann, Tammo; Lin-Hi, Nick; Müller, Karsten (2017): Consumer awareness and sustainability-focused value orientation as motivating factors of responsible consumer behavior. In *Rev Manag Sci* 11 (4), pp. 959–991. DOI: 10.1007/s11846-016-0211-2.

Buxel, Holger (2010): Akzeptanz und Nutzung von Güte- und Qualitätssiegeln auf Lebensmitteln. Ergebnisse einer empirischen Untersuchung. University of Applied Sciences Münster.

Callegaro, Mario; Baker, Reg; Bethlehem, Jelke; Göritz, Anja S.; Krosnick, Jon A.; Lavrakas, Paul J. (2014): Online Panel Research. A data quality perspective. Chichester, UK: John Wiley & Sons, Ltd.

Casimir, Gerda; Dutilh, Chris (2003): Sustainability: a gender studies perspective*. In *Int J Cons Stud* 27 (4), pp. 316–325. DOI: 10.1046/j.1470-6431.2003.00323.x.

Chekima, Brahim; Wafa, Syed Azizi Wafa Syed Khalid; Igau, Oswald Aisat; Chekima, Sohaib; Sondoh Jr, Stephen Laison (2016): Examining green consumerism motivational drivers. Does premium price and demographics matter to green purchasing? In *Journal of Cleaner Production* 112, pp. 3436–3450. DOI: 10.1016/j.jclepro.2015.09.102.

Chen, Yu-Shan; Chang, Ching-Hsun (2013a): Greenwash and green trust. The mediation effects of green consumer confusion and green perceived risk. In *Journal of Business Ethics* 114 (3), pp. 489–500. DOI: 10.1007/s10551-012-1360-0.

Chen, Yu-Shan; Chang, Ching-Hsun (2013b): Towards green trust. The influences of green perceived quality, green perceived risk, and green satisfaction. In *Management Decision* 51 (1), pp. 63–82. DOI: 10.1108/00251741311291319.

Childers, Terry L. (1986): Assessment of the psychometric properties of an opinion leadership scale. In *Journal of Marketing Research*, pp. 184–188.

Chiu, Chao-Min; Hsu, Meng-Hsiang; Lai, Hsiangchu; Chang, Chun-Ming (2012): Re-examining the influence of trust on online repeat purchase intention: The moderating role of habit and its antecedents. In *Decision Support Systems* 53 (4), pp. 835–845. DOI: 10.1016/j.dss.2012.05.021.

Cowan, Kirsten; Kinley, Tammy (2014): Green spirit. Consumer empathies for green apparel. In *International Journal of Consumer Studies* 38 (5), pp. 493–499. DOI: 10.1111/ijcs.12125.

Diamantopoulos, Adamantios; Schlegelmilch, Bodo B.; Sinkovics, Rudolf R.; Bohlen, Greg M. (2003): Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. In *Journal of Business Research* 56 (6), pp. 465–480. DOI: 10.1016/S0148-2963(01)00241-7.

Eckmann, Claire (2019): Strategies for the promotion of consumer acceptance within the bio-based economy. How to promote consumer acceptance for bio-based products manufactured from secondary biomass feedstocks: University of Twente.

Eggers, Felix; Sattler, Henrik (2011): Preference measurement with conjoint analysis. Overview of state-of-the-art approaches and recent developments. In *GfK Marketing Intelligence Review* 3 (1), pp. 36–47. DOI: 10.2478/gfkmir-2014-0054.

Endres, Hans-Josef (2019): Bioplastics. In Kurt Wagemann, Nils Tippkötter (Eds.): Biorefineries, vol. 166. Cham, Switzerland: Springer International Publishing (Advances in Biochemical Engineering/Biotechnology), pp. 427–468.

Endres, Hans-Josef; Siebert-Raths, Andrea (2011): Engineering biopolymers. Markets, manufacturing, properties, and applications. München, Germany: Hanser Publishers (71148).

Englis, Basil G.; Phillips, Diane M. (2013): Does Innovativeness Drive Environmentally Conscious Consumer Behavior? In *Psychol. Mark.* 30 (2), pp. 160–172. DOI: 10.1002/mar.20595.

Evans, Joel R.; Mathur, Anil (2005): The value of online surveys. In *Internet Research* 15 (2), pp. 195–219. DOI: 10.1108/10662240510590360.

Fandos Herrera, Carmina; Flavián Blanco, Carlos (2011): Consequences of consumer trust in PDO food products. The role of familiarity. In *Journal of Product & Brand Management* 20 (4), pp. 282–296. DOI: 10.1108/10610421111148306.

Gatersleben, Birgitta; Steg, Linda; Vlek, Charles (2002): Measurement and Determinants of Environmentally Significant Consumer Behavior. In *Environment and Behavior* 34 (3), pp. 335–362. DOI: 10.1177/0013916502034003004.

German Federal Statistical Office (2015): Mikrozensus. Edited by Statistisches Bundesamt. Statistisches Bundesamt (Mikrozensus). Available online at https://www.destatis.de/, checked on 5/14/2018.

Grimm, Pamela (2010): Social desirability bias. In *Wiley international encyclopedia of marketing*. DOI: 10.1002/9781444316568.wiem02057.

Grolleau, Gilles; Ibanez, Lisette; Mzoughi, Naoufel (2009): Too much of a good thing? Why altruism can harm the environment? In *Ecological Economics* 68 (7), pp. 2145–2149. DOI: 10.1016/j.ecolecon.2009.02.020.

Hamzaoui Essoussi, Leila; Zahaf, Mehdi (2008): Decision making process of community organic food consumers. An exploratory study. In *Journal of Consumer Marketing* 25 (2), pp. 95–104. DOI: 10.1108/07363760810858837.

Hartmann, Patrick; Apaolaza-Ibáñez, Vanessa (2012): Consumer attitude and purchase intention toward green energy brands. The roles of psychological benefits and environmental concern. In *Journal of Business Research* 65 (9), pp. 1254–1263. DOI: 10.1016/j.jbusres.2011.11.001.

Haws, Kelly L.; Winterich, Karen Page; Naylor, Rebecca Walker (2014): Seeing the world through GREEN-tinted glasses. Green consumption values and responses to environmentally friendly products. In *Journal of Consumer Psychology* 24 (3), pp. 336–354. DOI: 10.1016/j.jcps.2013.11.002.

Hefner, Dorothée (2013): „Wie kriegen wir sie ins Boot?" Eine Typologie zur Entwicklung von Kommunikationsstrategien zur Förderung umweltschützenden Verhaltens. In *M&K* 61 (3), pp. 387–405. DOI: 10.5771/1615-634x-2013-3-387.

Hess, Stephane; Shires, Jeremy; Jopson, Ann (2013): Accommodating underlying pro-environmental attitudes in a rail travel context: application of a latent variable latent class specification. In *Transportation Research Part D: Transport and Environment* 25, pp. 42–48.

Hustvedt, Gwendolyn; Bernard, John C. (2008): Consumer willingness to pay for sustainable apparel: the influence of labelling for fibre origin and production methods. In *Int J Cons Stud* 32 (5), pp. 491–498. DOI: 10.1111/j.1470-6431.2008.00706.x.

Hustvedt, Gwendolyn; Bernard, John C. (2010): Effects of social responsibility labelling and brand on willingness to pay for apparel. In *International Journal of Consumer Studies* 34 (6), pp. 619–626. DOI: 10.1111/j.1470-6431.2010.00870.x.

Hustvedt, Gwendolyn; Dickson, Marsha A. (2009): Consumer likelihood of purchasing organic cotton apparel. In *JFMM*.

IBM Corp. (2015): IBM SPSS 23 Statistics for Windows. Version 23.0. Armonk, NY, USA: IBM Corp. Available online at https://www.ibm.com/support/pages/downloading-ibm-spss-statistics-23, checked on 12/26/2019.

IfBB (2019): Biopolymers facts and statistics 2019. Production capacities, processing routes, feedstock, land and water use. Hochschule Hannover, IfBB – Institute for Bioplastics and Biocomposites. Hannover, Germany (Biopolymers facts and statistics, Edition 6). Available online at https://www.ifbb-hannover.de/files/IfBB/downloads/faltblaetter_broschueren/f+s/Biopolymers-Facts-Statistics-2019.pdf.

IfBB Hannover (2014-2020): Project homepage of BiNa (Biokunststoffe Nachhaltig). New pathways, strategies, business and communication models for bioplastics as a building block of a sustainable economy. Edited by IfBB Hannover. Institute for Bioplastics and Biocomposistes. Internet. Available online at http://www.biokunststoffe-nachhaltig.de/index.php/home.html.

Jaiswal, Deepak; Kant, Rishi (2018): Green purchasing behaviour: A conceptual framework and empirical investigation of Indian consumers. In *Journal of Retailing and Consumer Services* 41, pp. 60–69. DOI: 10.1016/j.jretconser.2017.11.008.

Jansson, Johan (2011): Consumer eco-innovation adoption. Assessing attitudinal factors and perceived product characteristics. In *Bus. Strat. Env.* 20 (3), pp. 192–210. DOI: 10.1002/bse.690.

Jiménez, Nadia Huitzilin; San Martín, Sonia (2010): The role of country-of-origin, ethnocentrism and animosity in promoting consumer trust. The moderating role of familiarity. In *International Business Review* 19 (1), pp. 34–45. DOI: 10.1016/j.ibusrev.2009.10.001.

Kainz, Ulla (2016): Consumers' Willingness to Pay for Durable Biobased Plastic Products. Findings from an Experimental Auction. Doctoral Dissertation. Technische Universität München, München, Germany. Faculty of Economics. Available online at https://mediatum.ub.tum.de/doc/1293618/file.pdf.

Kainz, Ulla; Zapilko, Marina; Decker, Thomas; Menrad, Klaus (2013): Consumer-relevant information about bioplastics. In *First International Conference on Resource Efficiency in Interorganizational Networks*, pp. 391–402. Available online at https://d-nb.info/104844399X/34#page=407.

Kaiser, Florian G.; Fuhrer, Urs (2003): Ecological Behavior's Dependency on Different Forms of Knowledge. In *Applied Psychology* 52 (4), pp. 598–613. DOI: 10.1111/1464-0597.00153.

Kaiser, Florian G.; Ranney, Michael; Hartig, Terry; Bowler, Peter A. (1999): Ecological Behavior, Environmental Attitude, and Feelings of Responsibility for the Environment. In *European Psychologist* 4 (2), pp. 59–74. DOI: 10.1027//1016-9040.4.2.59.

Kalwani, Manohar U.; Silk, Alvin J. (1982): On the Reliability and Predictive Validity of Purchase Intention Measures. In *Marketing Science* 1 (3), pp. 243–286. DOI: 10.1287/mksc.1.3.243.

Kaufmann, Hans Ruediger; Panni, Mohammad Fateh Ali Khan; Orphanidou, Yianna (2012): Factors affecting consumers' green purchasing behavior: An integrated conceptual framework. In *Amfiteatru Economic Journal* 14 (31), pp. 50–69. Available online at http://hdl.handle.net/10419/168746.

Khare, Arpita; Sadachar, Amrut (2017): Green apparel buying behaviour. A study on Indian youth. In *International Journal of Consumer Studies* 41 (5), pp. 558–569. DOI: 10.1111/ijcs.12367.

Kim, Yeonshin; Choi, Sejung Marina (2005): Antecedents of green purchase behavior: An examination of collectivism, environmental concern, and PCE. In *ACR North American Advances*.

Klein, Florian; Emberger-Klein, Agnes; Menrad, Klaus; Möhring, Wiebke; Blesin, Julia-Maria (2019): Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany. In *Sustainable Production and Consumption* 19, pp. 33–43. DOI: 10.1016/j.spc.2019.01.004.

Klein, Florian Felix; Emberger-Klein, Agnes; Menrad, Klaus (2020): Indicators of Consumers' Preferences for Bio-Based Apparel: A German Case Study with a Functional Rain Jacket Made of Bioplastic. In *Sustainability* 12 (2), p. 675. DOI: 10.3390/su12020675.

Koszewska, Małgorzata (2013): A typology of Polish consumers and their behaviours in the market for sustainable textiles and clothing. In *Int J Cons Stud* 37 (5), pp. 507–521.

Kozar, Joy M.; Connell, Kim Y. Hiller (2013): Socially and environmentally responsible apparel consumption: Knowledge, attitudes, and behaviors. In *Social responsibility journal*.

Kurka, Stefan (2012): Biomasse-basierte Produkte aus Konsumentensicht-ausgewählte europäische Länder im Vergleich. Doctoral dissertation. Technische Universität München, München, Germany. Faculty of Economics. Available online at https://mediatum.ub.tum.de/doc/1086928/file.pdf.

Laroche, Michel; Bergeron, Jasmin; Barbaro-Forleo, Guido (2001): Targeting consumers who are willing to pay more for environmentally friendly products. In *Journal of Consumer Marketing* 18 (6), pp. 503–520. DOI: 10.1108/EUM0000000006155.

Lee, Yung-Jaan; Young, Raymond de; Marans, Robert W. (1995): Factors Influencing Individual Recycling Behavior in Office Settings. In *Environment and Behavior* 27 (3), pp. 380–403. DOI: 10.1177/0013916595273006.

Lin, Shu-Hwa (2010): A case study in Hawaii. Who will pay more for organic cotton? In *International Journal of Consumer Studies* 34 (4), pp. 481–489. DOI: 10.1111/j.1470-6431.2010.00899.x.

Louviere, Jordan J.; Hensher, David A.; Swait, Joffre D. (2000): Stated choice methods: analysis and applications: Cambridge University Press.

Louviere, Jordan J.; Woodworth, George (1983): Design and analysis of simulated consumer choice or allocation experiments. An approach based on aggregate data. In *Journal of Marketing Research*, pp. 350–367. DOI: 10.1177/002224378302000403.

Lusk, Jayson L.; Nilsson, Tomas; Foster, Ken (2007): Public Preferences and Private Choices. Effect of Altruism and Free Riding on Demand for Environmentally Certified Pork. In *Environ Resource Econ* 36 (4), pp. 499–521. DOI: 10.1007/s10640-006-9039-6.

Lynch, Durwin H.J.; Klaassen, Pim; Broerse, Jacqueline E.W. (2017): Unraveling Dutch citizens' perceptions on the bio-based economy: The case of bioplastics, bio-jetfuels and small-scale bio-refineries. In *Industrial Crops and Products* 106, pp. 130–137. DOI: 10.1016/j.indcrop.2016.10.035.

McDonald, Seonaidh; Oates, Caroline; Thyne, Maree; Alevizou, Panayiota; McMorland, Leigh-Ann (2009): Comparing sustainable consumption patterns across product sectors. In *International Journal of Consumer Studies* 33 (2), pp. 137–145. DOI: 10.1111/j.1470-6431.2009.00755.x.

McFadden, Daniel (1986): The choice theory approach to market research. In *Marketing Science* 5 (4), pp. 275–297.

Microsoft Corporation (2016): Microsoft Excel. Version 2016: Microsoft Corporation. Available online at https://office.microsoft.com/excel.

Milfont, Taciano L. (2009): The effects of social desirability on self-reported environmental attitudes and ecological behaviour. In *Environmentalist* 29 (3), pp. 263–269. DOI: 10.1007/s10669-008-9192-2.

Mishra, Deepti; Akman, Ibrahim; Mishra, Alok (2014): Theory of Reasoned Action application for Green Information Technology acceptance. In *Computers in Human Behavior* 36, pp. 29–40. DOI: 10.1016/j.chb.2014.03.030.

Morrison, Donald G. (1979): Purchase Intentions and Purchase Behavior. In *Journal of Marketing* 43 (2), p. 65. DOI: 10.2307/1250742.

Morwitz, Vicki (2012): Consumers' Purchase Intentions and their Behavior. In *FNT in Marketing* 7 (3), pp. 181–230. DOI: 10.1561/1700000036.

Morwitz, Vicki G.; Fitzsimons, Gavan J. (2004): The mere-measurement effect: Why does measuring intentions change actual behavior? In *Journal of Consumer Psychology* 14 (1-2), pp. 64–74.

Nam, Changhyun; Dong, Huanjiao; Lee, Young-A (2017): Factors influencing consumers' purchase intention of green sportswear. In *Fash Text* 4 (1), p. 179. DOI: 10.1186/s40691-017-0091-3.

Nuttavuthisit, Krittinee; Thøgersen, John (2017): The Importance of Consumer Trust for the Emergence of a Market for Green Products. The Case of Organic Food. In *Journal of Business Ethics* 140 (2), pp. 323–337. DOI: 10.1007/s10551-015-2690-5.

Osburg, Victoria-Sophie; Strack, Micha; Toporowski, Waldemar (2016): Consumer acceptance of Wood-Polymer Composites. A conjoint analytical approach with a focus on innovative and environmentally concerned consumers. In *Journal of Cleaner Production* 110, pp. 180–190. DOI: 10.1016/j.jclepro.2015.04.086.

Padel, Susanne; Foster, Carolyn (2005): Exploring the gap between attitudes and behaviour. Understanding why consumers buy or do not buy organic food. In *British Food Journal* 107 (8), pp. 606–625. DOI: 10.1108/00070700510611002.

Pfattheicher, Stefan; Sassenrath, Claudia; Schindler, Simon (2016): Feelings for the Suffering of Others and the Environment. In *Environment and Behavior* 48 (7), pp. 929–945. DOI: 10.1177/0013916515574549.

Pilla, Srikanth (2011): Handbook of bioplastics and biocomposites engineering applications. Hoboken, NJ, USA: John Wiley & Sons (81).

Price, Linda L.; Feick, Lawrence F.; Guskey, Audrey (1995): Everyday Market Helping Behavior. In *Journal of Public Policy & Marketing* 14 (2), pp. 255–266.

Rahman, Saleem Ur; Saleem, Salman; Akhtar, Sana; Ali, Tajamal; Khan, Muhammad Adnan (2014): Consumers' adoption of apparel fashion. The role of innovativeness, involvement, and social values. In *International Journal of Marketing Studies* 6 (3), p. 49. DOI: 10.5539/ijms.v6n3p49.

Rammstedt, Beatrice; Kemper, Christoph J.; Klein, Mira Céline; Beierlein, Constanze; Kovaleva, Anastassiya (2013): A Short Scale for Assessing the Big Five Dimensions of Personality. Big-Five-Inventory-10 (BFI-10). Edited by GESIS Leibniz-Institut für Sozialwissenschaften. GESIS Leibniz-Institut

für Sozialwissenschaften. Köln, Germany (methoden, daten, analysen, 2). Available online at https://orbilu.uni.lu/bitstream/10993/21183/1/MDA_Vol7_2013-2_Rammstedt.pdf.

Reinders, Machiel J.; Onwezen, Marleen C.; Meeusen, Marieke J.G. (2017): Can bio-based attributes upgrade a brand? How partial and full use of bio-based materials affects the purchase intention of brands. In *Journal of Cleaner Production* 162, pp. 1169–1179. DOI: 10.1016/j.jclepro.2017.06.126.

Rezai, Golnaz; Teng, Phuah Kit; Mohamed, Zainalabidin; Shamsudin, Mad Nasir (2012): Consumers' awareness and consumption intention towards green foods. In *African Journal of Business Management* 6 (12), p. 4496.

Rumm, Stefanie (2016): Verbrauchereinschätzungen zu Biokunststoffen. eine Analyse vor dem Hintergrund des heuristic-systematic model. Doctoral Dissertation. Technische Universität München, München, Germany. Faculty of Economics. Available online at http://mediatum.ub.tum.de?id=1306582.

Rumm, Stefanie; Klein, Agnes; Zapilko, Marina; Menrad, Klaus (2013): Labelling for bio-based plastics. In Jutta Geldermann, Matthias Schumann (Eds.): First international Conference on Resource Efficiency in Interorganizational Networks. ResEff 2013. Göttingen, Germany: Universitätsdrucke Göttingen, pp. 403–414. Available online at https://www.researchgate.net/profile/Rupert_Wimmer/publication/260303161_From_waste_to_value_-_composite_materials_from_industrial_process_waste/links/0a85e530b4db7cc99d000000.pdf#page=419.

Sammer, Katharina; Wüstenhagen, Rolf (2006): The influence of eco-labelling on consumer behaviour–Results of a discrete choice analysis for washing machines. In *Bus. Strat. Env.* 15 (3), pp. 185–199. DOI: 10.1002/bse.522.

Sawtooth (2015): SSI Web 8. Version 8.4.8. Orem, Utah, USA: Sawtooth Software Inc., checked on 12/26/2019.

Sawtooth Software, Inc. (2004): The CBC Latent Class. Version 3. Edited by Inc. Sawtooth Software (Technical Paper Series). Available online at https://www.sawtoothsoftware.com/support/technical-papers/sawtooth-software-products/cbc-latent-class-technical-paper-2004, checked on 8/23/2019.

Scherer, Christoph; Emberger-Klein, Agnes; Menrad, Klaus (2017): Biogenic product alternatives for children. Consumer preferences for a set of sand toys made of bio-based plastic. In *Sustainable Production and Consumption* 10, pp. 1–14. DOI: 10.1016/j.spc.2016.11.001.

Scherer, Christoph; Emberger-Klein, Agnes; Menrad, Klaus (2018a): Consumer preferences for outdoor sporting equipment made of bio-based plastics. Results of a choice-based-conjoint experiment in Germany. In *Journal of Cleaner Production* 203, pp. 1085–1094. DOI: 10.1016/j.jclepro.2018.08.298.

Scherer, Christoph; Emberger-Klein, Agnes; Menrad, Klaus (2018b): Segmentation of interested and less interested consumers in sports equipment made of bio-based plastic. In *Sustainable Production and Consumption* 14, pp. 53–65. DOI: 10.1016/j.spc.2018.01.003.

Scherer, Christoph; Klein, Florian; Emberger-Klein, Agnes; Menrad, Klaus (2020): Einschätzung von Biokunststoffen in der Bevölkerung und bei KäuferInnen in Deutschland. In : Biokunststoffe unter dem Blickwinkel der Nachhaltigkeit und Kommunikation: Springer, pp. 159–181.

Schleenbecker, Rosa; Hamm, Ulrich (2013): Consumers' perception of organic product characteristics. A review. In *Appetite* 71, pp. 420–429.

Sijtsema, Siet J.; Onwezen, Marleen C.; Reinders, Machiel J.; Dagevos, Hans; Partanen, Asta; Meeusen, Marieke (2016): Consumer perception of bio-based products—An exploratory study in 5 European countries. In *NJAS-Wageningen Journal of Life Sciences* 77, pp. 61–69. DOI: 10.1016/j.njas.2016.03.007.

Spierling, Sebastian; Knüpffer, Eva; Behnsen, Hannah; Mudersbach, Marina; Krieg, Hannes; Springer, Sally et al. (2018): Bio-based plastics-A review of environmental, social and economic impact assessments. In *Journal of Cleaner Production* 185, pp. 476–491. DOI: 10.1016/j.jclepro.2018.03.014.

Steg, Linda; Vlek, Charles (2009): Encouraging pro-environmental behaviour: An integrative review and research agenda. In *Journal of Environmental Psychology* 29 (3), pp. 309–317. DOI: 10.1016/j.jenvp.2008.10.004.

Stern, Paul C.; Dietz, Thomas; Kalof, Linda (1993): Value Orientations, Gender, and Environmental Concern. In *Environment and Behavior* 25 (5), pp. 322–348. DOI: 10.1177/0013916593255002.

Straughan, Robert D.; Roberts, James A. (1999): Environmental segmentation alternatives: a look at green consumer behavior in the new millennium. In *Journal of Consumer Marketing* 16 (6), pp. 558–575. DOI: 10.1108/07363769910297506.

Tanner, Carmen; Wölfing Kast, Sybille (2003): Promoting sustainable consumption: Determinants of green purchases by Swiss consumers. In *Psychol. Mark.* 20 (10), pp. 883–902. DOI: 10.1002/mar.10101.

Tarkiainen, Anssi; Sundqvist, Sanna (2005): Subjective norms, attitudes and intentions of Finnish consumers in buying organic food. In *British Food Journal* 107 (11), pp. 808–822. DOI: 10.1108/00070700510629760.

Tellis, Gerard J.; Yin, Eden; Bell, Simon (2009): Global consumer innovativeness. Cross-country differences and demographic commonalities. In *Journal of International Marketing* 17 (2), pp. 1–22. DOI: 10.2139/ssrn.1335551.

Teng, Yi-Man; Wu, Kun-Shan; Liu, Hsiao-Hui (2015): Integrating Altruism and the Theory of Planned Behavior to Predict Patronage Intention of a Green Hotel. In *Journal of Hospitality & Tourism Research* 39 (3), pp. 299–315. DOI: 10.1177/1096348012471383.

Thøgersen, John (2002): Promoting "green" consumer behavior with eco-labels. Chapter 5 in New Tools for Environmental Protection: Education, Information and Voluntary Measure. In National Research Council (Ed.): New Tools For Environmental Protection. Education, Information, And Voluntary Measures. With assistance of Thomas Dietz, Paul C. Stern. Washington, DC, USA: The National Academies Press, pp. 83–104.

Trudel, Remi (2018): Sustainable consumer behavior. In *Consum Psychol Rev*. DOI: 10.1002/arcp.1045.

Untaru, Elena-Nicoleta; Ispas, Ana; Candrea, Adina Nicoleta; Luca, Marcela; Epuran, Gheorghe (2016): Predictors of individuals' intention to conserve water in a lodging context: the application of an extended Theory of Reasoned Action. In *International Journal of Hospitality Management* 59, pp. 50–59. DOI: 10.1016/j.ijhm.2016.09.001.

Valente, Thomas W.; Davis, Rebecca L. (1999): Accelerating the Diffusion of Innovations Using Opinion Leaders. In *The ANNALS of the American Academy of Political and Social Science* 566 (1), pp. 55–67. DOI: 10.1177/000271629956600105.

Venkatachalam, Venkateshwaran; Spierling, Sebastian; Endres, Hans-Josef; Siebert-Raths, Andrea (2018): Integrating Life Cycle Assessment and Eco-design Strategies for a Sustainable Production of Bio-based Plastics. In Enrico Benetto, Kilian Gericke, Mélanie Guiton (Eds.): Designing Sustainable Technologies, Products and Policies. Cham, Switzerland: Springer International Publishing, pp. 487–497.

White, Katherine; Habib, Rishad; Hardisty, David J. (2019): How to SHIFT Consumer Behaviors to be More Sustainable: A Literature Review and Guiding Framework. In *Journal of Marketing* 83 (3), pp. 22–49. DOI: 10.1177/0022242919825649.

Wiederhold, Marie; Martinez, Luis F. (2018): Ethical consumer behaviour in Germany. The attitude-behaviour gap in the green apparel industry. In *International Journal of Consumer Studies* 42 (4), pp. 419–429. DOI: 10.1111/ijcs.12435.

Young, Raymond de (2000): New Ways to Promote Proenvironmental Behavior: Expanding and Evaluating Motives for Environmentally Responsible Behavior. In *J Social Isssues* 56 (3), pp. 509–526. DOI: 10.1111/0022-4537.00181.

Young, William; Hwang, Kumju; McDonald, Seonaidh; Oates, Caroline J. (2010): Sustainable consumption. Green consumer behaviour when purchasing products. In *Sustainable Development* 18 (2), 20-31. DOI: 10.1002/sd.394.

Yue, Chengyan; Hall, Charles R.; Behe, Bridget K.; Campbell, Benjamin L.; Dennis, Jennifer H.; Lopez, Roberto G. (2010): Are consumers willing to pay more for biodegradable containers than for plastic ones? Evidence from hypothetical conjoint analysis and nonhypothetical experimental auctions.

Zsóka, Ágnes; Szerényi, Zsuzsanna Marjainé; Széchy, Anna; Kocsis, Tamás (2013): Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. In *Journal of Cleaner Production* 48, pp. 126–138.

Appendix A: Tables

Table 5: Variables and items used in the studies

Variable/item	Statements	Possible answers	Cronbach's Alpha	Sources
Gender	Please choose between the following answers.	1 = Female; 2 = Male	-	Reformulated according to Rumm (2016)
Age	In what year were you born?	metric input of the year of birth, open field	-	Reformulated according to Rumm (2016)
Education	What is your highest level of education?	1 = no general education (yet); 2 = Secondary school without apprenticeship; 3 = Secondary school and apprenticeship; 4 = Middle maturity / secondary school without high school diploma; 5 = High school graduation without university degree; 6 = Studies (university, college, academy, polytechnic school)	-	Reformulated according to Rumm (2016)
Purchase intention	How would you decide in future purchase situations? 1. I will consciously pay attention to bioplastic products made of renewable resources in future purchase decisions. 2. When I have the choice between a plastic product made of conventional materials and one made of renewable raw materials, I will choose the one made of renewable raw materials in the future.	1 = in no case; 2 = rather no; 3 = maybe; 4 = rather yes; 5 = certainly	0.816	Buxel (2010) and Rumm (2016)
Altruism	How important is to you: 1. To help other people 2. To serve mankind 3. To share what you have 4. To give to others 5. To be unselfish	1 = not important at all; 2 = rather not important; 3 = maybe important; 4 = rather important; 5 = important, in any case	0.845	Price et al. (1995)
Subjective norm towards bioplastics	How much do people close to you (e.g., partner, children, parents, friends) expect you to buy rain jackets / functional clothing made from bioplastics instead of petroleum-based plastic?	1 = in no case; 2 = rather no; 3 = maybe;	-	Reformulated according to Rumm (2016)

		4 = rather yes;		
		5 = certainly		
Innovativeness	Please indicate to what extent you agree with the following statements. 1. I hate any change in my routines and habits. 2. New products have an unacceptably high price. 3. I am excited to try out new products. 4. I enjoy the novelty of owning new products. 5. I like to be confronted with new ideas. 6. Products are getting shoddier and shoddier.	1 = I do not agree at all; 2 = rather, I do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.626	Tellis et al. (2009) and Scherer et al. (2017)
Green consumer values	Please indicate to what extent you agree with the following statements. 1. It is important to me that the products I use do not harm the environment. 2. I consider the potential environmental impact of my actions when making many of my decisions. 3. My purchase habits are affected by my concern for our environment. 4. I am concerned about wasting the resources of our planet. 5. I would describe myself as environmentally responsible. 6. I am willing to be inconvenienced in order to take actions that are more environmentally friendly.	1 = I do not agree at all; 2 = rather, I do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.895	Haws et al. (2014)
Attitude towards bioplastics	Below you can see statements from various organizations on bioplastics. Please state per statement whether you would convince them or prevent them from supporting increased use of bioplastics. If the statement does not matter for your rating, select "I do not care." 1. The long-term goal is to produce bioplastics from non-edible plant residues. 2. Bioplastics can withstand just as much as conventional plastics. 3. The carbon footprint of bioplastics is lower than that of conventional plastics. 4. The purchase of bioplastic products helps to conserve fossil resources (petroleum).	1 = I do not agree at all; 2 = rather, I do not agree; 3 = I do not care; 4 = I rather agree; 5 = I totally agree	0.782	Reformulated according to Rumm (2016)

Product experience with bioplastics	Have you ever deliberately opted for bioplastics products?	0 = No; 1 = Yes	-	Reformulated according to Scherer et al. (2018b) and Rumm (2016)
Interest in information about bioplastics	So overall, are you interested in bioplastics in general?	1 = I am not interested at all; 2 = I am rather less interested; 3 = I may be interested; 4 = I am a little bit interested; 5 = I am very interested	-	Reformulated according to Rumm (2016) and Blesin et al. (2017)
Perceived knowledge about bioplastics	We would like to know if you have ever heard of bioplastics.	1 = Yes, I've heard of bioplastics before and I know exactly what that is; 2 = Yes, I have heard of it before; 3 = No, I have never heard of it;	-	Reformulated according to Rumm (2016)
Perceived influential communication behavior	Here are some statements that relate to the exchange between you and your friends and acquaintances, regardless of the topic. Please use the scale to indicate to what extent these statements apply to you personally. 1. In my circle of friends and acquaintances, we often talk about topics that I have raised. 2. I have the impression that my friends and acquaintances generally regard me as a good source for advice and tips. 3. In my circle of friends and acquaintances, I am often the one who has to give the "OK" in important decisions. 4. If I want to convince someone of a thing, I usually manage to do this.	1 = I do not agree at all; 2 = I rather, do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.826	Reformulated according to Childers (1986) and Boster et al. (2011)

Table 6: Factor analysis of study 1 (Klein et al. 2019)

Variable	Items	matrix of rotated components - factors							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Sociodemographic characteristics	Gender	-0.21	-0.12	0.08	0.00	-0.01	-0.03	0.22	0.66
	Age	0.23	0.02	-0.13	-0.08	-0.29	-0.02	-0.24	0.63
	Education	-0.01	-0.02	0.31	0.15	-0.08	0.12	0.45	-0.20
Altruism	1	0.17	0.73	0.11	0.13	0.08	0.03	-0.07	-0.02
	2	0.21	0.65	0.03	0.01	0.01	0.09	0.10	0.21
	3	0.17	0.80	0.06	0.01	0.07	0.07	0.03	-0.07
	4	0.14	0.84	0.11	0.07	0.10	0.03	-0.01	-0.13
	5	0.17	0.77	0.08	0.10	0.02	-0.03	0.05	0.01
Subjective norm towards bioplastics		0.52	0.18	0.03	0.00	0.13	0.13	0.15	0.39
Innovativeness	1	0.17	0.08	0.06	0.09	0.18	0.51	-0.09	0.19
	2	0.11	0.04	0.07	-0.05	0.07	0.77	0.09	-0.02
	3	0.10	0.06	0.16	0.11	0.85	0.06	0.03	-0.08
	4	0.03	0.07	0.17	0.00	0.85	0.05	0.08	-0.04
	5	0.14	0.14	0.29	0.17	0.67	0.05	0.11	-0.01
	6	-0.08	0.03	-0.05	0.06	-0.06	0.71	0.03	-0.11
Green consumer values	1	0.83	0.15	0.09	0.13	0.06	0.04	0.01	0.00
	2	0.80	0.15	0.15	0.11	0.07	0.02	0.11	-0.04
	3	0.78	0.15	0.12	0.07	0.06	0.07	0.15	-0.03
	4	0.65	0.15	0.10	0.33	0.00	-0.09	0.04	-0.04
	5	0.79	0.11	0.10	0.01	0.02	0.02	0.00	0.09
	6	0.72	0.25	0.11	0.13	0.07	0.12	0.08	-0.05
Attitude towards bioplastics	1	0.12	0.06	0.07	0.76	0.04	-0.02	-0.05	0.14
	2	0.05	0.04	0.06	0.71	0.10	0.06	0.00	-0.13
	3	0.14	0.07	0.04	0.75	0.04	0.03	0.08	-0.13
	4	0.11	0.07	0.07	0.78	0.03	0.02	0.03	0.02
Product experience		0.16	0.04	0.04	-0.03	0.06	0.08	0.62	0.06
Interest in information		0.30	0.15	0.08	0.38	0.08	0.04	0.23	0.25
Perceived knowledge about bioplastics		0.14	0.03	0.07	0.05	0.16	-0.11	0.73	0.12
Perceived influential communication behavior	1	0.21	0.13	0.76	0.11	0.13	0.03	0.10	0.01
	2	0.13	0.13	0.81	0.08	0.16	-0.02	0.06	-0.07
	3	0.12	0.08	0.77	-0.07	0.18	0.03	0.10	0.05
	4	0.10	0.05	0.72	0.15	0.13	0.02	0.03	0.04

Extraction method: principal components analysis; rotation method: Varimax with Kaiser-normalization; the rotation is converged in 6 iterations.

Table 7: Factor analysis of study 2 (Klein et al. 2020)

Variable/Item(No.)	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Green Consumer Values (1)	0.741	0.251	0.121	0.086	0.094
Green Consumer Values (2)	0.667	0.158	0.316	0.036	0.006
Green Consumer Values (3)	0.824	0.162	0.096	0.027	0.111
Green Consumer Values (4)	0.804	0.106	−0.006	0.062	0.037
Green Consumer Values (5)	0.835	0.154	0.123	0.052	0.069
Green Consumer Values (6)	0.804	0.155	0.074	0.026	0.099
Innovation-friendly (1)	0.102	0.059	0.103	0.059	0.875
Innovation-friendly (2)	0.034	0.068	0.003	0.025	0.879
Innovation-friendly (3)	0.170	0.148	0.162	0.049	0.743
BFI10 (1 item on trust)	0.008	0.246	−0.040	0.600	0.030
KUSIV3 (1)	0.102	0.141	0.021	0.833	0.006
KUSIV3 (2)	0.019	0.029	0.070	0.714	0.035
KUSIV3 (3)	0.080	0.128	0.036	0.824	0.062
Altruism (1)	0.165	0.719	0.134	0.151	0.094
Altruism (2)	0.240	0.614	0.000	0.186	0.006
Altruism (3)	0.161	0.793	0.014	0.119	0.081
Altruism (4)	0.135	0.843	0.075	0.126	0.128
Altruism (5)	0.178	0.772	0.100	0.057	0.035
Attitude towards bioplastics (1)	0.147	0.071	0.774	0.039	0.052
Attitude towards bioplastics (2)	0.128	0.059	0.749	0.023	0.038
Attitude towards bioplastics (3)	0.052	0.040	0.728	0.029	0.119
Attitude towards bioplastics (4)	0.122	0.076	0.794	−0.002	0.047

Extraction method: principal components analysis; rotation method: Varimax with Kaiser-normalization; the rotation is converged in 5 iterations.

Table 8: Sociodemographic characteristics of the sample in %

Sociodemographic variables	Survey-sample	Population Germany 16+ (German Federal Statistical Office 2015)
Age		
16-19 years	5.0	4.6
20-29 years	12.7	14.1
30-39 years	12.4	14.1
40-49 years	16.6	18.0
50-59 years	18.5	18.0
60+ years	34.8	31.2
Gender		
Female	51.9	51.3
Male	48.1	48.7
Education		
No graduation yet	2.4	2.5
Secondary modern school without apprenticeship	7.1	7.9
Secondary modern school with apprenticeship	32.0	30.6
General certificate of secondary education	29.8	30.3
General qualification for university entrance	12.7	13.1
Academic studies	16.0	15.7

Appendix B: Publications & manuscript

Research article

Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany

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A R T I C L E   I N F O

A B S T R A C T

Plastic pollution is a massive global issue and it is increasing. However, there are possible solutions besides the abstinence of plastic-consumption. Particularly, bioplastics could be one part of the solution. So far, there has been little research on the consumption of bioplastic-products and consumers' choice behavior for bioplastics. We conducted the largest study so far, on preferences, choice, attitude, and perception in the context of bioplastics. Our sample of 1673 participants is representative of the German population including citizens 16 years of age and older, who were surveyed through an Online Access Panel. We conducted a logistic regression analysis combining the purchase intention for bioplastic-products as the dependent variable with 12 independent variables derived from the literature review. We found significant and comparably high influences on the purchase intention from the variables attitude towards bioplastics, green consumer values, product experience and interest in information on bioplastics. Politics and economic stakeholders promoting marketing and information activities related to bioplastic products can use the findings of this study.

1. Introduction

Nowadays, plastic pollution is one of the biggest problems worldwide. From January 2018, China stopped accepting imports of European plastic waste (Schilly, 2018; Uken, 2018) and the EU Commissioner Günther Oettinger declared plastic waste to be the new ecological challenge of the ocean and for Europe (Kerlund and Gaugele, 2018). This promotes national discussion concerning waste disposal, especially in Germany. Plastic waste causes a multitude of problems, such as the well-known problem of plastic pollution in the world's oceans (Eriksen et al., 2014) and due to its decay the releasing of fossil carbon dioxide into the atmosphere. Due to the vast and growing global consumption of plastic goods, finding a solution has become even more important, also with respect to the limitation of the planet's global warming (Spierling et al., 2018; Mülhaupt, 2013). In 2016, the annual worldwide plastic consumption was 322 million tons and in Europe, it was 58 million tons. This makes it clear that plastics play a crucial role in the world's economy and our daily life (PlasticsEurope, 2016).

Thus, it is necessary to address these opposing issues. On the one hand, there is economic growth, which is often associated with the increasing use of plastic products, and on the other hand, there are environmental and human health issues.

Some stakeholders have argued that refraining from plastic consumption is the main solution (BUND, 2018; Pollmer, 2017; Greenpeace, 2018). This could work for some specific mainly single-use products, such as plastic shopping bags or single-use plastic coffee cups. However, this suggestion becomes problematic when it comes to goods with special functions and for which plastic is a superior material, such as rain jackets, medical instruments, computer parts etc. Whereas the substitution of plastic seems feasible for some goods, it is not feasible for others. In these cases, bioplastics could be part of the solution (Álvarez-Chávez et al., 2012). However, the definition of bioplastics is not easy to understand for consumers. Bioplastics can be manufactured partly or completely from biogenic raw materials sourced from various types of plants. The raw material compounds can be, for example, bioethanol (sugar cane), oil (castor bean or rapeseed), starch (potatoes) or cellulose (leaves). Moreover, the different types of bioplastics are not necessarily biodegradable. Additionally, the "Drop-Ins"-bioplastics of the "New Economy" are chemically identical to their petrochemical equivalent, except that the carbon is not fossil. Besides that, there are the "Novel"

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bioplastics, which differ in chemical structure and therefore in their properties, e.g. PLA, PHA or PEF (Endres, 2017; Endres et al., 2011).

Differentiation between conventional plastic products and bioplastic products is not very obvious, especially for consumers, since there are no visible attributes to distinguish the two plastic-categories from one another. Considering these issues and the acuteness of the problems associated with plastic and the need to address those problems, it is important to understand consumers' reactions towards bioplastic. Consumers' decisions to purchase products generally or specifically bioplastic products can be driven by many factors (Balderjahn, 2013). Products differ and so do consumers' evaluations and the personal benefits gained by a product (Lin and Huang, 2012), for example, their view on sustainability. Previous consumer studies on bioplastics have mainly focused on consumer perceptions, choice behavior, segmentation of bioplastic consumers and their willingness to pay (Scherer et al., 2018b, 2017; Rumm, 2016; Lynch et al., 2017; Kurka, 2012; Kainz, 2016). But none of the previous studies related to bioplastic products has analysed consumer purchase intention in detail although this variable is regarded as a good predictor of an individual's decision to consume certain products (Morrison, 1979; Morwitz, 2012; Morwitz et al., 2006; Lin and Huang, 2012; Kalwani and Silk, 1982). This leads to the questions

- whether consumers intend to purchase bioplastic products, and
- what factors influence their intention to purchase such products?

In this study, we are investigating those factors that influence the intention to purchase bioplastic products on the German market. Therefore, relevant influencing factors were identified through literature review thereby taking into account studies related to bioplastic products in particular and green products in general. We show the results of this literature review and the derived hypotheses in Section 2.1, followed by information on data collection and analysis. In Sections 3 and 4, we present the results of the conducted logistic regression analysis and discuss the influences of the independent variables on the purchase intention. In addition, limitations of the study and implications for different stakeholder groups are derived based on the findings of this study.

2. Method

2.1. Literature findings and derived hypotheses

This study investigates factors that influence the purchase intention towards bioplastic products. Initially, we reviewed scientific literature to generate hypotheses relating to the purchase intention towards bioplastic products. The following section provides background information and the hypotheses are defined.

The intention to purchase green products can be seen as a specific form of behavioral intention, which refers to an individual's subjective possibility of engaging in a behavior. This can be influenced by attitudes towards performing the behavior (Ajzen and Fishbein, 1980). Morrison (1979) showed that purchase intention predicts purchase behavior. Green consumption has been analyzed through purchase intention in previous studies (Laroche et al., 2001; Nam et al., 2017; Kaufmann et al., 2012; Kim and Choi, 2005). These studies have shown the influence of several predictors on the purchase intention with respect to green products. In line with these studies, we aim to find relevant predictors for the intention to purchase bioplastic products. Considering the findings of the literature review, we were able to derive ten hypotheses.

There are several studies about the influence of consumers' sociodemographic characteristics on the purchase intention with respect to green products and on green behavior generally. Comparing these findings, it seems that these influences are ambiguous (Straughan and Roberts, 1999). One of the first studies on influences of gender was done by Stern et al. (1993), who found that women are more likely to choose green products. Studies by Diamantopoulos et al. (2003) and Casimir and Dutilh (2003) on the relationship between sociodemographic characteristics and environmental behavior found only partial support for a correlation between them. Due to the ambiguous results in the reviewed studies, we assumed that only single sociodemographic characteristics (in this study represented by age, gender and education) might have an influence on the intention to purchase bioplastic products.

Hypothesis 1. (H1) Single sociodemographic characteristics like gender, age or education have significant influence on the probability of the intention to purchase bioplastic products.

Altruism or prosocial behavior, as defined by Batson and Powell (2003), can be an antecedent of environmentally friendly consumption. Evidence for this assumption has been reported in several studies. Lusk et al. (2007) found that individuals who are more altruistic are willing to pay more for environmentally certified pork. Hefner (2013) identified altruism as one of the drivers for environmentally friendly behavior. Straughan and Roberts (1999) also found a strong correlation between altruism and environmentally conscious consumer behavior. Additionally, Stern et al. (1993) concluded that social-altruism and environmentally friendly behavior are correlated (measured by the predicted willingness to pay higher gasoline-taxes or income-taxes). Pfattheicher et al. (2015) and Teng et al. (2013) revealed that altruistic behavioral intentions are positively related to pro-environmental purchase intentions. Based on the described results, Hypothesis 2 was derived for the case of bioplastic products.

Hypothesis 2. (H2) As an individual's altruism increases, the probability of the intention to purchase bioplastic products increases.

Individuals tend to behave in a certain way if they think relevant people expect them to behave that way. This so called "subjective norm" is part of the Theory of reasoned action proposed by Fishbein (1980). This is a well-known and often measured influencing factor for environmentally friendly behavior. For example, Teng et al. (2013) measured a positive influence from the subjective norm on the purchase intention for green products. There are several other studies where the influence of this subjective norm has been demonstrated, e.g. Tarkiainen and Sundqvist (2005), Hefner (2013), Untaru et al. (2016) and Mishra et al. (2014). Hence, it is assumed that subjective norm towards bioplastic products has an effect on an individual's purchase intention for bioplastic products.

Hypothesis 3. (H3) As an individual's subjective norm towards bioplastics increases, the probability of the intention to purchase bioplastic products increases.

Consumers' innovativeness, as defined by Tellis et al. (2009), is an important driver for the adoption of environmentally friendly product innovations (Englis and Phillips, 2013; Jansson, 2011). Osburg et al. (2016) found that choices for wood–plastic composites over conventional plastics correlated with their innovativeness. Additionally, Scherer et al. (2017) found that ecologically sensitive consumers are more innovative than consumers of conventional plastic. Hence, it seems that an individuals' interest in innovations has a positive influence on the purchase of

green products. We assume that this would also be the case for bioplastic products.

Hypothesis 4. (H4) As an individual's innovativeness increases, the probability of the intention to purchase bioplastic products increases.

Haws et al. (2014) constructed scales for environmental attitudes and values to investigate the relationship between an individual's green values and their environmentally friendly purchase decisions. They found evidence for a correlation between green consumer values and the respondents purchase intentions for eco-products. Using similar items, this was also shown by Scherer et al. (2017) and Kurka (2012). Thus, it is assumed that green consumer values would also affect purchase intention with respect to bioplastic products.

Hypothesis 5. (H5) As an individual's green consumer values increase, the probability of the intention to purchase bioplastic products increases.

Hartmann and Apaolaza-Ibáñez (2012) and Teng et al. (2013) showed that consumer environmental concern has a positive influence on the purchase intention towards green products. Recent studies by Rumm et al. (2013), Scherer et al. (2017) and Rumm (2016) also found a connection between environmental attitudes and choice behavior with respect to bioplastic products. Hence, we expect that attitudes towards bioplastics influence the intention to purchase bioplastic products positively.

Hypothesis 6. (H6) As an individual's attitude towards bioplastics increases, the probability of the intention to purchase bioplastic products increases.

Young (2000) and Lee et al. (1995) claimed that prior recycling behavior leads to future recycling behavior. More evidence for the influence of product experience on the purchase intention towards green products was also found by Young et al. (2009). Blesin et al. (2017) revealed that prior product experience leads to a higher purchase intention for bioplastic products. Therefore, it is expected that prior consumption behavior is a strong predictor of the purchase intention with respect to bioplastic products.

Hypothesis 7. (H7) As an individual's product experience with bioplastics increases, the probability of the intention to purchase bioplastic products increases.

Rumm et al. (2013) and Schleenbecker and Hamm (2013) found that there is a positive influence from product and resource information about green products and that this has a positive effect on the decision to purchase environmentally friendly products. Similarly, McDonald et al. (2009) found green consumers seek information about green products. In Hypothesis 8, we expect that interest in information about bioplastics has a positive influence on the purchase decision.

Hypothesis 8. (H8) As an individual's interest in information about bioplastics increase, the probability of the intention to purchase bioplastic products increases.

Kaiser and Fuhrer (2003) stated "… knowledge remains an important and highly significant predictor of ecological behavior". They relate specific types of knowledge to environmentally friendly behavior. Also, Jaiswal and Kant (2018) found a significant effect from respondents' perceived environmental knowledge on green purchase decisions. Hence, it is stated that perceived knowledge influences the intention to purchase bioplastic products.

Hypothesis 9. (H9) As an individual's perceived knowledge about bioplastics increases, the probability of the intention to purchase bioplastic products increases.

When it comes to communication in diffusion processes, opinion leaders often play important roles as change agents and they may accelerate the adoption of innovations in their social environment (Valente and Davis, 1999). According to Boster et al. (2011), opinion leaders have three important characteristics. They are very knowledgeable in the sphere in which they exert opinion leadership, they are well connected socially, and they have a high perceived interpersonal communication strength (Boster et al., 2011). As one cannot expect a high level of knowledge about bioplastics or bioplastics to be a relevant topic in interpersonal communication in general (Kurka, 2012; Scherer et al., 2017; Rumm, 2016), the present study focuses on the third characteristic of opinion leaders, which is the perceived interpersonal communication strength. We expect that people who consider themselves as having strong interpersonal communication skills might consume an innovative product or material to gain this experience and hold their position as an opinion leader within a group. Thus, it is proposed that individuals perceived influential communication behavior is an antecedent of the intention to purchase bioplastic products.

Hypothesis 10. (H10) As an individual's perceived influential communication behavior increases, the probability of the intention to purchase bioplastic products increases.

2.2. Survey: variables, scales and data

Data of the study was collected through an online access panel in June 2016. For that purpose, a market research company was subcontracted to recruit the respondents. The participants received pre-determined incentives for completing the full survey. Online surveys are less costly and allow data to be collected quickly (Evans and Mathur, 2005). The target group was the German population aged 16 or older. In order to get a representative view about their perception, attitude and behavior towards bioplastic products, a sample of 1500 to 2000 people was selected using specific sociodemographic characteristics based on the German sample census (="Microzensus 2015") (German Federal Statistical Office, 2015). Quotas were set on gender, age, education and number of inhabitants in the town of residence (Table 2).

The independent variables derived from the literature review as well as the operationalization of the dependent variable purchase intention are listed in Table 1, as well as the wording of the statements, the answering scales and the sources used for elaborating the statements of the different variables. Additionally, Cronbach's Alpha was added for variables with more than one statement to show the reliability-value of the item-scales.

The data were subsequently cleaned to remove answers that were not feasible (straight-liners, Christmas-tree-behavior, conflicting answers, wrongly answered test-questions, etc.), leaving 1673 respondents for the statistical analysis. Data analysis was performed using Sawtooth 8 and SPSS 23.

The dependent variable "purchase intention" was measured with the two items "I will consciously pay attention to bioplastic products made of biogenic resources in future purchase decisions" and "When I have the choice between a conventional plastic product and one made of renewable raw materials, I will choose the one made of biogenic raw materials in the future" using a 5-point-Likert-scale. Afterwards we substituted the scale using a dichotomous dummy-variable to form the binary variable needed for the binary logistic regression. Answers from 1 to 3 were coded as 0, which was "no purchase intention" and answers

Table 1
Constructs of the survey.

Variable/item	Statements	Possible answers	Cronbach's Alpha	Sources
Purchase intention	How would you decide in future purchase situations? 1. I will consciously pay attention to bioplastic products made of renewable resources in future purchase decisions. 2. When I have the choice between a plastic product made of conventional materials and one made of renewable raw materials, I will choose the one made of renewable raw materials in the future.	1 = in no case; 2 = rather no; 3 = maybe; 4 = rather yes; 5 = certainly	0.816	Buxel (2010), Rumm (2016)
Gender	Please choose between the following answers.	1 = Female; 2 = Male	–	Reformulated according to Rumm (2016)
Age	In what year were you born?	metric input of the year of birth, open field	–	Reformulated according to Rumm (2016)
Education	What is your highest level of education?	1 = no general education (yet); 2 = Secondary school without apprenticeship; 3 = Secondary school and apprenticeship; 4 = Middle maturity / secondary school without high school diploma; 5 = High school graduation without university degree; 6 = Studies (university, college, academy, polytechnic school)	–	Reformulated according to Rumm (2016)
Altruism	How important is to you: 1. To help other people 2. To serve mankind 3. To share what you have 4. To give to others 5. To be unselfish	1 = not important at all; 2 = rather not important; 3 = maybe important; 4 = rather important; 5 = important, in any case	0.845	Price et al. (1995)
Subjective norm towards bioplastics	How much do people close to you (e.g., partner, children, parents, friends) expect you to buy rain jackets / functional clothing made from bioplastics instead of petroleum-based plastic?	1 = in no case; 2 = rather no; 3 = maybe; 4 = rather yes; 5 = certainly	–	Reformulated according to Rumm (2016)
Innovativeness	Please indicate to what extent you agree with the following statements. 1. I hate any change in my routines and habits. 2. New products have an unacceptably high price. 3. I am excited to try out new products. 4. I enjoy the novelty of owning new products. 5. I like to be confronted with new ideas. 6. Products are getting shoddier and shoddier.	1 = I do not agree at all; 2 = rather, I do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.626	Tellis et al. (2009), Scherer et al. (2017)
Green consumer values	Please indicate to what extent you agree with the following statements. 1. It is important to me that the products I use do not harm the environment. 2. I consider the potential environmental impact of my actions when making many of my decisions. 3. My purchase habits are affected by my concern for our environment. 4. I am concerned about wasting the resources of our planet. 5. I would describe myself as environmentally responsible. 6. I am willing to be inconvenienced in order to take actions that are more environmentally friendly.	1 = I do not agree at all; 2 = rather, I do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.895	Haws et al. (2014)
Attitude towards bioplastics	Below you can see statements from various organizations on bioplastics. Please state per statement whether you would convince them or prevent them from supporting increased use of bioplastics. If the statement does not matter for your rating, select "I do not care." 1. The long-term goal is to produce bioplastics from non-edible plant residues. 2. Bioplastics can withstand just as much as conventional plastics. 3. The carbon footprint of bioplastics is lower than that of conventional plastics. 4. The purchase of bioplastic products helps to conserve fossil resources (petroleum).	1 = I do not agree at all; 2 = rather, I do not agree; 3 = I do not care; 4 = I rather agree; 5 = I totally agree	0.782	Reformulated according to Rumm (2016)

Table 1 (continued).

Variable/item	Statements	Possible answers	Cronbach's Alpha	Sources
Product experience with bioplastics	Have you ever deliberately opted for bioplastics products?	0 = No; 1 = Yes	–	Reformulated according to Rumm (2016), (Scherer et al., 2018b)
Interest in information about bioplastics	So overall, are you interested in bioplastics in general?	1 = I am not interested at all; 2 = I am rather less interested; 3 = I may be interested; 4 = I am a little bit interested; 5 = I am very interested	–	Reformulated according to Rumm (2016)
Perceived knowledge about bioplastics	We would like to know if you have ever heard of bioplastics.	1 = Yes, I have heard of bioplastics before and I know exactly what that is; 2 = Yes, I have heard of it before; 3 = No, I have never heard of it;	–	Reformulated according to Rumm (2016)
Perceived influential communication behavior	Here are some statements that relate to the exchange between you and your friends and acquaintances, regardless of the topic. Please use the scale to indicate to what extent these statements apply to you personally. 1. In my circle of friends and acquaintances, we often talk about topics that I have raised. 2. I have the impression that my friends and acquaintances generally regard me as a good source for advice and tips. 3. In my circle of friends and acquaintances, I am often the one who has to give the "OK" in important decisions. 4. If I want to convince someone of a thing, I usually manage to do this.	1 = I do not agree at all; 2 = I rather, do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.826	Reformulated according to Childers (1986), Boster et al. (2011)

Table 2

Sociodemographic data of the sample (in %).

Sociodemographic variables	Survey-sample	German population 16+ (German Federal Statistical Office, 2015)
Age		
16–19 years	5.0	4.6
20–29 years	12.7	14.1
30–39 years	12.4	14.1
40–49 years	16.6	18.0
50–59 years	18.5	18.0
60+ years	34.8	31.2
Gender		
Female	51.9	51.3
Male	48.1	48.7
Education		
No graduation yet	2.4	2.5
Secondary modern school without apprenticeship	7.1	7.9
Secondary modern school with apprenticeship	32.0	30.6
General certificate of secondary education	29.8	30.3
General qualification for university entrance	12.7	13.1
Academic studies	16.0	15.7

from 4 to 5 were coded as 1, which was "purchase intention". The answer 3 ("maybe") of the Likert-scale was added to "no purchase intention" in order to avoid over-interpretation of this position. To apply the derived independent variables in the logistic regression model, the means of each scale were calculated for each respondent and used as input-variables. The construct-validity of all defined independent variables was verified by means of a factor analysis that is added in Table 6 in the annex.

2.3. Mathematical approach

As a logistic regression was used to analyze the influence of the different factors on the intention to purchase bioplastic products, the principles of this method are explained. The logistic regression has a categorical outcome variable with a binary characteristic, which is calculated through continuous or categorical predictor variables (Backhaus et al., 2016). The Logit-model (1)(7) computes the logarithmized probability of an event occurring, calculated by β_0 the log-odds of the event not occurring plus $\beta_1 \ldots \beta_n$ the differences in log-odds each multiplied by the factors considered $x_1 \ldots x_n$ adding the residual term ε.

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \varepsilon \quad (1)$$

This means that one can estimate which of two categories a person is likely to belong to given certain other information,

Table 3
Independent variables.

Independent variable	Scale (*)	Mean (SD)
Sociodemographic variables see above (Table 2)		
Altruism	Ordinal, 5-point Likert scale	3.38 (0.714)
Subjective norm towards bioplastics	Ordinal, 5-point Likert scale	2.97 (1.122)
Innovativeness	Ordinal, 5-point Likert scale	3.00 (0.593)
Green consumer values (GCV)	Ordinal, 5-point Likert scale	3.48 (0.772)
Attitude towards bioplastics (AB)	Ordinal, 5-point Likert scale	4.18 (0.618)
Product experience with bioplastics	Categorical	0.12 (0.325)
Interest in information	Categorical	1.33 (0.471)
Perceived knowledge about bioplastics	Ordinal	1.50 (0.626)
Perceived influential communication behavior	Ordinal, 5-point Likert scale	3.04 (0.767)

represented by the independent variables. In logistic regression, the probability of the event Y occurring, given known values of X_i, is predicted. The simplest form of predicting the probability of Y, given only one predictor variable X_1, would be as displayed in (2). As P(Y) is the probability of Y occurring, b_0 is the intercept and constant, b_i are the coefficients attached to the predictor variables, e is the base of the natural logarithms and the predictors X_i form a linear combination, equivalent to a linear regression (Field, 2013).

$$P(Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_{1i})}} \tag{2}$$

Including more than one predictor, the equation is as shown in (3).

$$P(Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_{1i} + b_2 X_{2i} + \cdots + b_n X_{ni})}} \tag{3}$$

Thus, the probability P that an event Y occurs for a given person i would be $P(Y_i)$. The event for that person will be either 1 or 0 and the probability of Y will be a value between 1 and 0.

Moreover, for the interpretation of logistic regression, the odds ratios are of crucial value. Generally, the odds of an event occurring are defined as the probability of an event occurring, divided by the probability of that event not occurring. In this case, the odds of having the intention to purchase are calculated as the probability of having a purchase intention divided by the probability of not having a purchase intention, as shown in (4)–(7) (Field, 2013).

$$odds = \frac{P(event)}{P(no\ event)} \tag{4}$$

$$P(event\ Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_1)}} \tag{5}$$

$$P(no\ event\ Y) = 1 - P(event\ Y) \tag{6}$$

The proportionate change in the odds is the odds ratio. If the value is greater than 1, it indicates that as the predictor increases, the odds of the outcome occurring increase. Whereas, a value less than 1 indicates that as the predictor increases, the odds of the outcome occurring decrease (Field, 2013), see (7).

$$\Delta odds = \frac{odds\ after\ a\ unit\ change\ in\ the\ predictor}{original\ odds} \tag{7}$$

3. Results

The results of the statistical analysis are presented in two sections. In Section 3.1, we display the sociodemographic data and the descriptive data from the applied variables. We introduce the model results of the binary logistic regression in Section 3.2.

3.1. Descriptive statistics of sample and variables

3.1.1. Sociodemographic data of the sample
Table 2 includes information about the sociodemographic key data (SOD) taken from the German census 2015 (German Federal Statistical Office, 2015) and the SOD-distribution of the survey-sample. The results show that the sample data hardly deviates from the German census data. A closer comparison of the sample data, however, reveals that the age distribution of the sample differs slightly. Participants older than 60 are somewhat overrepresented, whereas respondents from 20 to 49 are slightly underrepresented. Looking at the education, respondents with "secondary modern school with apprenticeship" are somewhat overrepresented (Table 2). Altogether, no further correction of the data was necessary.

3.1.2. Influencing factors, descriptive statistics
Table 3 displays the descriptive statistics of the independent variables used in this study. Respondents show positive attitudes towards bioplastics (AB) displayed by a high mean of 4.18. On average, respondents have a medium green consumer value (AB) and a medium level of altruism, with means of 3.48 for the GCV and 3.38 for altruism respectively. The mean of the subjective norm towards bioplastics was 2.97 and showed a high standard deviation of 1.122. Moreover, the respondents' innovativeness shows a mean right in the middle of the scale (3.0), which indicates a balanced interest in this topic. The reported experience with bioplastic products was relatively low, with 12 per cent of the participants having some relevant experience. Generally, respondents showed a medium level interest in information about bioplastic products and perceived themselves as knowing about bioplastic and its background. Furthermore, most respondents perceived themselves as being moderately influential in their communication behavior in their social environment.

Furthermore, multicollinearity of the derived predictors was tested. The mean variance inflation factors (VIF) for the 12 variables is 1.29, whereas the minimum VIF-value is 1.07 and the maximum 1.77, which indicates that no multicollinearity problem appeared. The reliability of the variables was measured through Cronbach's Alpha and all item-scales showed acceptable values (Table 1).

3.2. Model results of the binary logistic regression

The logistic regression analysis showed a significance level of the likelihood-ratio test of 0.000 and a Chi-square of 754.892. Thus, the null-hypothesis, i.e. that there is no influence on the purchase intention by any predictor, is rejected. Therefore, we conclude that the independent variables significantly influence purchase intention with respect to bioplastic products and the model fits well in distinguishing the purchase intention towards bioplastic products. The estimated Pseudo-R^2-statistics displays a good model fit: Cox & Snell $R^2 = 0.363$ and Nagelkerke $R^2 = 0.497$. The effect-strengths f according to Cohen has a high value of 0.573 (Table 4).

The classification matrix of the estimated model shows that the model correctly predicted 66.3% of the respondents with no purchase intention, 87.5% of the participants with a purchase intention, which adds to 79.8% of the individuals of the total sample (Table 4).

Table 4
Model values & classification matrix.

Model values:			
−2 Log-Likelihood	Cox & Snell R^2	Nagelkerkes R^2	Cohens f
1439.061	0.363	0.497	0.573

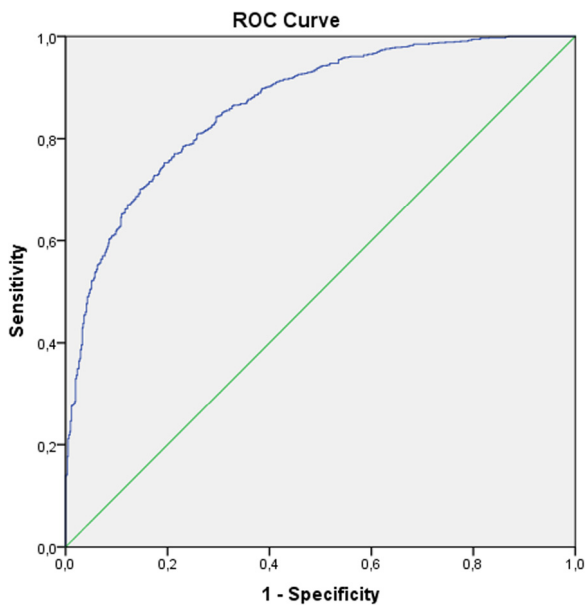| Classification matrix:				
Purchase intention		Forecast		
		No	Yes	Forecast (%)
Observed	No	**404**	205	66.3
	Yes	133	**931**	87.5
Total percentage of forecast				**79.8**

Fig. 1. ROC curve.

The ROC-curve shows the tradeoff between the "true positive rate" (sensitivity) versus the "false positive rate" (1-specificity) of the model (Fawcett, 2006). Hence, the classification focuses on the positive-predicted-ratio. The sensitivity-index is 0.733 and the area under the curve (AUC) 0.866 (Fig. 1).

Table 5 displays the results of the estimated model to differentiate the two groups of participants who stated purchase intention for bioplastic products or not, thereby showing the β-coefficients, the standard errors (SE), the p-values, the odds ratios and their 95% confidence intervals (CI). All significant variables, except the intercept, are positive and therefore reveal the same direction of influence. The 95% CI's confirm all significant odds ratios above 1, since there is no value below 1. For the interpretation of the results, we focus on the odds ratios. Generally, for a unit change of an independent variable, the odds are expected to change by a factor of Exp($\beta_{variable}$), holding all other variables constant (Long and Freese, 2006). The sociodemographic characteristics gender, age and education have no significant influence on the purchase intention for bioplastics. Most independent variables have a strong significant influence on the dependent variable. First, the predictor green consumer values has the strongest measured impact on the purchase intention with an odds ratio of 3.602, holding all other variables constant. Furthermore, when the attitude towards bioplastics increases by 1, the chance for purchase intention increases by the factor of 2.28. For a one-unit increase in subjective norm towards bioplastics, the odds for purchase intention of bioplastic

products are expected to change by the factor of 1.408, holding all other variables constant. The variable altruism reveals an impact through the odds ratios with of about 1.377. Furthermore, the innovativeness-variable reveals an impact of 1.298, whereas the odds ratio of product experience shows a higher impact. When increased by one unit, the odds for purchase intention increase by the factor 2.547. Moreover, if a respondent were to increase the interest in information score by one unit, the chance of having a purchase intention would be 2.45 times greater if the other variables are held constant. The variable perceived knowledge has no significant measured influence on the dependent variable. However, if participants were to increase the perceived influential communication behavior by one scale-unit, the probability for purchase intention increases by 1.320.

4. Discussion and conclusion

This study analyzes influencing factors for distinguishing groups of consumers who intend to purchase bioplastic products or not. The results of the logistic regression model reveal significant influences for such factors that support the purchase of bioplastic products. Altogether, eight of the ten derived a priori hypotheses can be confirmed as shown in Fig. 2.

4.1. Hypotheses

The sociodemographic characteristics showed insignificant influence on the purchase intention towards bioplastic products. Weak influence or no influence of sociodemographic predictors on the purchase intention was also found in previous studies by Straughan and Roberts (1999), Stern et al. (1993), Diamantopoulos et al. (2003) and Laroche et al. (2001). Our study measured insignificant influence of age, gender and education on the purchase intention towards bioplastic products. Thus, Hypothesis 1 "*Single sociodemographic characteristics like gender, age or education have significant influence on the probability of the intention to purchase bioplastic products*". is rejected.

The finding of our study that altruism is an antecedent of green consumption is in line with previous studies of Lusk et al. (2007), Pfattheicher et al. (2015), Teng et al. (2013) and Hustvedt and Dickson (2009). This result strengthens the assumption that altruism and green consumption are related to each other. Furthermore, the purchase intention towards bioplastic products increases when consumers have higher values for their subjective norm towards bioplastics. Previous studies measured similar effects on the purchase intention for green products (Teng et al., 2013; Mishra et al., 2014; Han and Chung, 2014; Hustvedt and Dickson, 2009; Laroche et al., 2001; Nam et al., 2017; Reinders et al., 2017). Thus Hypotheses 2 "*As an individual's altruism increases, the probability of the intention to purchase bioplastic products increases*". and 3 "*As an individual's subjective towards bioplastics norm increases, the probability of the intention to purchase bioplastic products increases*". are confirmed.

Table 5
Results of the binary logistic regression model.

Independent variable	B(SE)	95% CI for Odds Ratio		
		Odds ratio	Lower	Upper
Intercept (β_0)	**−11.522 (0.822)*****	0.000		
Gender (male = 0)	−0.079 (0.137)	0.924	0.707	1.208
Age (in years)	0.009 (0.004)	1.009	1.000	1.017
Education	−0.049 (0.055)	0.952	0.855	1.060
Altruism	**0.320 (0.108)****	**1.377**	**1.114**	**1.703**
Subjective norm towards bioplastics	**0.342 (0.071)*****	**1.408**	**1.224**	**1.619**
Innovativeness	**0.261 (0.132)***	**1.298**	**1.002**	**1.682**
Green consumer values	**1.281 (0.126)*****	**3.602**	**2.814**	**4.610**
Attitude towards bioplastics	**0.824 (0.119)*****	**2.280**	**1.806**	**2.878**
Product experience	**0.935 (0.266)*****	**2.547**	**1.513**	**4.289**
Interest in information	**0.896 (0.141)*****	**2.450**	**1.857**	**3.232**
Perceived knowledge	−0.070 (0.118)	0.933	0.740	1.176
Perceived influential communication behavior	**0.278 (0.103)****	**1.320**	**1.080**	**1.614**

*Significant at the 0.05 level.
**Significant at the 0.01 level.
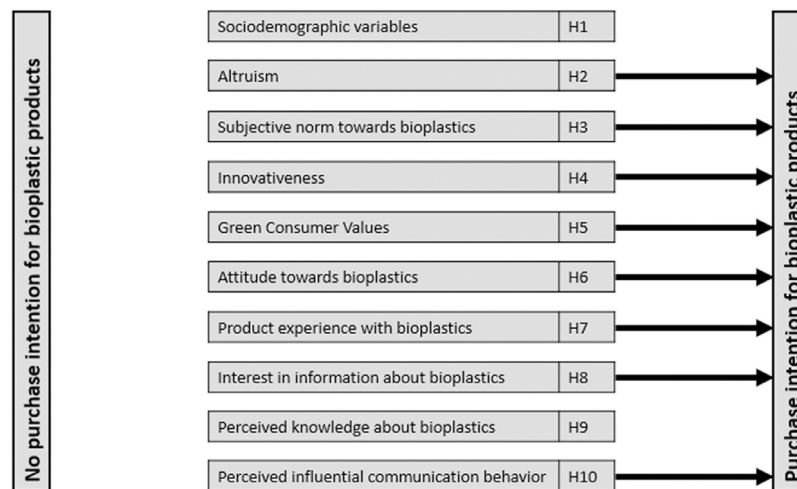***Significant at the 0.001 level.

Fig. 2. Significant influencing factors for purchase intention for bioplastic products.

Furthermore, innovativeness is an important driver for potential consumers to adopt innovative products (Tellis et al., 2009). Our findings related to this factor are in line with previous studies of Jansson (2011) and Osburg et al. (2016). Thus, Hypothesis 4 "*As an individual's innovativeness increases, the probability of the intention to purchase bioplastic products increases*". is supported. As environmental attitudes can be strong predictors towards environmental behavior (Straughan and Roberts, 1999; Kaufmann et al., 2012), we included five attitude scales in this study and showed evidence of the importance of these predictors. The green consumer values as well as attitudes towards bioplastics have a strong influence on purchase intention with odds ratios of 3.6 and 2.3 (Table 5) what has been shown in previous studies conducted in different countries (Scherer et al., 2017; Haws et al., 2014; Hartmann and Apaolaza-Ibáñez, 2012) . Thus, Hypotheses 5 "*As an individual's green consumer values increase, the probability the intention to purchase bioplastic products increases.*" and 6 "*As an individual's attitude towards bioplastics increases, the probability of the intention to purchase bioplastic products increases*" are supported.

Furthermore, prior behavior can influence purchase intention of green products, as it was shown in several studies (Young, 2000; Lee et al., 1995; Chiu et al., 2012; Lin, 2010; Reinders et al., 2017; Blesin et al., 2017). In this study, experience with the product had a strong influence on purchase intention towards bioplastic products. Thus, Hypothesis 7 "*As an individual's product

experience with bioplastics increases, the probability of the intention to purchase bioplastic products increases.*" is supported.

The testing of the adopted a priori hypotheses H8, H9 and H10 showed divergent results. Whereas interest in information and perceived influential communication behavior both showed significant and strong influences as it was also shown by McDonald et al. (2009) and in the broader sense by Boster et al. (2011) and Jaiswal and Kant (2018), perceived knowledge about bioplastics had an insignificant influence on the dependent variable. Thus, Hypotheses 8 "*As an individual's interest in information about bioplastics increase, the probability of the intention to purchase bioplastic products increases*". and 10 "*As an individual's perceived influential communication behavior increases, the probability of the intention to purchase bioplastic products increases*". are supported. However, Hypothesis 9 "*As an individual's perceived knowledge about bioplastics increases, the probability of the intention to purchase bioplastic products increases*". which was related to the findings of Jaiswal and Kant (2018) is rejected. Altogether, the results of previous studies in Germany show that there is a low to medium level of knowledge related to bioplastic products in the population in Germany (Blesin et al., 2017). In addition, there is no legally binding definition of bioplastic nor any clear standards for the end-of-life handling of such products in Germany. This uncertain situation leads to confusion for consumers, which could be the main reason for the insignificant influence of the variable perceived knowledge.

Table 6
Matrix of factor analysis.

Variable	Items	Matrix of rotated components							
		1	2	3	4	5	6	7	8
Sociodemographic characteristics	Gender	−0.21	−0.12	0.08	0.00	−0.01	−0.03	0.22	**0.66**
	Age	0.23	0.02	−0.13	−0.08	−0.29	−0.02	−0.24	**0.63**
	Education	−0.01	−0.02	0.31	0.15	−0.08	0.12	0.45	−0.20
Altruism	No. 1	0.17	**0.73**	0.11	0.13	0.08	0.03	−0.07	−0.02
	No. 2	0.21	**0.65**	0.03	0.01	0.01	0.09	0.10	0.21
	No. 3	0.17	**0.80**	0.06	0.01	0.07	0.07	0.03	−0.07
	No. 4	0.14	**0.84**	0.11	0.07	0.10	0.03	−0.01	−0.13
	No. 5	0.17	**0.77**	0.08	0.10	0.02	−0.03	0.05	0.01
Subjective norm towards bioplastics		**0.52**	0.18	0.03	0.00	0.13	0.13	0.15	0.39
Innovativeness	No. 1	0.17	0.08	0.06	0.09	0.18	**0.51**	−0.09	0.19
	No. 2	0.11	0.04	0.07	−0.05	0.07	**0.77**	0.09	−0.02
	No. 3	0.10	0.06	0.16	0.11	**0.85**	0.06	0.03	−0.08
	No. 4	0.03	0.07	0.17	0.00	**0.85**	0.05	0.08	−0.04
	No. 5	0.14	0.14	0.29	0.17	**0.67**	0.05	0.11	−0.01
	No. 6	−0.08	0.03	−0.05	0.06	−0.06	**0.71**	0.03	−0.11
Green consumer values	No. 1	**0.83**	0.15	0.09	0.13	0.06	0.04	0.01	0.00
	No. 2	**0.80**	0.15	0.15	0.11	0.07	0.02	0.11	−0.04
	No. 3	**0.78**	0.15	0.12	0.07	0.06	0.07	0.15	−0.03
	No. 4	**0.65**	0.15	0.10	0.33	0.00	− 0.09	0.04	−0.04
	No. 5	**0.79**	0.11	0.10	0.01	0.02	0.02	0.00	0.09
	No. 6	**0.72**	0.25	0.11	0.13	0.07	0.12	0.08	−0.05
Attitude towards bioplastics	No. 1	0.12	0.06	0.07	**0.76**	0.04	−0.02	−0.05	0.14
	No. 2	0.05	0.04	0.06	**0.71**	0.10	0.06	0.00	−0.13
	No. 3	0.14	0.07	0.04	**0.75**	0.04	0.03	0.08	−0.13
	No. 4	0.11	0.07	0.07	**0.78**	0.03	0.02	0.03	0.02
Product experience		0.16	0.04	0.04	−0.03	0.06	0.08	**0.62**	0.06
Interest in information		0.30	0.15	0.08	0.38	0.08	0.04	0.23	0.25
Perceived knowledge about bioplastics		0.14	0.03	0.07	0.05	0.16	−0.11	**0.73**	0.12
Perceived influential communication behavior	No. 1	0.21	0.13	**0.76**	0.11	0.13	0.03	0.10	0.01
	No. 2	0.13	0.13	**0.81**	0.08	0.16	−0.02	0.06	−0.07
	No. 3	0.12	0.08	**0.77**	−0.07	0.18	0.03	0.10	0.05
	No. 4	0.10	0.05	**0.72**	0.15	0.13	0.02	0.03	0.04

(extraktionmethod: maincomponentanalysis. rotationmethod: varimax with Kaiser-normalization. the rotation is converged in 6 iterations.)

4.2. Limitations

One limitation could be that more psychographic scales could have been measured in this study. However, it was necessary to limit the number of scales, which were defined based on a comprehensive literature review. There is also the possibility of selection bias as the data was collected through an Online Access Panel (Bethlehem, 2010). Although, we compared our sociodemographic data with the German census data, a certain selection bias cannot be excluded. However, OAC has advantages over other methods, e.g. the quick collection of data, controlled sampling etc. (Evans and Mathur, 2005). Furthermore, the participants self-reported the intention to purchase bioplastic products but this does not necessarily mean that an individual will actually buy the product (Morrison, 1979; Kalwani and Silk, 1982). Intention still is a strong predictor but a bias in true behavior is possible and cannot be totally excluded. We conclude that our results provide a reliable picture of possible purchase behavior related to bioplastic products and its essential predictors. Furthermore, the study was conducted in Germany and its international adaptability for other countries is unclear. Therefore, comparable studies in foreign countries should be conducted and used for comparison. Another limitation is the known fact that there can be social desirability bias in responses (Grimm, 2010). Milfont (2009) and Kaiser et al. (1999) found small impact of the social desirability bias restricted to behavioral aspects in the environmental domain and stated that "…socially desirable responding is not a problem in measures assessing environmental attitudes and self-reported ecological behaviors (Milfont, 2009). Therefore, we argue that the social desirability responding bias is negligible.

4.3. Conclusions and implications

The urgency to manage the global plastic pollution issue is well known and discussed since several years. Although substantial research has been realized in different fields of environmental behavior and green consumerism in recent years, stakeholders and policy makers need to utilize the derived insights to inform consumers and the public more intensively about more sustainable solutions. In this study, we found evidence for the important role of personal psychographic characteristics and the importance of information about bioplastics on the purchase intention to buy these products. Green consumer values, attitudes towards bioplastic, product experience and interest in information have the strongest influences measured in our model. This supports the crucial role of communication and information activities in this field which are impeded e.g. by the multiplicity of application fields of bioplastic products, the differing product characteristics of bioplastics as well as often small-scale companies being active in this field (Rumm, 2016; Kainz, 2016).

Additionally, the purchase intention for bioplastic products measured for all German citizens is moderate at about 56%. In contrast, about 95% of the consumers with product experience intend to buy bioplastic products (Blesin et al., 2017). This finding could be a starting point to implement strategies for promoting bioplastic products, so that they can play a more prominent role in Germany's economy in the long term. Thereby, marketing strategies for bioplastic products could focus on interested consumer groups and illustrate their properties and functions to those groups. In this context Scherer et al. (2018a, 2017) showed

that more than 60% of the population are interested in bioplastic products in Germany. Additionally, bioplastic products could benefit from the EU strategy to reduce plastic waste in the next years (European Commission, 2018). However, a starting point from policy-makers in setting standards for the end-of-life-usage of bioplastics will be necessary to eliminate confusion for consumers and waste management companies likewise. Life-cycle assessments need to support these standards and substitution of conventional plastic products to assure a wise substitution and resource management (European Commission, 2018).

Acknowledgments

Appendix

See Table 6.

References

Ajzen, Icek, Fishbein, Martin, 1980. Understanding Attitudes and Predicting Social Behavior. Prentice-Hall, Upper Saddle River, NJ.

Álvarez-Chávez, Clara Rosalía, Edwards, Sally, Moure-Eraso, Rafael, Geiser, Kenneth, 2012. Sustainability of bio-based plastics. General comparative analysis and recommendations for improvement. J. Clean. Prod. 23 (1), 47–56. http://dx.doi.org/10.1016/j.jclepro.2011.10.003.

Backhaus, Klaus, Erichson, Bernd, Plinke, Wulff, Weiber, Rolf, 2016. Multivariate Analysemethoden. Springer Berlin Heidelberg, Berlin, Heidelberg.

Balderjahn, Ingo, 2013. Nachhaltiges management und konsumentenverhalten. Konstanz, Konstanz: UTB and UVK / Lucius (UTB, 3902 : Wirtschaftswissenschaften).

Batson, C. Daniel, Powell, Adam A., 2003. Altruism and prosocial behavior. In: HandBook of Psychology.

Bethlehem, Jelke, 2010. Selection bias in web surveys. Internat. Statist. Rev. 78 (2), 161–188. http://dx.doi.org/10.1111/j.1751-5823.2010.00112.

Blesin, J.M., Klein, F., Emberger-Klein, A., Scherer, C., Menrad, K., Möhring, W., 2017. Bevölkerungsrepräsentative Online-Befragung in Deutschland zu Biokunststoffen. Arbeitsbericht Oktober 2017. Hochschule Hannover, Hochschule Weihenstephan-Triesdorf. Available online at https://www.ifbb.wp.hs-hannover.de/bina/files/Downloads/BiNa%20Working%20Paper%20zur%20Bevoelkerungsbefragung%202016.pdf, checked on 6/14/2018.

Boster, Franklin J., Kotowski, Michael R., Andrews, Kyle R., Serota, Kim, 2011. Identifying influence. development and validation of the connectivity, persuasiveness, and maven scales. J. Commun. 61 (1), 178–196. http://dx.doi.org/10.1111/j.1460-2466.2010.01531.x.

BUND, 2018. Plastikfasten! Der erste Schritt zum Ausstieg aus dem Plastikwahn. Available online at https://www.bund.net/chemie/achtung-plastik/plastikfasten/, checked on 1/11/2018.

Buxel, Holger, 2010. Akzeptanz Und Nutzung Von Güte- Und Qualitätssiegeln Auf Lebensmitteln. Ergebnisse Einer Empirischen Untersuchung. University of Applied Sciences Münster.

Casimir, Gerda, Dutilh, Chris, 2003. Sustainability. A gender studies perspective*. Int. J. Consum. Stud. 27 (4), 316–325. http://dx.doi.org/10.1046/j.1470-6431.2003.00323.x.

Childers, Terry L., 1986. Assessment of the psychometric properties of an opinion leadership scale. J. Mark. Res. 184–188.

Chiu, Chao-Min, Hsu, Meng-Hsiang, Lai, Hsiangchu, Chang, Chun-Ming, 2012. Re-examining the influence of trust on online repeat purchase intention. The moderating role of habit and its antecedents. Decis. Support Syst. 53 (4), 835–845. http://dx.doi.org/10.1016/j.dss.2012.05.021.

Diamantopoulos, Adamantios, Schlegelmilch, Bodo B., Sinkovics, Rudolf R., Bohlen, Greg M., 2003. CaN socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. J. Bus. Res. 56 (6), 465–480. http://dx.doi.org/10.1016/S0148-2963(01)00241-7.

Endres, Hans-Josef, 2017. Bioplastics. Adv. Biochem. Eng./Biotechnol. http://dx.doi.org/10.1007/10_2016_75.

Endres, H.-J., Bengs, M., Schulz, C., Siebert-Raths, A., 2011. Market opportunities, land use requirement and future developments. Kunststoffe Int. 101 (9), 54–58.

Englis, Basil G., Phillips, Diane M., 2013. Does innovativeness drive environmentally conscious consumer behavior?. Psychol. Mark. 30 (2), 160–172.

Eriksen, Marcus, Lebreton, Laurent C.M., Carson, Henry S., Thiel, Martin, Moore, Charles J., Borerro, Jose C., et al., 2014. Plastic pollution in the world's oceans. More than 5 trillion plastic pieces weighing over 250, 000 tons afloat at sea. PLoS One 9 (12), e111913.

European Commission, 2018. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A European Strategy for Plastics in a Circular Economy, SWD/2018/016. With assistance of Commission Staff, 2018.

Evans, Joel R., Mathur, Anil, 2005. The value of online surveys. Int. Res. 15 (2), 195–219. http://dx.doi.org/10.1108/10662240510590360.

Fawcett, Tom, 2006. An introduction to ROC analysis. Pattern Recognit. Lett. 27 (8), 861–874. http://dx.doi.org/10.1016/j.patrec.2005.10.010.

Field, Andy, 2013. Discovering Statistics using IBM SPSS Statistics, fourth ed. SAGE Publications Ltd., London.

Fishbein, M., 1980. A theory of reasoned action. Some applications and implications. In: Nebraska Symposium on Motivation. Nebraska Symposium on Motivation, vol. 27, pp. 65–116.

German Federal Statistical Office, 2015. Microzensus. Edited by Statistisches Bundesamt. Statistisches Bundesamt (Mikrozensus). Available online at https://www.destatis.de/, checked on 5/14/2018.

Greenpeace, 2018. 10 Tipps für weniger Plastik. erpackungsfolien, Einweggeschirr, Abreißtüten: Plastik ist aus unserem Alltag nicht mehr wegzudenken – und doch gar nicht so schwer zu vermeiden. Wir haben dazu ein paar Tipps 2018. Available online at https://www.greenpeace.de/themen/endlager-umwelt/plastikmuell/10-tipps-fuer-weniger-plastik.

Grimm, Pamela, 2010. Social desirability bias. In: Wiley International Encyclopedia of Marketing.

Han, Tae-Im, Chung, Jae-Eun, 2014. Korean consumers' motivations and perceived risks toward the purchase of organic cotton apparel. Clothing and Textiles Research Journal 32 (4), 235–250.

Hartmann, Patrick, Apaolaza-Ibáñez, Vanessa, 2012. Consumer attitude and purchase intention toward green energy brands. The roles of psychological benefits and environmental concern. J. Bus. Res. 65 (9), 1254–1263. http://dx.doi.org/10.1016/j.jbusres.2011.11.001.

Haws, Kelly L., Winterich, Karen Page, Naylor, Rebecca Walker, 2014. Seeing the world through GREEN-tinted glasses. Green consumption values and responses to environmentally friendly products. J. Consum. Psychol. 24 (3), 336–354. http://dx.doi.org/10.1016/j.jcps.2013.11.002.

Hefner, Dorothée, 2013. Wie kriegen wir sie ins Boot? Eine Typologie zur Entwicklung von Kommunikationsstrategien zur Förderung umweltschützenden Verhaltens. M & K Medien & Kommunikationswissenschaft 61 (3), 387–405. http://dx.doi.org/10.5771/1615-634x-2013-3-387.

Hustvedt, Gwendolyn, Dickson, Marsha A., 2009. Consumer likelihood of purchasing organic cotton apparel. Influence of attitudes and self-identity. J. Fash. Mark. Manag.: Int. J. 13 (1), 49–65.

Jaiswal, Deepak, Kant, Rishi, 2018. Green purchasing behaviour. A conceptual framework and empirical investigation of Indian consumers. J. Retail. Consum. Serv. 41, 60–69. http://dx.doi.org/10.1016/j.jretconser.2017.11.008.

Jansson, Johan, 2011. Consumer eco-innovation adoption. assessing attitudinal factors and perceived product characteristics. Bus. Strat. Env. 20 (3), 192–210. http://dx.doi.org/10.1002/bse.690.

Kainz, Ulla, 2016. Consumers' Willingness to Pay for Durable Biobased Plastic Products. Findings from an Experimental Auction (Dissertation), Technical University Munich.

Kaiser, Florian G., Fuhrer, Urs, 2003. Ecological behavior's dependency on different forms of knowledge. Appl. Psychol. 52 (4), 598–613. http://dx.doi.org/10.1111/1464-0597.00153.

Kaiser, Florian G., Ranney, Michael, Hartig, Terry, Bowler, Peter A., 1999. Ecological behavior, environmental attitude, and feelings of responsibility for the environment. Eur. Psychol. 4 (2), 59.

Kalwani, Manohar U., Silk, Alvin J., 1982. On the reliability and predictive validity of purchase intention measures. Mark. Sci. 1 (3), 243–286. http://dx.doi.org/10.1287/mksc.1.3.243.

Kaufmann, Hans Ruediger, Panni, Mohammad Fateh Ali Khan, Orphanidou, Yianna, 2012. Factors affecting consumers' green purchasing behavior. An integrated conceptual framework. Amfiteatru Econ. 14 (31), 50.

Kerlund, C., Gaugele, J., 2018. EU-Kommission Kämpft Gegen Plastikmüll. Mitgliedstaaten Sollen Wegwerfgeschirr Verbieten Und Müllabgabe an Den EU-Haushalt Abführen. Bis Zur Umsetzung Des Vorhabens Wird Es Aber Noch Dauern. Berliner Morgenpost, 5/27/2018. Available online at https://www.morgenpost.de/politik/article214398155/EU-Kommission-kaempft-gegen-Plastikmuell.html.

Kim, Yeonshin, Choi, Sejung Marina, 2005. Antecedents of green purchase behavior. An examination of collectivism, environmental concern, and PCE. In: ACR North American Advances.

Kurka, Stefan, 2012. Biomasse-Basierte Produkte Aus Konsumentensicht - Ausgewählte Europäische Länder im Vergleich. München, Technische Universität München. Diss., Universitätsbibliothek der TU München, München.

Laroche, Michel, Bergeron, Jasmin, Barbaro-Forleo, Guido, 2001. Targeting consumers who are willing to pay more for environmentally friendly products. J. Consum. Mark. 18 (6), 503–520.

Lee, Yung-Jaan, Young, Raymond de, Marans, Robert W., 1995. Factors influencing individual recycling behavior in office settings. Environ. Behav. 27 (3), 380–403. http://dx.doi.org/10.1177/0013916595273006.

Lin, Shu-Hwa, 2010. A case study in Hawaii: Who will pay more for organic cotton?. Int. J. Consum. Stud. 34 (4), 481–489.

Lin, Pei-Chun, Huang, Yi-Hsuan, 2012. The influence factors on choice behavior regarding green products based on the theory of consumption values. J. Cleaner Prod. 22 (1), 11–18. http://dx.doi.org/10.1016/j.jclepro.2011.10.002.

Long, J. Scott, Freese, Jeremy, 2006. Regression Models for Categorical Dependent Variables using Stata, second ed. Stata Press, College Station, Tex.

Lusk, Jayson L., Nilsson, Tomas, Foster, Ken, 2007. Public preferences and private choices. Effect of altruism and free riding on demand for environmentally certified pork. Environ. Resour. Econ. 36 (4), 499–521. http://dx.doi.org/10.1007/s10640-006-9039-6.

Lynch, Durwin H.J., Klaassen, Pim, Broerse, Jacqueline E.W., 2017. Unraveling Dutch citizens' perceptions on the bio-based economy, The case of bio-plastics, bio-jetfuels and small-scale bio-refineries. Ind. Crops Prod. 106, 130–137. http://dx.doi.org/10.1016/j.indcrop.2016.10.035.

McDonald, Seonaidh, Oates, Caroline, Thyne, Maree, Alevizou, Panayiota, McMorland, Leigh-Ann, 2009. Comparing sustainable consumption patterns across product sectors. Int. J. Cons. Stud. 33 (2), 137–145. http://dx.doi.org/10.1111/j.1470-6431.2009.00755.

Milfont, Taciano L., 2009. The effects of social desirability on self-reported environmental attitudes and ecological behaviour. Environmentalist 29 (3), 263–269. http://dx.doi.org/10.1007/s10669-008-9192-2.

Mishra, Deepti, Akman, Ibrahim, Mishra, Alok, 2014. Theory of reasoned action application for green information technology acceptance. Comput. Hum. Behav. 36, 29–40. http://dx.doi.org/10.1016/j.chb.2014.03.030.

Morrison, Donald G., 1979. Purchase intentions and purchase behavior. J. Mark. 43 (2), 65. http://dx.doi.org/10.2307/1250742.

Morwitz, Vicki, 2012. Consumers' purchase intentions and their behavior. FNT Mark. 7 (3), 181–230. http://dx.doi.org/10.1561/1700000036.

Morwitz, Vicki, Steckel, Joel, Gupta, Alok, 2006. When do purchase intentions predict sales?. SSRN J. http://dx.doi.org/10.2139/ssrn.946194.

Mülhaupt, Rolf, 2013. Green polymer chemistry and bio-based plastics. Dreams and reality. Macromol. Chem. Phys. 214 (2), 159–174. http://dx.doi.org/10.1002/macp.201200439.

Nam, Changhyun, Dong, Huanjiao, Lee, Young-A, 2017. Factors influencing consumers' purchase intention of green sportswear. Fash. Text. 4 (1), 2. http://dx.doi.org/10.1186/s40691-017-0091-3.

Osburg, Victoria-Sophie, Strack, Micha, Toporowski, Waldemar, 2016. Consumer acceptance of wood-polymer composites. A conjoint analytical approach with a focus on innovative and environmentally concerned consumers. J. Cleaner Prod. 110, 180–190. http://dx.doi.org/10.1016/j.jclepro.2015.04.086.

Pfattheicher, Stefan, Sassenrath, Claudia, Schindler, Simon, 2015. Feelings for the suffering of others and the environment. Environ. Behav. 48 (7), 929–945. http://dx.doi.org/10.1177/0013916515574549.

PlasticsEurope, 2016. Plastics – the Facts 2016. An analysis of European plastics production, demand and waste data. Messe Düsseldorf.

Pollmer, Udo, 2017. Ökowahn Plastikfasten. 3/24/2017. Available online at http://www.deutschlandfunkkultur.de/neuer-trend-oekowahn-plastikfasten.993.de.html?dram:article_id=382123.

Price, Linda L., Feick, Lawrence F., Guskey, Audrey, 1995. Everyday market helping behavior. J. Publ. Policy Mark. 14 (2), 255–266.

Reinders, Machiel J., Onwezen, Marleen C., Meeusen, Marieke J.G., 2017. CaN bio-based attributes upgrade a brand? How partial and full use of bio-based materials affects the purchase intention of brands. J. Cleaner Prod. 162, 1169–1179. http://dx.doi.org/10.1016/j.jclepro.2017.06.126.

Rumm, Stefanie, 2016. Verbrauchereinschätzungen Zu Biokunststoffen: Eine Analyse Vor Dem Hintergrund Des Heuristic-Systematic Model. Dissertation.

Rumm, Stefanie, Klein, Agnes, Zapilko, Marina, Menrad, Klaus, 2013. Labelling for Bio-Based Plastics. Universitätsdrucke Göttingen, Göttingen, pp. 403–414.

Scherer, Christoph, Emberger-Klein, Agnes, Menrad, Klaus, 2017. Biogenic product alternatives for children. Consumer preferences for a set of sand toys made of bio-based plastic. Sustain. Prod. Consum. 10, 1–14. http://dx.doi.org/10.1016/j.spc.2016.11.001.

Scherer, Christoph, Emberger-Klein, Agnes, Menrad, Klaus, 2018a. Consumer preferences for outdoor sporting equipment made of bio-based plastics. Results of a choice-based-conjoint experiment in Germany. J. Cleaner Prod. 203, 1085–1094. http://dx.doi.org/10.1016/j.jclepro.2018.08.298.

Scherer, Christoph, Emberger-Klein, Agnes, Menrad, Klaus, 2018b. Segmentation of interested and less interested consumers in sports equipment made of bio-based plastic. Sustain. Prod. Consum. 14, 53–65. http://dx.doi.org/10.1016/j.spc.2018.01.003.

Schilly, Julia, 2018. China will keinen Plastikabfall aus Europa mehr. Mit Jahresende stoppte China den Import von Altkunststoff. Länder wie Deutschland stehen nun vor einem Problem. In der Standard. Available online at https://derst{and}ard.at/2000071489042/China-will-keinen-Plastikabfall-aus-Europa-mehr.

Schleenbecker, Rosa, Hamm, Ulrich, 2013. The role of information in ethical purchase decisions: An information display matrix approach.

Spierling, Sebastian, Knüpffer, Eva, Behnsen, Hannah, Mudersbach, Marina, Krieg, Hannes, Springer, Sally, et al., 2018. Bio-based plastics - A review of environmental, social and economic impact assessments. J. Cleaner Prod. 185, 476–491. http://dx.doi.org/10.1016/j.jclepro.2018.03.014.

Stern, Paul C., Dietz, Thomas, Kalof, Linda, 1993. Value orientations, gender, and environmental concern. Environ. Behav. 25 (5), 322–348. http://dx.doi.org/10.1177/0013916593255002.

Straughan, Robert D., Roberts, James A., 1999. Environmental segmentation alternatives. A look at green consumer behavior in the new millennium. J. Consum. Mark. 16 (6), 558–575. http://dx.doi.org/10.1108/07363769910297506.

Tarkiainen, Anssi, Sundqvist, Sanna, 2005. Subjective norms, attitudes and intentions of finnish consumers in buying organic food. Br. Food J. 107 (11), 808–822. http://dx.doi.org/10.1108/00070700510629760.

Tellis, Gerard J., Yin, Eden, Bell, Simon, 2009. Global consumer innovativeness. Cross-country differences and demographic commonalities. J. Int. Mark. 17 (2), 1–22.

Teng, Yi-Man, Wu, Kun-Shan, Liu, Hsiao-Hui, 2013. Integrating altruism and the theory of planned behavior to predict patronage intention of a green hotel. J. Hosp. Tour. Res. 39 (3), 299–315. http://dx.doi.org/10.1177/1096348012471383.

Uken, Marlies, 2018. Die Weltmüllkippe schließt. Müllexporte nach China. In Die Zeit, 2018. Available online at http://www.zeit.de/wirtschaft/2018-01/muellexporte-china-plastikmuell-recycling, checked on 1/11/2018.

Untaru, Elena-Nicoleta, Ispas, Ana, Candrea, Adina Nicoleta, Luca, Marcela, Epuran, Gheorghe, 2016. Predictors of individuals' intention to conserve water in a lodging context. The application of an extended theory of reasoned action. Int. J. Hosp. Manag. 59, 50–59. http://dx.doi.org/10.1016/j.ijhm.2016.09.001.

Valente, Thomas W., Davis, Rebecca L., 1999. Accelerating the diffusion of innovations using opinion leaders. Ann. Am. Acad. Polit. Soc. Sci. 566 (1), 55–67. http://dx.doi.org/10.1177/000271629956600105.

Young, Raymond de, 2000. New ways to promote proenvironmental behavior. Expanding and evaluating motives for environmentally responsible behavior. J. Soc. Isssues 56 (3), 509–526. http://dx.doi.org/10.1111/0022-4537.00181.

Young, William, Hwang, Kumju, McDonald, Seonaidh, Oates, Caroline J., 2009. Sustainable consumption. Green consumer behaviour when purchasing products. Sust. Dev. 37 (2), n/a-n/a. http://dx.doi.org/10.1002/sd.394.

Article

Indicators of Consumers' Preferences for Bio-Based Apparel: A German Case Study with a Functional Rain Jacket Made of Bioplastic

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Abstract: Plastic pollution is an increasing global problem, however, replacing fossil resources with bioplastics made from renewable resources could be part of the solution. Currently, no research analyzing the influencing factors for consumers' preferences for functional apparel made of bioplastic material could be found. To close this gap in research, we conducted this study with a sample of 1673 participants that were representative of the German population aged 16 years and above. We conducted a choice based conjoint analysis for a bio-based rain jacket and measured psychographic indicators that were used as covariates in the statistical estimation of participants' preferences for the rain jacket. Our results show the high level of importance of prior product experience, Green Consumer Values and attitude towards bioplastic for selecting bio-based apparel, and thus give first insights related to the influence of psychographic characteristics of consumers when selecting bio-based apparel.

Keywords: bio-based apparel; choice based conjoint analysis; psychographic indicators; bioplastic; preferences; covariates

1. Introduction

Plastics have become an increasing global waste problem over the last decades [1–4]. Plastic waste and micro-plastics can be found in almost every ecosystem in the world. Awareness of plastic pollution in the air, on land and in the oceans has raised the need to protect these ecosystems and find cleaner solutions or even substitutes for conventional plastics. One possible strategy is changing the raw materials in plastic products by replacing crude oil with biomass. Therefore, bioplastics are considered to be part of the answer to this challenge and a substitute for conventional plastics.

Bioplastics are made of renewable resources and contain carbon dioxide sequestered by plants. Bioplastics have been part of industrial life for several decades. There is strong demand for renewable solutions with respect to plastic pollution and the substitution of fossil resources use, meaning that bioplastics are gaining importance. However, the definition of bioplastics is not easy to understand for consumers. Bioplastics can be manufactured partly or completely from biogenic raw materials from various types of plants. The raw material compounds can be, for example, bioethanol (sugar cane), oil (castor bean or canola oil), starch (potatoes) or cellulose (leaf of plants). The different types of bioplastic are not necessarily biodegradable. Additionally, current "drop-in" bioplastics are chemically identical to their petrochemical equivalents, with the only difference being that the source of the carbon is not fossil fuel. There are also "novel" bioplastics (like e.g., polylactic acid, polyhydroxyalkanoates or polyethylene furanoate), which differ in chemical structure and properties from conventional plastic [5–8].

The differentiation between conventional plastic products and bioplastic products is not obvious for consumers, as there are usually no visible attributes that can be used to distinguish the plastics from one another, especially in situations where consumers make a choice. In addition, public knowledge about bioplastics is very diffuse and limited in Germany [9]. Considering these issues and the acuteness of the pollution problems, it is important to understand consumers' choices with respect to bioplastic products.

Apparel is a product that is used daily. Modern apparel often uses plastic fibers, especially for functional clothes. Hence, fibers stemming from bio-based plastics with lower carbon dioxide emissions could be used to substitute large amounts of fibers made from crude oil [10–12]. This leads to the question as to whether consumers intend to purchase bio-based functional apparel and what the possible drivers of consumer choice for bio-based functional apparel are.

So far, the drivers and factors influencing consumer choice for bio-based products are not well known and only a few studies have been carried out in this field [13–19]. None of these studies analyzed consumer choices relating to bio-based apparel. Another path of research has examined the relationship between the choice of green or organic apparel and psychographic variables [20–26]. However, no study thus far was found to combine these two fields of research. To partially close this gap, we place special emphasis on the choices made by consumers with respect to a functional rain jacket made of bioplastic using a choice-based conjoint experiment (CBC) in this study. Furthermore, we analyze the influence of psychographic indicators (covariates), which we assume affect the preference for bio-based apparel. Based on these covariates, we describe the relationship between the selected psychographic scales and the preferences measured through the CBC. Thus, this study gives first insights related to the influence of psychographic characteristics of consumers when selecting bio-based apparels. Relevant influencing factors were identified through a literature review, which especially focused on previous studies relating to green apparel, bio-based products and green products in general. Our main research questions are:

Which attributes of bio-based apparel are relevant for consumers' preferences?
Which covariates have an influence on certain attributes of bio-based apparel?
How strong are the influences of certain covariates on consumer choices?

The results of the literature review and the derived hypotheses are described in Section 2, followed by information on data collection and analysis in Section 3. In Section 4, we present the results of the covariate-estimation and discuss the influences of the covariates on the choices made by respondents relating to the attributes of the bio-based rain jacket. In addition, the limitations of the study and the implications for different stakeholder groups are discussed.

2. Literature Findings and Hypotheses

This study investigates psychographic and other factors that influence preferences for specific attributes of apparel made of bioplastic. Initially, we reviewed scientific literature to generate hypotheses that investigate the influence of psychographic and other variables on the attributes that are relevant choosing bio-based and green products. In this section, the investigated psychographic variables are defined, the reasoning for each variable is provided and the relationship to the attribute used in the CBC is shown. Finally, we postulate the hypotheses to be tested.

Product experience: Cowan and Kinley [27], Khare and Sadachar [28] and Nam et al. [29] show that prior purchases of green apparel is an indicator for future purchases. Lin [30] showed that consumers are interested in the fabric content label prior to the purchase of a garment and that this also relates to the past purchase of organic apparel. Therefore, we expect that prior consumption behavior is an indicator for the preference for rain jackets made of bioplastic. This also leads to the assumption that no prior product experience negatively affects the preference for a rain jackets made of bioplastic and that consumers would choose a conventional rain jacket.

Hypothesis 1 (H1). *No prior product experience with bio-based apparel decreases the probability of consumers' preferences for it.*

Green Consumer Values (GCV): Haws et al. [31] found evidence of a correlation between an environmental attitude (scale: GCV) and respondents' preferences for ecological products. Kurka [19], Scherer et al. [13] and Scherer et al. [15] revealed that consumers with stronger environmental attitudes or higher GCV tend to choose bio-based products. Thus, we assume that consumers with high GCV prefer a high percentage of bio-based material in the fabric that is used to make a functional jacket and vice versa.

Hypothesis 2a (H2a). *Higher GCV increase consumers' preferences for a high percentage of bioplastic in the fabric used to make bio-based apparel.*

Hypothesis 2b (H2b). *Lower GCV decrease consumers' preferences for a high percentage of bioplastic in the fabric used to make bio-based apparel.*

The intensively debated food versus fuel dilemma has been examined in various studies [32–34]. Consumers with higher GCV possibly perceive the use of agricultural resources for bioplastic as conflicting more with food security, whereas products made from forest wood can be perceived as conflicting less with food resources. Scherer et al. [13,15] found that the resources used to create the bio-based material used for a product is relevant for consumers' preferences for products such as this. We assume that the food versus fuel dilemma influences the choice of product when the resources the product is made of are taken into account. Thus, we expect that the crop used as a source of material is a factor that influences preference for bio-based rain jackets in consumers with high GCV.

Hypothesis 2c (H2c). *Higher GCV increase consumers' preferences for resources with a perceived low food versus fuel dilemma in the case of bio-based apparel.*

Ellis et al. [35], Chen and Chai [36] and Umberson [37] found that environmental attitudes are positively related to a high purchase intention towards green sportswear. Furthermore, Scherer et al. [13], Kainz [18] and Kurka [19] showed that respondents with high GCV are less sensitive to increased prices for bio-based products. Thus, we assume that higher GCV would decrease the importance of low prices with respect to bio-based apparel.

Hypothesis 2d (H2d). *Higher GCV decrease the relevance of low prices for bio-based apparel.*

Altruism: Altruism produces prosocial behavior. As defined by Batson and Powell [38], altruism is the motivation to increase another person's welfare and has been found to be a predictor for the preference for green products and green consumption by Stern et al. [39], Pfattheicher et al. [40], Teng et al. [41] or Hefner [42]. Based on these findings, we assume that a person's level of altruism is an indicator for the preference for green apparel and is expressed by reduced relevance of paying lower prices for bio-based products.

Hypothesis 3a (H3a). *Higher altruism decreases the relevance of low prices for bio-based apparel.*

Lusk et al. [43] found that individuals who are more altruistic are willing to pay more for environmentally certified pork. Grolleau et al. [44] also showed that altruism influences the preference for eco-labelled environmentally friendly products. Thus, we conclude that consumers with a higher level of altruism are more likely to prefer certified bio-based apparel.

Hypothesis 3b (H3b). *Higher altruism increases consumers' preferences for the certification of bio-based apparel.*

Attitude towards bioplastics: Hartmann and Apaolaza-Ibáñez [45] and Teng et al. [41] revealed that consumers' environmental attitudes have a positive influence on the preference for green products. Recent studies by Rumm [17], Kurka [19] and Scherer et al. [13] found a connection between environmental attitudes and preferences for bioplastic products. As bioplastics are expected to help solve environmental issues caused by conventional plastics, they can be considered environmentally advantageous. Thus, environmental attitudes and the attitude towards bioplastics seem to be strongly related. Hence, we expect that attitude towards bioplastics has a similar influence on preferences as environmental attitudes have on green products. Furthermore, environmental attitude is an indicator for the preference for bio-based apparel and a higher percentage of bioplastic in the fabric.

Hypothesis 4a (H4a). *Higher attitude towards bioplastics increases consumers' preferences for bio-based apparel.*

Hypothesis 4b (H4b). *Higher attitude towards bioplastics increases consumers' preferences for a high percentage of bioplastic in the fabric of bio-based apparel.*

As consumers can hardly distinguish bio-based plastic products from conventional plastic products, the recognition of bio-based products needs to be supported through visual aids, such as labelling or certification. Nam et al. [29] revealed that consumers' attitude have a positive influence on the intention to purchase green sportswear. D'Souza et al. [46] found that there is a relationship between consumers perceiving labels as relevant for the willingness to pay higher prices for green-labelled alternatives and argued that environmental attitude can be a relevant factor for perceiving eco-labels. We propose that attitude towards bioplastics as a type of environmental attitude influences preference for the labelling of bio-based apparel.

Hypothesis 4c (H4c). *Higher attitude towards bioplastics increases consumers' preferences for a certification of bio-based apparel.*

Trust: Trust as defined by Beierlein et al. [47] is an indicator of someone's ability to trust other persons' actions. According to Atkinson and Rosenthal [48], trust in green products is influenced by the source of an eco-label and the argument specificity of the product. Several previous studies measured green trust scales as predictors of green consumption [48–54]. Atkinson and Rosenthal [48] and Young et al. [49] argued a possible general influence of trust towards green products. Thus, we assume that trust is a possible factor influencing preferences for bio-based apparel generally as trust in claims can be understood as trust in agents' products. Especially eco-labels must be seen as an effort to gain consumers' trust [55,56]. Therefore, we claim that trust can be connected towards the trust into the certification of product labels of bio-based apparel.

Hypothesis 5a (H5a). *Higher trust increases consumers' preferences for a certification of bio-based apparel.*

For consumers to purchase products, they need to trust in the product and this is connected to familiarity with products and their origin, as found by Fandos Herrera and Flavián Blanco [57] and Jiménez and San Martín [58]. Consequently, we assume that lower levels of trust increase the preference for bio-based apparel with a biomass source that is produced nationally.

Hypothesis 5b (H5b). *Lower trust increases consumers' preferences for bio-based apparel made with biomass from sources that are produced nationally.*

Innovation-friendly: Consumers' innovativeness is also an important driver for the adoption of environmentally friendly product innovations, as found by Tellis et al. [59], Rahman et al. [60] and Jansson [61]. Recently, Osburg et al. [62] showed that choices for wood-plastic composites over conventional plastics correlated with the respondents' innovativeness. Furthermore, Scherer et al. [13]

revealed that ecologically sensitive respondents are more innovative. Thus, we assume that respondents that are more innovative (short scale of Tellis et al. [59] innovativeness-scale) prefer bio-based apparel with a higher percentage of bioplastic in the fabric.

Hypothesis 6 (H6). *Higher innovation-friendly increases consumers' preferences for a high percentage of bioplastic in the fabric of bio-based apparel.*

3. Data and Methods

Here, we describe how the data was collected and the theoretical background on the choice based conjoint analysis (CBC) and the covariates used in our model.

3.1. Data Collection

We collected data through an online access panel in June 2016. This was done through a subcontracted market research company, which recruited the respondents. The participants in the study received pre-determined incentives for completing the full survey. Web surveys are less costly and allow a fast data collection [63]. We aimed for a representative group of the German population aged 16 or above, with the sociodemographic characteristics being based on the German sample census from 2015 (="Mikrozensus") [64]. Quotas were set on gender, age, education and the number of inhabitants in the town of residence (Table 1). The questionnaire of the survey included—amongst other topics—a CBC experiment, items operationalizing the chosen psychographic variables, and sociodemographic information related to the respondents. Subsequent to the data collection, we cleaned the data to remove answers that were not feasible (straight-liners, Christmas-tree-behavior, conflicting answers, incorrectly answered test-questions, etc.), which left 1,673 responses for the statistical analysis. Data management and analysis was performed using Sawtooth 8 [65] and SPSS 23 [66]. The identical data set was used in the study by Klein et al. [67] that was targeted to other research questions.

Table 1. Sociodemographic data of the sample *.

Variable	Sample	Germany Population 16+ [64]
Age		
16–19 years	0.050	0.046
20–29 years	0.127	0.141
30–39 years	0.124	0.141
40–49 years	0.166	0.180
50–59 years	0.185	0.180
60+ years	0.348	0.312
Sex		
Female	0.519	0.513
Male	0.481	0.487
Education		
Not yet graduated	0.025	0.025
Secondary modern school without apprenticeship	0.071	0.079
Secondary modern school with apprenticeship	0.320	0.306
General certificate of secondary education	0.298	0.303
General qualification for university entrance	0.127	0.131
Academic studies	0.160	0.157

Note: * The same data was used in the study of Klein et al. [67] with an identical socio-demographic structure of the sample.

3.2. Methods

We conducted a CBC and used Hierarchical Bayes (HB) estimation to analyze the data. We included several covariates in the HB estimation, which we derived through factor analysis. In this section, we describe the approach and methods used.

3.2.1. Choice Based Conjoint Analysis

Choice-based conjoint analysis is a well-known and valid method to research preferences for innovations or existing products [68,69]. Even though the measured choices do not necessarily lead to purchase behavior, they provide insights into motivations for buying certain products, for example, the attributes that consumer consider important or willingness-to-pay. This enables research on the current state of consumers' demand or for marketing strategies to be developed. Choice measurements with a high number of respondents can help to reveal the predictors of decision making processes. A respondent's preference results from the chosen product concepts in the CBC. Therefore, a set of attributes with realistic and existing occurrences (levels) need to be set (Table 2). The product concepts are randomly constructed (random tasks) or explicitly selected (fixed tasks). The fixed tasks are part of the validation of the method. By choosing the illustrated product concepts, respondents value each attribute-level. Through the utility function, it is possible to translate the choices made into the consumers' perceived preferences, which can potentially be used to predict purchase decisions [69].

Table 2. Attributes and levels of the choice-based conjoint-analysis.

Attributes	Levels
Percentage of bioplastic in fabric	100%
	50%
	20%
Biogenic resource	Potatoes
	Chipped wood
	Sugar cane
	Corn
Origin of resource	South America
	European Union
	United States of America
	Asia
Product certificate	Free of pollutants
	Climate protection
	Fair production
	Without certificate
Price	349 €
	239 €
	109 €
	69 €

3.2.2. Attributes, Levels and Product-Concepts

When conducting CBC-experiments, a set of attributes with different levels is needed for the product concepts. In our study, we considered attributes that either already exist or potentially play a role in the German market. We defined the attributes and levels based on expert interviews, a market analysis and a literature review (Table 2). We found the lowest attribute-levels for "percentage of bioplastic in fabric" (20%) in the market for rain jackets in 2016. The higher levels (50%, 100%) were set in order to simulate the effects of more ambitious targets. The biogenic resources shown in the CBC contain plants/byproducts that can be used to manufacture bioplastics for use in textiles. Sanad [70] found that the origin of the apparel is relevant for consumers. Furthermore, Scherer et al. [13,15] showed that the origin of the plant material is important for consumers' preferences for bioplastic products. Thus, the attribute "origin of resource" was included in the choice set, with its levels representing the globalized economy and considering important regions in which raw material plants for apparel could be produced. According to Chekima et al. [71] and Borin et al. [72] eco-labels or certificates are of value for consumers to build trustworthy products, to communicate certain properties of a product and to promote the purchase of green products. Hence, we included the attribute "product certificate" in our CBC design and defined three certificate types frequently found on the German

market. The prices we chose for the CBC cover a wide range (69 € to 349 €), but this depicts a realistic view of the German market for functional rain jackets. Additionally, we included a "None" option that is interpreted as a choice threshold, where respondents prefer none of the three listed product concepts. Three randomly created product-concepts were part of every choice set plus the "None option". Therefore, respondents could choose one option out of four (three alternative product concepts or the "None option", Tables A1 and A2). Thereby the "None" option represented the influence on the utility of not choosing a shown product.

3.2.3. Factor Analysis

All factors were examined for their construct validity and internal reliability. Factor analysis is often used to reduce the dimensions, measured through certain defined items. Through factor analysis, item-groups of the measured scales that highly correlate with each other are found and can be aggregated in one influencing factor. We conducted the principal components analysis as extraction method used within the factor analysis. We applied the rotation method Varimax with Kaiser-normalization and the rotation was converged in 5 iterations. The variable "prior behavior" was not included in the factor analysis as it was measured by one item only. Table 3 shows the derived factors and the statements used for covariate-estimation in this study. The results of the original factor analysis are displayed in the Appendix A (Table A3). No evidence of multicollinearity was found. All factor loadings are reflected in the factors given (Table 3).

3.2.4. Mathematical Approach for the Estimation of the Covariates

We estimated the part-worths of the CBC data using the Hierarchical Bayes statistic (HB), which requires repeated choices per respondent within the CBC as it is necessary to measure variation within and between the respondents' choices. The HB models respondents' preferences as a function of an upper-level model and a lower level individual model [75]. The upper-level model describes the part-worths β_i distributed with means α and covariance matrix D, subscript i is the respondent, as shown in Equation (1).

$$\beta_i \sim Normal(\propto, D) \tag{1}$$

The lower-level model is described by Equation (2) and estimates the utility u_k that respondent i gains through the choice for alternative k.

$$u_k = x'_k \beta_i \tag{2}$$

Furthermore, the probability p of the choice for alternative k made by respondent i is estimated by Equation (3).

$$p_k = \frac{\exp(x'_k \beta_i)}{\sum_j \exp(x'_j \beta_j)} \tag{3}$$

The integration of the model for the psychographic features into the HB-logit-choice-model takes place by the assumption through the regression Equation (4). Where Θ is a matrix (q by b) of regression parameters, z_i is a q vector of covariates, and ε_i is a b vector of random error terms and D is a covariance matrix, the output β_i displays the part-worths of an analyzed attribute-level for respondent i [75].

$$\beta_i = \Theta' z_i + \varepsilon_i \ where \ \varepsilon_i \sim Normal(0, D) \tag{4}$$

We conducted the CBC with 8 random tasks and 2 fixed tasks using the default balanced overlap estimation. The HB had 40,000 iterations using 30,000 for the statistical analysis. The estimation was computed using only the random tasks. Six covariates were included into the statistical estimation.

Table 3. Items and factors used for covariate-estimation *.

Factors & Item-Scales of Factors	Statements	Possible Answers	Cronbachs Alpha	Source
Prior behavior Product experience	Have you ever deliberately opted for bioplastic products?	1 = No; 2 = Yes	n.a.	Reformulated according to [15,17]
Factor 1 Green Consumer Values	Please indicate to what extent you agree with the following statements. 1. It is important to me that the products I use do not harm the environment. 2. I consider the potential environmental impact of my actions when making many of my decisions. 3. My purchase habits are affected by my concern for our environment. 4. I am concerned about wasting the resources of our planet. 5. I would describe myself as environmentally responsible. 6. I am willing to be inconvenienced in order to take actions that are more environmentally friendly.	1 = I do not agree at all; 2 = I rather do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.895	[31]
Factor 2 Altruism	How important is to you: A1) To help other people A2) To serve mankind A3) To share what you have A4) To give to others A5) To be unselfish	1 = not important at all; 2 = rather not important; 3 = maybe important; 4 = rather important; 5 = important in any case	0.845	[73]
Factor 3 Attitude towards bioplastics	Below you can see statements from various organizations on bioplastics. Please state per statement whether you would convince them or prevent them from supporting increased use of bioplastics. If the statement does not matter for your rating, select "I do not care." 1. The long-term goal is to produce bioplastics from non-edible plant residues. 2. Bioplastics can withstand just as much as conventional plastics. 3. The carbon footprint of bioplastics is lower than that of conventional plastics. 4. The plants for bioplastics come from non-regional cultivation.	1 = I do not agree at all; 2 = I rather do not agree; 3 = I do not care; 4 = I rather agree; 5 = I totally agree	0.782	Reformulated according to [17]

Table 3. *Cont.*

Factors & Item-Scales of Factors	Statements	Possible Answers	Cronbachs Alpha	Source
Factor 4 Trust (KUSIV3 and trust-item of BFI-10 short scale)	KUSIV3: The next questions are about your attitude towards other people. Please indicate to what extent you agree with each statement. 1. I am convinced that most people have good intentions. 2. You cannot rely on anyone these days. 3. In general people can be trusted.	1 = don't agree at all 2 = agree a bit 3 = agree somewhat 4 = agree mostly 5 = agree completely	0.747	[47]
	BFI10-Item: 4. How well do the following statements describe your personality? I see myself as someone who is generally trusting	1 = disagree strongly 2 = disagree a little 3 = neither agree nor disagree 4 = agree a little 5 = agree strongly		[74]
Factor 5 Innovation-friendly	Please indicate to what extent you agree with the following statements. 1. I am excited to try out new products. 2. I appreciate having novel products. 3. I like to be confronted with new ideas.	1 = I do not agree at all; 2 = I rather do not agree; 3 = partly; 4 = I rather agree; 5 = I totally agree	0.810	[13,59]

Note: Most of the items were used in the study of Klein et al. [67] focusing on different research questions.

4. Results and Discussion

Below, we show the relative importance and the utilities of the tested attribute levels as computed through the HB estimation and compare our results with the existing literature. Additionally, we show the estimation of the covariates in Section 4.3 and discuss their influence on consumers' preferences for selected attributes of bio-based apparel.

4.1. Relative Importance of the Attributes

Table 4 shows the average relative importance values of the attributes of the functional jacket based on the HB estimation. Price was the attribute with the highest average relative importance (45.3%). The relevance of price for green apparel is well known and supported by previous studies described in the literature [27,70,71]. Product certificate showed the second highest average importance, which indicates the importance of labeling and information for many consumers. This is also in line with other studies [71,76]. The average relative importance of the attributes "percentage of bioplastic in fabric" and "origin of resource" had very similar values. The least important attribute was the "biogenic resource" itself. It seems that abstract information provided through certificates was more valuable to consumers than detailed information like the exact source of the biomass. Several previous studies have confirmed the importance of eco-labels for the awareness and the consumption of green products [20,21,53,71,77–79].

Table 4. Average importance values of attributes of a bio-based functional rain jacket.

Attributes	Average Importance (%)	Standard Deviation
Percentage of bioplastic in fabric	13.6	8.6
Biogenic resource	8.4	5.7
Origin of resource	13.6	9.3
Product certificate	19.1	9.4
Price	45.3	17.9

Note: Source: own estimation.

4.2. Utilities of the Attribute-levels

Table 5 displays the part-worth utilities of the levels of the analyzed attributes. Our results show that 100% bioplastic in the fabric had the highest marginal utility within this attribute. The highest utility within the biogenic resource attribute was for the level chipped wood. Forest wood as a raw material is not directly related with the production of food crops on arable land and therefore does not contribute to the food-versus-fuel dilemma. This could be the reason for respondents' preference for biomass from this source in comparison to maize or potatoes. The European Union as location for the raw material plants had the highest marginal utility for respondents and was preferred over all overseas locations. This finding is also supported by Scherer et al. [13,14], who found a preference for national or regional production of raw material plants used for bioplastic products. The marginal utilities of the product certificates "free of pollutants", "climate protection" and "fair production" ranged from 17 to 20, whereas the level "no certificate" had a high negative utility value. This supports the value of certificates for informing consumers about the specific characteristics of green products, which is in line with previous studies [29,46,76,80]. The highest marginal utility within the price attribute was found for the lowest price of 69 € followed by 109 €. Prices are often important for consumer choices and the majority of respondents also preferred low prices also for bio-based products [13,14]. The "None" option, meaning that no product was chosen in the CBC, had a mean utility value of 37.4. This means that the sum of the utilities of a product concept with the displayed attributes and levels must show a higher value than the utility of the "None" option so that consumers prefer this concept. Otherwise, they would decide not to choose any of product alternatives offered in the CBC.

Table 5. Utilities of the attribute levels of a bio-based functional rain jacket.

Attributes	Attribute-Levels	Average Utilities (Zero-Centered Diffs)	Standard Deviation
Percentage of bioplastic in fabric	100%	29.97	26.54
	50%	1.80	11.30
	20%	−31.76	25.36
Biogenic resource	Potatoes	−2.53	15.64
	Chipped wood	6.44	27.41
	Sugar cane	−0.06	15.72
	Corn	−3.84	16.39
Origin of resource	South America	−11.57	15.39
	European Union	36.95	35.91
	United States	−6.01	15.08
	Asia	−19.36	21.24
Product certificate	Free of pollutants	20.37	22.42
	Climate protection	17.74	20.67
	Fair production	18.09	24.36
	No certificate	−56.20	31.67
Price	349 €	−116.06	54.12
	239 €	−35.47	36.27
	109 €	61.53	27.94
	69 €	90.00	68.42
None Option		37.44	145.42

Note: Source: own estimation.

4.3. Influences of the Covariates

Covariates interpretation: As displayed in Table 3, the psychographic scales of the survey were factorized and the scores for each factor were implemented as covariates in the HB estimation. The results of this analysis are shown in Table 6 and illustrated in Figure 1. The intercept shows a respondent's individual utility considering the zero centered means of all factors. Additionally, the intercept shows the characteristic of having prior product experience, whereas the covariate product experience shows the theta-values of having no prior experience. We considered the significant theta-values of the included covariates for the interpretation. Significant positive theta-values lead to an increase of the individual utility of a respondent for a specific attribute-level if the measured value of the covariate is above the mean given all other variables are held constant. For example, a person's utility for the attribute-level "100% bioplastic" was estimated as shown in Equation (5). The figure of the intercept (1.13) added by the product of the theta-weight (0.36) and the measured value of "attitude towards bioplastics" of an individual results in the utility of the attribute level for the individual.

$$\beta_{100\% \ bioplastic} = 1.13 + 0.36 \times Attitude \ towards \ bioplastics \qquad (5)$$

Table 6. Theta-parameter estimation of the covariates.

Attributes & Levels	Intercept	Product-Experience	Green Consumer Values	Altruism	Attitude towards Bioplastic	Trust	Innovation-Friendly
			Percentage of Bioplastic				
100%	1.13 ***	0.05	0.21 ***	−0.01	0.36 ***	0.02	0.21 ***
50%	0.00	0.10	0.02	0.01	0.02	0.02	0.00
20%	−1.14 ***	−0.15	−0.23 ***	0.00	−0.38 ***	−0.03	−0.21 **
			Biogenic resource				
Potatoes	0.38 *	−0.56 ***	0.02	−0.04	−0.18 ***	−0.12 *	−0.03
Chipped wood	0.22	0.04	0.00	0.04	0.15 *	0.04	−0.09
Sugar cane	−0.43 **	0.49 **	0.08	0.08	0.04	−0.01	0.03
Corn	−0.17	0.04	−0.10	−0.07	0.00	0.09	0.09
			Origin of resource				
South America	−0.59 ***	0.18	−0.02	0.07	0.05	−0.12 *	0.04
European Union	1.23 ***	0.15	0.16 *	0.01	0.02	0.11	−0.07
United States	0.00	−0.26	−0.11	−0.06	0.06	0.11 *	0.05
Asia	−0.65 ***	−0.06	−0.03	−0.01	−0.13 *	−0.09	−0.02
			Product certificate				
Pollutant free	0.84 ***	−0.13	0.09	0.18 **	−0.01	−0.11 *	−0.08
Climate protection	0.65 ***	0.05	0.08	0.07	0.13 *	−0.02	−0.05
Fair production	0.40 *	0.34 *	0.09	−0.05	0.19 **	0.18 **	0.15 **
Without certificate	−1.89 ***	−0.26	−0.26 ***	−0.20 **	−0.31 ***	−0.05	−0.02
			Price				
349 €	−4.23 ***	−0.59 *	0.66 ***	0.52 ***	−0.26 *	0.00	0.11
239 €	−1.27 ***	−0.30	0.19 *	0.21 **	−0.05	0.09	0.25 ***
109 €	2.12 ***	0.43 *	−0.12	−0.20 **	0.25 ***	0.08	−0.08
69 €	3.38 ***	0.45	−0.72 ***	−0.53 ***	0.05	−0.17 *	−0.28 **
			None option				
None	−0.25	2.22 ***	−0.53 ***	−0.50 ***	−0.80 ***	−0.67 ***	−1.04 ***

Note: * significant at the level 0.05; ** significant at the level 0.01; *** significant at the level 0.001.
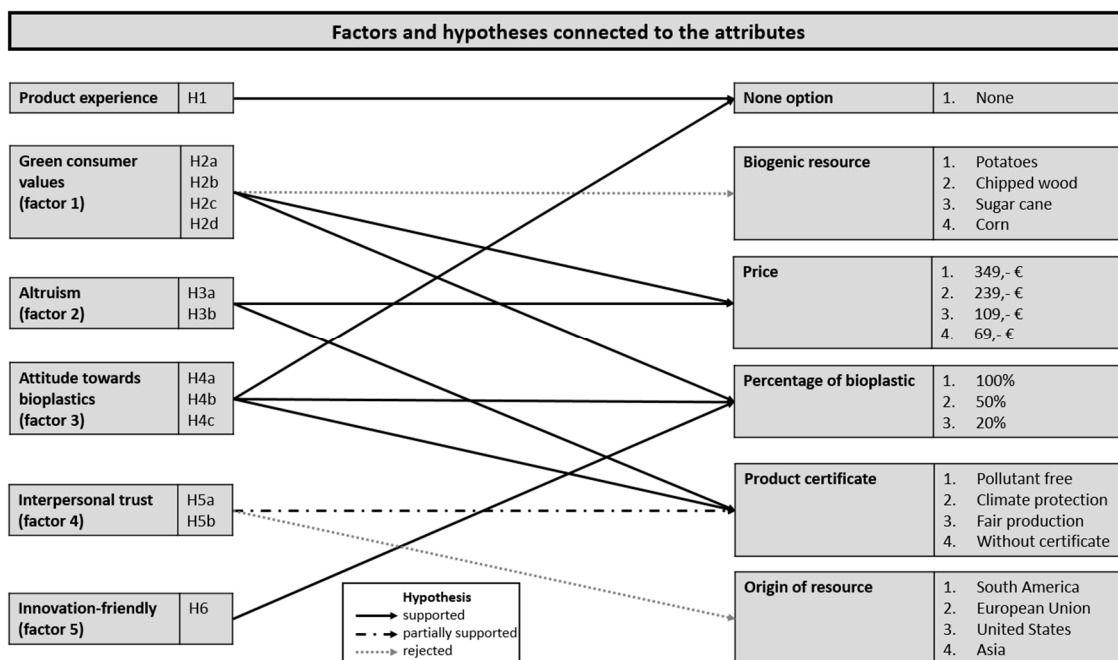
Figure 1. Summary of results of the testing of the hypotheses.

Fit-statistics: The root likelihood (RLH) is the geometric mean of the predicted probabilities for the concepts the respondent actually chose. This data set has four alternatives per choice task, including the "None" option. The expected RLH value for a chance model would be 0.25. Our computed value of 0.700 for 40,000 iterations is interpreted to be 2.8 times better than the chance level. The percent certainty typically varies between 0 and 1, with a value of 0 meaning that the model fits the data at only chance level, and a value of 1 meaning perfect fit. Our percent certainty value of 0.743 indicates that the log likelihood is 74.3% of the way between the value that would be expected by chance and the value for a perfect fit [81].

Product experience: As stated in Section 2, prior product experience with green products can be regarded as an influencing factor for purchasing bioplastic products. The theta value of the "None option" indicates a highly significant positive value for respondents without product experience and illustrates that these respondents tend to reject bio-based rain jackets. This finding is consistent with previous studies considering actual green behavior based on prior behavior [27–29,82]. Therefore, hypothesis H1 "No prior product experience with bio-based apparel decreases the probability of consumers' preferences for it" is supported.

Green Consumer Values: The utility for 100% bioplastics in the fabric increases with higher GCV as shown in Table 6. Additionally, a significant decrease in the utility for 20% bioplastics in the fabric is seen as GCV increases. The influence of GCV are in line with previous studies considering the consumption of green products and the influence of GCV product choice [13,15,31]. Hence, we assume that higher GCV lead to a higher preference for green functional clothes. Thus, hypotheses H2a "Higher GCV increase consumers' preferences for a high percentage of bioplastic in the fabric of bio-based apparel" and H2b "Lower GCV decrease consumers' preferences for a high percentage of bioplastic in the fabric of bio-based apparel" are supported. We also expected consumers with a higher GCV to prefer chipped wood over other resources. We postulated that consumers with green attitudes are more sensitive to the food-versus-fuel-dilemma identified in previous studies [32–34]. However, our results show no evidence for hypothesis H2c "Higher GCV increase consumers' preferences for resources with a perceived low food versus fuel dilemma in the case of bio-based apparel", which we therefore reject. Additionally, with increasing GCV, the utilities for the price-levels 349 € and 239 € increase, whereas the utility for the price level of 69€ decreases. The influence of GCV on respondents

accepting higher prices was also found in previous studies [13,18,19]. Hence, hypothesis H2d "Higher GCV decrease the relevance of low prices for bio-based apparel" is supported.

Altruism: With increasing levels of altruism, the utilities for the higher price-levels increase, whereas the utilities for the lower price-levels decrease (Table 6). Thus, the more altruistic a person is, the less price sensitive she or he is with respect to bio-based products. This result is also in line with previous studies of Scherer et al. [15], Stern et al. [39], Lusk et al. [43] and Thøgersen and Ölander [83] who found that altruistic values are predictors for a higher willingness to pay for more environmentally-friendly products. This supports hypothesis H3a "Higher altruism decreases the relevance of low prices for bio-based apparel". Additionally, with increasing levels of altruism, the utility for the certificate "free of pollutants" increases. In contrast, the higher the level of altruism of a respondent, the lower the utility for a rain jacket without a certificate is. Thus, hypothesis H3b "Higher altruism increases consumers' preferences for a certification of bio-based apparel" is supported.

Attitude towards bioplastic: A higher positive attitude towards bioplastics increases the utility for 100% bioplastics in the fabric, whereas the utility for 20% bioplastic decreases (Table 6). This result shows that a strong attitude towards bioplastics is positively related to the preference for functional clothes made of bioplastic. In addition, the utility of the "None option" of the covariate attitude towards bioplastic shows a negative utility value. Therefore, hypotheses H4a "Higher attitude towards bioplastics increases consumers' preferences for bio-based apparel" and H4b "Higher attitude towards bioplastics increases consumers' preferences for a high percentage of bioplastic in the fabric of bio-based apparel" are supported. With an increasingly strong attitude towards bioplastic, the utilities for the certificates "protects the climate" and "fair production" increase. In contrast, a significant decrease in the utility for no certificate is seen for an increasingly strong attitude towards bioplastic. Thus, hypothesis H4c "Higher attitude towards bioplastics increases consumers' preferences for a certification of bio-based apparel" is supported.

Trust: The higher the level of trust, the higher the utility for a certificate "fair production" is. In contrast, the utility for a certificate stating "free of pollutants" decreases. Thus, hypothesis H5a "Higher trust increases consumers' preferences for a certification of bio-based apparel" is partially supported. Padel and Foster [56] revealed that locally grown organic food generates higher trust than products from abroad. Furthermore, previous studies have found the influence of trust on familiarity and the origin of products for the choice for them [57,58]. However, we could not find a relation between a low levels of trust and lower preferences for bio-based apparel produced abroad. Therefore, hypothesis H5b "Lower trust increases consumers' preferences for bio-based apparel using biomass sources that are produced nationally" is rejected.

Innovation-friendly: The higher the levels of innovativeness, the higher the utilities for 100% bioplastic and the lower the utility for 20% bioplastic in the rain jacket (Table 6). Thus, hypothesis H6 "Higher innovation-friendly increases consumers' preferences for a high percentage of bioplastic in the fabric of bio-based apparel" is supported. This result is in line with previous studies showing that consumer innovativeness promotes the adoption of innovative green products [13,59,62].

5. Methodological Limitations, Conclusions and Implications

Methodological limitations: As with all empirical work, this study is not without some limitations. First, respondents might have been confused by the relatively high prices of the rain jacket. However, these prices represent the current market prices of functional rain jackets in Germany in a realistic way. We even found higher prices for a superior quality jackets. Second, selection bias through the online access panel cannot be excluded, although it seems unlikely. The quotas were set considering important sociodemographic characteristics, which should ensure that a representative sample is obtained from the crowd of the panel. In this sense, the results of this study are assumed to be representative for the population in Germany. Third, all responses were self-reported and the buying process was simulated by the CBC and was therefore hypothetical. In future, a study investigating a real market situation may be a promising approach to identify further important attributes, such as style of the product

or other haptic aspects of bio-based apparel. Fourth, this study was conducted in an online access panel in Germany and an international comparability of the results always faces possible influences of cultural differences related to the market or society of other countries. Therefore, results of this study should be interpreted with caution when transferring them to other countries. Future studies in other countries could improve insights on consumer's preferences for bio-based apparel in an international context. Fifth, panel-members seem to be familiar with questionnaires, which possibly influences their responses [84,85]. Conspicuous responses were cleaned from the data set as mentioned in Section 3.1 in an attempt to minimize the potential effect. In conclusion, the applied methods and their statistical analysis show results that are strongly related to previous studies. In addition, 9 of 12 hypotheses are supported and one more is partially supported.

Conclusions and implications: The major contribution of this study is to reveal the factors influencing consumers' preferences for bio-based apparel. We examined the importance and the utilities of the attributes of bio-based apparel and investigated the factors significance and their influential strength. In this study, prior product experience, GCV and attitudes towards bioplastics are the strongest factors promoting the preference for bio-based apparel. Blesin et al. [9] stated that only 12% of German consumers have product experience with bioplastics. Hence, it is advisable to increase the perception of bioplastic products in the general public and address further marketing efforts to interested groups.

Since product experience has a significant influence on the preference for bio-based apparel, it is necessary to increase the awareness of bioplastics to promote bio-based apparel. This might have the effect that more consumers intend to buy bio-based apparel and gain product experience, which promotes a preference for bio-based apparel. Possible instruments to increase the awareness are the presentation at the point of sale for better product attention, a targeted communication for specific product segments or nudging. Furthermore, policy makers should elaborate a clear definition of bioplastics and improve labeling of bioplastic products to support the awareness of them.

Consumers with higher preferences for bio-based apparel show higher GCV and attitudes towards bioplastics. Moreover, a European origin of the vegetable raw materials used is preferred by green consumers as well as high levels of bioplastics in the fabric. Thus, consumers with these preferences should be strengthened in their confidence in bio-based products. A largely positive attitude towards bioplastics in the population should be maintained and—if possible—expanded. This can be supported above all by clear claims and transparent value chains. This also includes recognizable labeling, verified life cycle assessments and standards. Policy should set the rules in these areas, and state institutions should be responsible for reviewing these tools to create security, reliability and trust among consumers.

Finally, the identified influencing factors should be taken into account and used in the "emotional" design and the tonality of communication measures. It is advisable to put positively assessed product properties of bioplastic products in the foreground and consider them in communication measures.

Appendix A

Table A1. CBC introduction text.

First, please put yourself in the following situation:
You want to buy a new rain jacket. You are looking for a high-quality product from a brand you know in an outdoor clothing store. After a short search, you will find what you are looking for and have the choice between different alternatives. Size, color, cut and function of the jacket meet your expectations. The seller points out that some jackets are made of bioplastics. He goes on to say that, various renewable raw materials were used instead of petroleum for its production, but that no impairment of product quality is to be expected. He advises you further that the raw materials come from different countries of origin, and there are also various certifications on the rain jackets, which say something about production or material of functional clothing.

Table A2. Choice set (example for random task).

	Alternative 1	**Alternative 2**	**Alternative 3**	
Percentage of bioplastic	100%	20%	50%	
Raw material	Sugar cane	Potatoes	Corn	NONE: I would not choose any of these.
Origin of resource	USA	Asia	EU	
Certification	Free of pollutants	No certificate	Fair production	
Price	239 €	349 €	109 €	

Table A3. Rotated covariance-matrix of factor analysis.

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Green Consumer Values (1)	0.741	0.251	0.121	0.086	0.094
Green Consumer Values (2)	0.667	0.158	0.316	0.036	0.006
Green Consumer Values (3)	0.824	0.162	0.096	0.027	0.111
Green Consumer Values (4)	0.804	0.106	−0.006	0.062	0.037
Green Consumer Values (5)	0.835	0.154	0.123	0.052	0.069
Green Consumer Values (6)	0.804	0.155	0.074	0.026	0.099
Innovation-friendly (1)	0.102	0.059	0.103	0.059	0.875
Innovation-friendly (2)	0.034	0.068	0.003	0.025	0.879
Innovation-friendly (3)	0.170	0.148	0.162	0.049	0.743
BFI10 (1 item on trust)	0.008	0.246	−0.040	0.600	0.030
KUSIV3 (1)	0.102	0.141	0.021	0.833	0.006
KUSIV3 (2)	0.019	0.029	0.070	0.714	0.035
KUSIV3 (3)	0.080	0.128	0.036	0.824	0.062
Altruism (1)	0.165	0.719	0.134	0.151	0.094
Altruism (2)	0.240	0.614	0.000	0.186	0.006
Altruism (3)	0.161	0.793	0.014	0.119	0.081
Altruism (4)	0.135	0.843	0.075	0.126	0.128
Altruism (5)	0.178	0.772	0.100	0.057	0.035
Attitude towards bioplastics (1)	0.147	0.071	0.774	0.039	0.052
Attitude towards bioplastics (2)	0.128	0.059	0.749	0.023	0.038
Attitude towards bioplastics (3)	0.052	0.040	0.728	0.029	0.119
Attitude towards bioplastics (4)	0.122	0.076	0.794	−0.002	0.047

Extraction method: principal components analysis; rotation method: Varimax with Kaiser-normalization; the rotation is converged in 5 iterations.

References

1. Verma, R.; Vinoda, K.S.; Papireddy, M.; Gowda, A.N.S. Toxic Pollutants from Plastic Waste—A Review. *Procedia Environ. Sci.* **2016**, *35*, 701–708. [CrossRef]
2. Jambeck, J.R.; Geyer, R.; Wilcox, C.; Siegler, T.R.; Perryman, M.; Andrady, A.; Narayan, R.; Law, K.L. Marine pollution. Plastic waste inputs from land into the ocean. *Science* **2015**, *347*, 768–771. [CrossRef] [PubMed]
3. Benson, P.J. China's plastic waste import ban. *Science* **2018**, *360*, 1310. [CrossRef]

4. Eriksen, M.; Lebreton, L.C.M.; Carson, H.S.; Thiel, M.; Moore, C.J.; Borerro, J.C.; Galgani, F.; Ryan, P.G.; Reisser, J. Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea. *PLoS ONE* **2014**, *9*, e111913. [CrossRef] [PubMed]

5. Endres, H.-J.; Siebert-Raths, A. *Engineering Biopolymers. Markets, Manufacturing, Properties, and Applications*; Hanser Publishers: München, Germany, 2011; ISBN 978-1-56990-461-9.

6. Endres, H.-J. Bioplastics. In *Biorefineries*; Wagemann, K., Tippkötter, N., Eds.; Springer International Publishing: Cham, Switzerland, 2019; pp. 427–468. ISBN 978-3-319-97117-9.

7. Endres, H.-J.; Bengs, M.; Schulz, C.; Siebert-Raths, A. Market opportunities, Land Use Requirement and Future Developments. *Kunstst. Int.* **2011**, *101*, 54–58.

8. Pilla, S. *Handbook of Bioplastics and Biocomposites Engineering Applications*; John Wiley & Sons: Hoboken, NJ, USA, 2011; ISBN 1118177045.

9. Blesin, J.M.; Klein, F.; Emberger-Klein, A.; Scherer, C.; Menrad, K.; Möhring, W. Bevölkerungsrepräsentative Online-Befragung in Deutschland zu Biokunststoffen: Arbeitsbericht Oktober 2017. Available online: http://biokunststoffe-nachhaltig.de/files/Downloads/BiNa%20Working%20Paper%20zur% 20Bevoelkerungsbefragung%202016.pdf (accessed on 25 December 2019).

10. Behnsen, H.; Spierling, S.; Endres, H.-J. Biobasierte Kunststoffe als Produkt der Bioökonomie. *Ökologisches Wirtsch. Fachz.* **2018**, *33*, 28–29. [CrossRef]

11. Venkatachalam, V.; Spierling, S.; Endres, H.-J.; Siebert-Raths, A. Integrating Life Cycle Assessment and Eco-design Strategies for a Sustainable Production of Bio-based Plastics. In *Designing Sustainable Technologies, Products and Policies*; Springer: Berlin/Heidelberg, Germany, 2018; pp. 487–497.

12. Spierling, S.; Knüpffer, E.; Behnsen, H.; Mudersbach, M.; Krieg, H.; Springer, S.; Albrecht, S.; Herrmann, C.; Endres, H.-J. Bio-based plastics-A review of environmental, social and economic impact assessments. *J. Clean. Prod.* **2018**, *185*, 476–491. [CrossRef]

13. Scherer, C.; Emberger-Klein, A.; Menrad, K. Biogenic product alternatives for children: Consumer preferences for a set of sand toys made of bio-based plastic. *Sustain. Prod. Consum.* **2017**, *10*, 1–14. [CrossRef]

14. Scherer, C.; Emberger-Klein, A.; Menrad, K. Consumer preferences for outdoor sporting equipment made of bio-based plastics: Results of a choice-based-conjoint experiment in Germany. *J. Clean. Prod.* **2018**, *203*, 1085–1094. [CrossRef]

15. Scherer, C.; Emberger-Klein, A.; Menrad, K. Segmentation of interested and less interested consumers in sports equipment made of bio-based plastic. *Sustain. Prod. Consum.* **2018**, *14*, 53–65. [CrossRef]

16. Sijtsema, S.J.; Onwezen, M.C.; Reinders, M.J.; Dagevos, H.; Partanen, A.; Meeusen, M. Consumer perception of bio-based products—An exploratory study in 5 European countries. *NJAS Wagening. J. Life Sci.* **2016**, *77*, 61–69. [CrossRef]

17. Rumm, S. Verbrauchereinschätzungen Zu Biokunststoffen: Eine Analyse Vor Dem Hintergrund Des Heuristic-Systematic Model. Ph.D. Thesis, Technische Universität München, München, Germany, 2016.

18. Kainz, U. Consumers' Willingness to Pay for Durable Biobased Plastic Products. Findings from an Experimental Auction. Ph.D. Thesis, Technische Universität München, München, Germany, 2016.

19. Kurka, S. Biomasse-basierte Produkte Aus Konsumentensicht-Ausgewählte Europäische Länder Im Vergleich. Ph.D. Thesis, Technische Universität München, München, Germany, 2012.

20. Nimon, W.; Beghin, J. Are Eco-Labels Valuable?: Evidence from the Apparel Industry. *Am. J. Agric. Econ.* **1999**, *81*, 801. [CrossRef]

21. Nimon, W.; Beghin, J. Ecolabels and international trade in the textile and apparel market. In *Nontariff Measures and International Trade: World Scientific Studies in International Economics*; Beghin, J.C., Ed.; World Scientific: London, UK, 2017; pp. 321–326. ISBN 978-981-314-440-8.

22. Meyer, A. What's in it for the customers?: Successfully marketing green clothes. *Bus. Strat. Environ.* **2001**, *10*, 317–330. [CrossRef]

23. Brosdahl, D.J.C.; Carpenter, J.M. Consumer knowledge of the environmental impacts of textile and apparel production, concern for the environment, and environmentally friendly consumption behavior. *J. Text. Appar. Technol. Manag.* **2010**, *6*, 4.

24. Han, T.-I.; Chung, J.-E. Korean consumers' motivations and perceived risks toward the purchase of organic cotton apparel. *Cloth. Text. Res. J.* **2014**, *32*, 235–250. [CrossRef]

25. Casadesus-Masanell, R.; Crooke, M.; Reinhardt, F.; Vasishth, V. Households' willingness to pay for "green" goods: Evidence from Patagonia's introduction of organic cotton sportswear. *J. Econ. Manag. Strategy* **2009**, *18*, 203–233. [CrossRef]

26. Wiederhold, M.; Martinez, L.F. Ethical consumer behaviour in Germany: The attitude-behaviour gap in the green apparel industry. *Int. J. Consum. Stud.* **2018**, *42*, 419–429. [CrossRef]

27. Cowan, K.; Kinley, T. Green spirit: Consumer empathies for green apparel. *Int. J. Consum. Stud.* **2014**, *38*, 493–499. [CrossRef]

28. Khare, A.; Sadachar, A. Green apparel buying behaviour: A study on I ndian youth. *Int. J. Consum. Stud.* **2017**, *41*, 558–569. [CrossRef]

29. Nam, C.; Dong, H.; Lee, Y.-A. Factors influencing consumers' purchase intention of green sportswear. *Fash. Text.* **2017**, *4*, 179. [CrossRef]

30. Lin, S.-H. A case study in Hawaii: Who will pay more for organic cotton? *Int. J. Consum. Stud.* **2010**, *34*, 481–489. [CrossRef]

31. Haws, K.L.; Winterich, K.P.; Naylor, R.W. Seeing the world through GREEN-tinted glasses: Green consumption values and responses to environmentally friendly products. *J. Consum. Psychol.* **2014**, *24*, 336–354. [CrossRef]

32. Rosegrant, M.W.; Msangi, S. Consensus and contention in the food-versus-fuel debate. *Annu. Rev. Environ. Resour.* **2014**, *39*, 271–294. [CrossRef]

33. Harrison, R.W. The food versus fuel debate: Implications for consumers. *J. Agric. Appl. Econ.* **2009**, *41*, 493–500. [CrossRef]

34. Thompson, P.B. The agricultural ethics of biofuels: The food vs. fuel debate. *Agriculture* **2012**, *2*, 339–358. [CrossRef]

35. Ellis, J.L.; McCracken, V.A.; Skuza, N. Insights into willingness to pay for organic cotton apparel. *J. Fash. Mark. Manag. Int. J.* **2012**, *16*, 290–305. [CrossRef]

36. Chen, T.B.; Chai, L.T. Attitude towards the environment and green products: Consumers' perspective. *Manag. Sci. Eng.* **2010**, *4*, 27–39.

37. Umberson, K. Environmentally-Friendly Purchase Intentions. Debunking the Misconception Behind Apathetic Consumer Attitudes. Master's Thesis, University of North Texas, Denton, TX, USA, 2008.

38. Batson, C.D.; Powell, A.A. *Altruism and Prosocial Behavior. Handbook of Psychology*; Wiley, J., Ed.; Wiley & Sons, Inc.: Hoboken, NJ, USA, 2003; pp. 463–484.

39. Stern, P.C.; Dietz, T.; Kalof, L. Value Orientations, Gender, and Environmental Concern. *Environ. Behav.* **1993**, *25*, 322–348. [CrossRef]

40. Pfattheicher, S.; Sassenrath, C.; Schindler, S. Feelings for the Suffering of Others and the Environment. *Environ. Behav.* **2016**, *48*, 929–945. [CrossRef]

41. Teng, Y.-M.; Wu, K.-S.; Liu, H.-H. Integrating Altruism and the Theory of Planned Behavior to Predict Patronage Intention of a Green Hotel. *J. Hosp. Tour. Res.* **2015**, *39*, 299–315. [CrossRef]

42. Hefner, D. Wie kriegen wir sie ins Boot? Eine Typologie zur Entwicklung von Kommunikationsstrategien zur Förderung umweltschützenden Verhaltens. *Medien. Kommun.* **2013**, *61*, 387–405. [CrossRef]

43. Lusk, J.L.; Nilsson, T.; Foster, K. Public Preferences and Private Choices: Effect of Altruism and Free Riding on Demand for Environmentally Certified Pork. *Environ. Resour. Econ.* **2007**, *36*, 499–521. [CrossRef]

44. Grolleau, G.; Ibanez, L.; Mzoughi, N. Too much of a good thing? Why altruism can harm the environment? *Ecol. Econ.* **2009**, *68*, 2145–2149. [CrossRef]

45. Hartmann, P.; Apaolaza-Ibáñez, V. Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern. *J. Bus. Res.* **2012**, *65*, 1254–1263. [CrossRef]

46. D'Souza, C.; Taghian, M.; Lamb, P. An empirical study on the influence of environmental labels on consumers. *Corp. Commun. Int. J.* **2006**, *11*, 162–173. [CrossRef]

47. Beierlein, C.; Kemper, C.; Kovaleva, A.; Rammstedt, B. Kurzskala Zur Messung Des Zwischenmenschlichen Vertrauens. Die Kurzskala Interpersonales Vertrauen (KUSIV3). GESIS-Working Papers No. 22. 2012. Available online: https://nbn-resolving.org/urn:nbn:de:0168-ssoar-312126 (accessed on 25 December 2019).

48. Atkinson, L.; Rosenthal, S. Signaling the green sell: The influence of eco-label source, argument specificity, and product involvement on consumer trust. *J. Advert.* **2014**, *43*, 33–45. [CrossRef]

49. Young, W.; Hwang, K.; McDonald, S.; Oates, C.J. Sustainable consumption: Green consumer behaviour when purchasing products. *Sustain. Dev.* **2009**, *37*. [CrossRef]

50. Chen, Y.-S.; Chang, C.-H. Greenwash and green trust: The mediation effects of green consumer confusion and green perceived risk. *J. Bus. Ethics* **2013**, *114*, 489–500. [CrossRef]

51. Chen, Y.-S.; Chang, C.-H. Towards green trust: The influences of green perceived quality, green perceived risk, and green satisfaction. *Manag. Decis.* **2013**, *51*, 63–82. [CrossRef]

52. Thøgersen, J. Promoting "green" consumer behavior with eco-labels.: Chapter 5 in New Tools for Environmental Protection: Education, Information and Voluntary Measure. In *New Tools for Environmental Protection: Education, Information, And Voluntary Measures*; National Research Council, Ed.; The National Academies Press: Washington, DC, USA, 2002; pp. 83–104.

53. Sammer, K.; Wüstenhagen, R. The influence of eco-labelling on consumer behaviour–Results of a discrete choice analysis for washing machines. *Bus. Strategy Environ.* **2006**, *15*, 185–199. [CrossRef]

54. Nuttavuthisit, K.; Thøgersen, J. The Importance of Consumer Trust for the Emergence of a Market for Green Products: The Case of Organic Food. *J. Bus. Ethics* **2017**, *140*, 323–337. [CrossRef]

55. Hamzaoui Essoussi, L.; Zahaf, M. Decision making process of community organic food consumers: An exploratory study. *J. Consum. Mark.* **2008**, *25*, 95–104. [CrossRef]

56. Padel, S.; Foster, C. Exploring the gap between attitudes and behaviour: Understanding why consumers buy or do not buy organic food. *Br. Food J.* **2005**, *107*, 606–625. [CrossRef]

57. Fandos Herrera, C.; Flavián Blanco, C. Consequences of consumer trust in PDO food products: The role of familiarity. *J. Prod. Brand Manag.* **2011**, *20*, 282–296. [CrossRef]

58. Jiménez, N.H.; San Martín, S. The role of country-of-origin, ethnocentrism and animosity in promoting consumer trust. The moderating role of familiarity. *Int. Bus. Rev.* **2010**, *19*, 34–45. [CrossRef]

59. Tellis, G.J.; Yin, E.; Bell, S. Global consumer innovativeness: Cross-country differences and demographic commonalities. *J. Int. Mark.* **2009**, *17*, 1–22. [CrossRef]

60. Rahman, S.U.; Saleem, S.; Akhtar, S.; Ali, T.; Khan, M.A. Consumers' adoption of apparel fashion: The role of innovativeness, involvement, and social values. *Int. J. Mark. Stud.* **2014**, *6*, 49. [CrossRef]

61. Jansson, J. Consumer eco-innovation adoption: Assessing attitudinal factors and perceived product characteristics. *Bus. Strategy Environ.* **2011**, *20*, 192–210. [CrossRef]

62. Osburg, V.-S.; Strack, M.; Toporowski, W. Consumer acceptance of Wood-Polymer Composites: A conjoint analytical approach with a focus on innovative and environmentally concerned consumers. *J. Clean. Prod.* **2016**, *110*, 180–190. [CrossRef]

63. Evans, J.R.; Mathur, A. The value of online surveys. *Internet Res.* **2005**, *15*, 195–219. [CrossRef]

64. German Federal Statistical Office. Microzensus. Available online: https://www.destatis.de/ (accessed on 14 May 2018).

65. Sawtooth. *SSI Web*; Sawtooth Software Inc.: Orem, UT, USA, 2015.

66. IBM Corp. *IBM SPSS Statistics for Windows*; IBM Corp.: Armonk, NY, USA, 2015.

67. Klein, F.; Emberger-Klein, A.; Menrad, K.; Möhring, W.; Blesin, J.-M. Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany. *Sustain. Prod. Consum.* **2019**, *19*, 33–43. [CrossRef]

68. Louviere, J.J.; Woodworth, G. Design and analysis of simulated consumer choice or allocation experiments: An approach based on aggregate data. *J. Mark. Res.* **1983**, 350–367. [CrossRef]

69. Eggers, F.; Sattler, H. Preference measurement with conjoint analysis. Overview of state-of-the-art approaches and recent developments. *GfK Mark. Intell. Rev.* **2011**, *3*, 36–47. [CrossRef]

70. Sanad, R.A. Consumer Attitude and Purchase Decision towards Textiles and Apparel Products. *World J. Text. Eng. Technol.* **2016**, *2*, 16–30.

71. Chekima, B.; Wafa, S.A.W.S.K.; Igau, O.A.; Chekima, S.; Sondoh Jr, S.L. Examining green consumerism motivational drivers: Does premium price and demographics matter to green purchasing? *J. Clean. Prod.* **2016**, *112*, 3436–3450. [CrossRef]

72. Borin, N.; Cerf, D.C.; Krishnan, R. Consumer effects of environmental impact in product labeling. *J. Consum. Mark.* **2011**, *28*, 76–86. [CrossRef]

73. Price, L.L.; Feick, L.F.; Guskey, A. Everyday Market Helping Behavior. *J. Public Policy Mark.* **1995**, *14*, 255–266. [CrossRef]

74. Rammstedt, B.; Kemper, C.J.; Klein, M.C.; Beierlein, C.; Kovaleva, A. A Short Scale for Assessing the Big Five Dimensions of Personality. Big-Five-Inventory-10 (BFI-10). methoden, daten, analysen No. 2. 2013. Available online: https://orbilu.uni.lu/bitstream/10993/21183/1/MDA_Vol7_2013-2_Rammstedt.pdf (accessed on 25 December 2019).

75. Orme, B.; Howell, J. Application of Covariates within Sawtooth Software's CBC/HB progr$am: Theory and Practical Example. Available online: https://www.sawtoothsoftware.com/download/techpap/HBCovariates.pdf (accessed on 25 December 2019).

76. Rahbar, E.; Abdul Wahid, N. Investigation of green marketing tools' effect on consumers' purchase behavior. *Bus. Strategy Ser.* **2011**, *12*, 73–83. [CrossRef]

77. Rumm, S.; Klein, A.; Zapilko, M.; Menrad, K. Labelling for bio-based plastics. In *First International Conference on Resource Efficiency in Interorganizational Networks ResEff 2013*; Geldermann, J., Schumann, M., Eds.; Universitätsdrucke Göttingen: Göttingen, Germany, 2013; pp. 403–414. ISBN 978-3-86395-142-9.

78. Aguilar, F.X.; Cai, Z. Conjoint effect of environmental labeling, disclosure of forest of origin and price on consumer preferences for wood products in the US and UK. *Ecol. Econ.* **2010**, *70*, 308–316. [CrossRef]

79. Hustvedt, G.; Bernard, J.C. Effects of social responsibility labelling and brand on willingness to pay for apparel. *Int. J. Consum. Stud.* **2010**, *34*, 619–626. [CrossRef]

80. D'Souza, C.; Taghian, M.; Lamb, P.; Peretiatko, R. Green decisions: Demographics and consumer understanding of environmental labels. *Int. J. Consum. Stud.* **2007**, *31*, 371–376. [CrossRef]

81. Sawtooth Software, I. *The CBC/HB System for Hierarchical Bayes Estimation Version 5.0 Technical Paper*; Sawtooth Software, Inc.: Sequim, WA, USA, 2009.

82. Lee, Y.-J.; Young, R.D.; Marans, R.W. Factors Influencing Individual Recycling Behavior in Office Settings. *Environ. Behav.* **1995**, *27*, 380–403. [CrossRef]

83. Thøgersen, J.; Ölander, F. Human values and the emergence of a sustainable consumption pattern: A panel study. *J. Econ. Psychol.* **2002**, *23*, 605–630. [CrossRef]

84. Callegaro, M.; Baker, R.; Bethlehem, J.; Göritz, A.S.; Krosnick, J.A.; Lavrakas, P.J. *Online Panel Research*; John Wiley & Sons, Ltd.: Chichester, UK, 2014; ISBN 9781118763520.

85. Hillygus, D.S.; Jackson, N.; Young, M. Professional respondents in non-probability online panels. *Online Panel Res. Data Qual. Perspect.* **2014**, *1*, 219–237.

Consumer preferences in Germany for bio-based apparel with low and moderate prices, and the influence of specific factors in distinguishing between these groups

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Abstract

Bioplastics are a potential alternative to conventional plastics both when it comes to reducing the use of the fossil resource of crude oil and as a means of carbon storage. There have so far been very few studies on the consumption of bio-based apparel and consumer preferences relating to it. In 2016, we conducted the largest study to date on consumer preferences, attitudes, and perceptions relating to bioplastics in Germany. Our sample of 1,673 participants is representative of the German population and comprises citizens over the age of 16; these were surveyed via an online access panel. We conducted a choice-based conjoint analysis (CBC) for a functional rain jacket. We performed a latent class cluster analysis to segment consumers of green bioplastics apparel. We identified psychographic factors that play a significant role in distinguishing between consumer groups of bio-based apparel with a 'preference for a low price' and those showing 'acceptance of a moderate price'. The strongest dividing variables found by discriminant analysis are the intention to purchase bio-based apparel, followed by GCV and subjective norms of bio-based apparel. This study helps to better illuminate the heterogeneity of consumer preferences for bio-based apparel.

Consumer preferences in Germany for bio-based apparel with low and moderate prices, and the influence of specific factors in distinguishing between these groups

1 Introduction

The consumption of apparel has increased worldwide. A large proportion of apparel is made from conventional plastics, which causes substantial environmental problems, not least the fossil carbon dioxide footprint that is increasing every year (Šajn 2019; UNECE 2018; UNFCCC 2018; Chrobot et al. 2018; Textile Exchange 2017). This is why sustainable or green apparel is becoming a frequent topic of discussion as an alternative strategy that can help to protect the climate (Klein 2019; Balster 2019; Muthu 2014). The global market for apparel is increasing steadily (CO Data 2018; Šajn 2019; Fashion United 2017). In this context, Germany plays a leading role in Europe and produces more than 25% of all technical textiles (Euratex 2019). Technical textile production is mainly based on crude oil. However, since petroleum is a fossil fuel and also the primary factor responsible for the heating of the earth's atmosphere, a more appropriate aim would be to dissolve the link between consumption and the use of fossil resources and to move over to using renewable resources. This includes plastics. In addition, plastic apparel enables the formation of a circular economy, as both conventional plastics and bio-based plastics used for textiles lend themselves to recycling (Textile Exchange 2017). In order to mitigate the effects of carbon dioxide emissions on the atmosphere and instead store carbon in textiles by using plant material as a resource, it is essential that the manufactured garments are not fast fashion items and that they are suitable for frequent recycling (Fuhr et al. 2019; Šajn 2019; Muthu 2014; Rana et al. 2014). In addition, strategies are needed for preventing the release of microplastics during washing, such as using washing machine filters (Leinfelder and Regensburger 2019).

So far, the market share of bio-based plastics in the textile sector is comparatively low, as the associated manufacturing industries are still in their development phase (Šajn 2019). Up until now, there have only been a few studies looking into consumer decisions, behavior and intentions regarding the consumption of green apparel or bio-based products (Klein et al. 2020; Hustvedt and Bernard 2008; Nam et al. 2017; Hustvedt and Dickson 2009; Austgulen 2016; Koszewska 2013; Niinimäki 2010; Scherer et al. 2017, 2018a, 2018b; Klein et al. 2019), even though consumer preferences and choices are an essential factor when it comes to developing innovative and sustainable products (Austgulen 2016). Furthermore, Scherer et al. (2018b) found that consumers accepted a moderately higher price (compared to fossil oil-based products) if a bio-based product fulfilled certain criteria, such as the raw material being of regional origin or the use of a high proportion of bio-based plastic. Hustvedt and Bernard (2008) also found that participants in an experimental auction displayed a greater willingness to pay for organic socks. However, no recent studies

have investigated the factors influencing the differences in price preference with regard to bio-based apparel. It is therefore necessary to identify those factors that help to distinguish between heterogeneous groups of consumers who express different preferences for variant prices of bio-based apparel. This gives rise to the main research questions of our study:

- What consumer segments with a focus on product pricing can be identified for bio-based apparel?
- What are the factors that influence consumers' price preferences for different bio-based apparel and that play a role in distinguishing between different consumer groups?

This study serves to shed more light on the heterogeneity of consumer preferences, especially in the case of green or bio-based apparel. In particular, we focus on consumer preferences with regard to the price of green apparel, bearing in mind its attendant environmental benefits. Furthermore, we indicate the psychographic factors that play a significant role in determining different groups of consumers of bio-based apparel, i.e. those with a 'preference for a low price' and those showing 'acceptance of a moderate price'.

Section 2 presents the influencing factors, as identified by a literature review. In section 3, we describe the dataset, the scales employed and the mathematical methods applied. Section 4 presents our results along with a discussion as well as additional subsections focusing on the limitations of the study and the future research implications.

2 Factors influencing consumers' price preferences with bio-based apparel

This study investigates factors that influence consumers' price preferences relating to bio-based apparel. For this purpose, we conducted a review of the scientific literature to determine relevant variables relating to price preference and particular attributes of bio-based apparel. The following section therefore provides background information and defines the independent variables.

Sociodemographic variables: age, gender, education

Sociodemographic characteristics are often employed in consumer research studies, but their inflow towards green consumption tends to be low (Diamantopoulos et al. 2003; Casimir and Dutilh 2003; Straughan and Roberts 1999; Tanner and Wölfing Kast 2003; Hess et al. 2013). Due to the ambiguous results presented in the studies reviewed, we assume that sociodemographic characteristics (in this study represented by age, gender and education) have no influence on price preferences relating to bio-based apparel.

Altruism

Altruism or prosocial behavior as defined by Batson and Powell (2003) can be a precursor to eco-friendly consumption. Evidence of this has been reported in several studies. For instance, Lusk et al. (2007) found that people who are more altruistic are willing to pay more for environmentally certified pork. Hefner (2013)

identified altruism as one of the drivers of eco-friendly behavior. Straughan and Roberts (1999) also found a strong correlation between altruism and environmentally friendly consumer behavior. In addition, Stern et al. (1993) concluded that social altruism and environmentally friendly behavior are related (as measured by the predicted willingness to pay higher gas prices or income taxes). Pfattheicher et al. (2016) and Teng et al. (2015) showed that altruistic behavioral intentions are positively related to eco-friendly buying intentions. Hence, we see altruism as a factor that determines consumers' willingness to purchase bio-based apparel and that influences them to accept higher prices for bio-based apparel.

Subjective norms of bio-based apparel

Individuals tend to behave in a particular way when they believe that they are expected to do so by certain people. These so-called subjective norms are an element of the theory of reasoned action proposed by Ajzen and Fishbein (1980). It is a well-known influencing factor that is frequently used for measuring environmentally friendly behavior. For example, Teng et al. (2015) reported a positive influence of subjective norms on purchase intentions for green products. In addition, several other studies have demonstrated the influence of subjective norms (Tarkiainen and Sundqvist 2005; Hefner 2013; Untaru et al. 2016 and Mishra et al. 2014). Nam et al. (2017) found that subjective norms relating to green sportswear had a positive impact on the intention to purchase green sportswear. We assume that when subjective norms have a stronger influence, consumers will tend to accept a moderately higher price for bio-based apparel.

Innovativeness

The power of consumers to be innovative, as discussed by Tellis et al. (2009) is an important driver in the introduction of environmentally friendly product innovations (Englis and Phillips 2013; Jansson 2011). Osburg et al. (2016) found that the likelihood of a consumer choosing wood-plastic composites over conventional plastics correlates with the consumer's innovativeness. In addition, Scherer et al. (2017) noted that ecologically sensitive consumers are more innovative than consumers of conventional plastic. Therefore, an individual's interest in innovation seems to have a positive impact on their decision to purchase eco-friendly apparel. We claim that a higher level of consumer innovativeness leads to increased acceptance of a moderate price for bio-based apparel.

Green consumer values (GCV)

Haws et al. (2014) developed a set of environmental conservation attitudes and values with which to examine the relationship between an individual's green values and his or her eco-friendly purchasing decisions. They found evidence of a correlation between GCV and consumer buying intentions for green products. This was also reported for similar items by Kurka (2012) and Scherer et al. (2017). We therefore assume that increasing GCV would also affect consumers' acceptance of moderate prices for bio-based apparel.

Attitude towards bioplastics

Hartmann & Apaolaza-Ibáñez (2012) and Teng et al. (2015) have shown that consumers' concern for the environment has a positive impact on their intention to purchase green products. Recent studies by Rumm et al. (2013), Rumm (2016) and Scherer et al. (2017) also found a link between environmental attitudes and choice-based behavior with regard to bio-based products. We assume that an attitude of increased acceptance towards bioplastics affects consumers' willingness to accept moderate prices for bio-based apparel.

Product experience made with bio-based products

Young (2000) and Lee et al. (1995) claimed that past recycling behavior evolves into future recycling behavior. Further evidence of the impact of product experience on purchase intent with green products has been provided by Young et al. (2009). Blesin et al. (2017) showed that past product experience leads to a greater purchase intention for bio-based products. Therefore, previous consumer behavior is expected to affect consumers' acceptance of moderate prices for bio-based apparel.

Interest in bioplastics

Rumm et al. (2013) and Schleenbecker and Hamm (2013) found that product and resource information has a positive impact on both green products themselves and the decision to purchase them. Similarly, McDonald et al. (2009) found that green consumers seek out information about sustainable products. We claim that a higher influence of interest in bioplastics leads to consumers accepting a moderate price for bio-based apparel.

Purchase intention

The intention to buy environmentally friendly products can be regarded as a form of behavioral purpose, which refers to the subjective ability of an individual to engage in behavior. This can be influenced by behavioral attitudes (Ajzen and Fishbein 1980). Morrison (1979) showed that purchase intent predicts buying behavior. Green consumption has been analyzed in previous studies on the basis of purchase intent (Laroche et al. 2001; Nam et al. 2017; Hartmann and Apaolaza-Ibáñez 2012). In line with these studies, we assume that purchase intention is a relevant influencing factor towards consumers acceptance of moderate prices for bio-based apparel.

3 Methods

3.1 Data

The data was collected in June 2016 by a professional market research company that was commissioned to recruit respondents through an online access panel. Participants received little financial incentive to

complete the full survey. Web surveys are cheaper than other survey methods and enable faster data collection (Evans and Mathur 2005). The representative group of the German population over the age of 16 was based on the socio-demographic characteristics as indicated by the German sample survey 2015 (German Federal Statistical Office 2015). The quotas were determined by gender, age, education and population of the city of residence (Table 1). Once the data was collected, we purged the data relating to unworkable responses (straight-liners, Christmas tree behavior, conflicting answers, incorrectly answered test questions, etc.). After statistical evaluation, there remained 1,673 respondents. Further data management and analysis were performed using Sawtooth 8 (Sawtooth 2015) and SPSS 23 (IBM Corp. 2015). The independent variables and covariates used in the CBC analysis, the latent class analysis and the discriminant analysis were derived from the literature review. They were mainly measured on the basis of 5-point Likert scales. All the factors and variables used are listed in Table 3.

Table 1: Sociodemographic data of the sample

Variable	Sample	Population of Germany 16+ (German Federal Statistical Office 2015)
Age		
16-19 years	0.050	0.046
20-29 years	0.127	0.141
30-39 years	0.124	0.141
40-49 years	0.166	0.180
50-59 years	0.185	0.180
60+ years	0.348	0.312
Sex		
Female	0.519	0.513
Male	0.481	0.487
Education		
Not yet graduated	0.025	0.025
Secondary modern school without apprenticeship	0.071	0.079
Secondary modern school with apprenticeship	0.320	0.306
General certificate of secondary education	0.298	0.303
General qualification for university entrance	0.127	0.131
Academic studies	0.160	0.157
The same sample was used in the studies of Klein et al. (2019) and Klein et al. (2020) but with different study objectives and methods.		

3.2 Choice based conjoint analysis

Choice-based Conjoint Analysis (CBC) is a widely used and valid method of examining preferences for either innovative or existing products (Louviere and Woodworth 2018; Eggers and Sattler 2011). Although the decisions measured do not necessarily result in purchasing behavior, they shed light on the purchasing

motivation for certain products, for example, on the basis of important properties that consumer products offer as well as the willingness of consumers to pay. A respondent's preference is based on the product concepts chosen in the CBC. A set of attributes with realistic and existing occurrences (levels) is selected (Table 2). The product concepts are either constructed randomly (random tasks) or chosen selectively (fixed tasks). The defined tasks form part of the validation of the method. The respondents rate each attribute level by selecting the depicted product concepts. The utility function is used to translate decisions made into the consumer's perceived preferences and to predict buying decisions (Eggers and Sattler 2011).

3.3 Attributes and levels, product-concepts

CBC experiments require a set of attributes with different levels, for implementation of the product concepts created. In our study, we considered attributes that either already exist or can potentially play a role in the German market. We defined the attributes and levels on the basis of an expert interview, market analysis and literature review (Table 2). We either located the attribute levels in terms of the percentage of bioplastic in fabric in the market for rain jackets in 2016 (20%) or assumed that higher percentages of bioplastics might potentially be of importance to consumers (50%, 100%). The biogenic resources shown in the CBC contain substances/compounds that can be used to manufacture bioplastics for textile usage. Sanad (2016) found that the origin of the apparel is of relevance to consumers. The attribute levels in terms of origin of resource were selected in accordance with the potential location of crop cultivation. According to Chekima et al. (2016) and Borin et al. (2011), eco-labels or certificates are of value to consumers in that they serve to create product trust, communicate certain properties of a product, and promoting the purchase of green products. We therefore included three certificate types familiar from the German market. The prices we chose for the CBC display a wide range of 69€ to 349€. However, this price range is realistic for the German market for functional rain jackets for outdoor usage. Respondents were also able to select the option 'None'. This is interpreted as the choice threshold, as it means that the respondents preferred none of the three product concepts listed. The 'None' option formed part of every choice set and represented the influence on utility of not choosing a product.

Table 2: Attributes and levels of the choice-based conjoint analysis

Attributes	Levels
Percentage of bioplastic in fabric	100%
	50%
	20%
Biogenic resource	Potatoes
	Woodchip
	Sugar cane
	Maize
Origin of resource	South America

	European Union
	United States of America
	Asia
Product certificate	Free of pollutants
	Climate protection
	Fair production
	No certificate
Price	349.- €
	239.- €
	109.- €
	69.- €

The CBC setting was also used in the study of Klein et al. (2020) but with different study objectives and analyzing methods.

3.4 Relevant factors influencing price preference

The relevant factors were determined by way of an extensive literature review, as presented in section 2. The factors were measured with validated scales used in previous studies, reformulated as necessary for the purpose of this study (Table 3).

Table 3: Constructs of the survey

Variable/item	Statements	Possible answers	Cronbach's Alpha	Sources
Gender	Please choose one of the following answers.	1 = Female; 2 = Male	-	Reformulated according to Rumm (2016)
Age	In what year were you born?	Metric input of the year of birth, open field	-	Reformulated according to Rumm (2016)
Education	What is your highest level of education?	1 = No general education (as yet); 2 = Secondary school without apprenticeship; 3 = Secondary school with apprenticeship; 4 = General certificate of secondary education; 5 = General qualification for university entrance 6 = Studies (university, or other institute of higher education)	-c	Reformulated according to Rumm (2016)
Altruism	How important is to you: 1. To help other people 2. To serve mankind 3. To share what you have 4. To give to others 5. To be unselfish	1 = Not important at all; 2 = Not so important; 3 = Sometimes important; 4 = Quite important; 5 = Important in all cases	0.845	Price et al. (2018)
Subjective norm for bio-based apparel	How much would people close to you (e.g., partner, children, parents, friends) expect you to buy a rain jacket / other functional apparel made from bioplastics rather than petroleum-based plastic?	1 = Definitely would not; 2 = Unlikely to; 3 = Maybe; 4 = Probably; 5 = Certainly	-	Reformulated according to Rumm (2016)

Innovativeness	Please indicate to what extent you agree with the following statements. 1. I hate any change in my routines and habits. 2. New products have an unacceptably high price. 3. I am excited to try out new products. 4. I enjoy the novelty of owning new products. 5. I like to be confronted with new ideas. 6. Products are getting shoddier and shoddier.	1 = I don't agree at all; 2 = I generally don't agree; 3 = I agree in part; 4 = I would tend to agree; 5 = I totally agree	0.626	Scherer et al. (2017), Tellis et al. (2009)
Green consumer values	Please indicate to what extent you agree with the following statements. 1. It is important to me that the products I use do not harm the environment. 2. I consider the potential environmental impact of my actions when making many of my decisions. 3. My purchasing habits are affected by my concern for our environment. 4. I am concerned about wastage of resources on our planet. 5. I would describe myself as environmentally responsible. 6. I am willing to accept inconvenience in order to take actions that are more environmentally friendly.	1 = I don't agree at all; 2 = I generally don't agree; 3 = I agree in part 4 = I would tend to agree; 5 = I totally agree	0.895	Haws et al. (2014)
Attitude towards bioplastics	Below are a number of statements from various organizations about bioplastics. Please state for each statement whether you would persuade or dissuade them from supporting the increased use of bioplastics. If the statement is of little or no relevance to you, please select "I don't really care." 1. The long-term goal is to produce bioplastics from non-edible plant residues. 2. Bioplastics can withstand just as much as conventional plastics. 3. The carbon footprint of bioplastics is lower than that of conventional plastics. 4. The purchase of bioplastic products helps to conserve fossil resources (petroleum).	1 = I don't agree at all; 2 = I generally don't agree; 3 = I don't really care; 4 = I would tend to agree; 5 = I totally agree	0.782	Reformulated according to Rumm (2016)
Product experience with bioplastics	Have you ever deliberately opted for bioplastics in products?	0 = No; 1 = Yes	-	Reformulated according Rumm (2016), Scherer et al. (2018b)
Interest in bioplastics	Overall, are you interested in bioplastics in general?	1 = I am not interested at all; 2 = I am not so interested; 3 = I could be interested; 4 = I am a little interested; 5 = I am very interested	-	Reformulated according to Rumm (2016)
Purchase intention for bio-based products	How will you decide in future purchase situations? 1. I will consciously pay attention to bioplastic products made of renewable resources in future purchase decisions. 2. When I have the choice between a plastic product made of conventional materials and one made of renewable raw materials in the future, I will choose the one made of renewable raw materials.	1 = Definitely not; 2 = Not really; 3 = Maybe; 4 = Probably; 5 = Certainly	0.816	Rumm (2016); Buxel (2010)

Some of the variables were also used in the studies of Klein et al. (2019) and Klein et al. (2020) but with different study objectives and methods.

3.5 Segmentation through latent class analysis

A latent class analysis based on a maximum likelihood estimation was performed with Sawtooth 8 to calculate clusters within the sample for the purpose of dividing consumers into heterogeneous classes based

on their preferences for certain product attributes (Sawtooth Software 2004). At the beginning of the estimation process, the utility values for each segment were determined randomly. The data from each respondent was then compared with the utility values of each segment and the probabilities of each respondent belonging to each segment calculated, while utility values and group affiliations were iteratively improved. The clustering was estimated with different group solutions. The best group solution was chosen by an appropriate Consistent Akaike Information Criterion (CAIC) and an appropriate relative Chi-square. Group size and coherence were also considered (Sawtooth Software 2004).

3.6 Discriminant analysis

Discriminant analysis is a method of classifying a dependent variable by the independent variables; it enables the study of two or more groups (Backhaus et al. 2000). In this study, we identified the variables that distinguished respondents who either indicated high part-worth utility values for low prices or moderate prices for bio-based apparel. Respondents were divided into two group clusters based on the results of the latent class analysis. All six groups of latent-class analysis were thus scrutinized to determine values of relative importance and values of part-worth utilities within the latent-class analysis. It was found that the latent class analysis segments A, D, E and F all had the highest significance with regard to the importance of price, and the utility values within the price attribute-levels had the highest values for the lowest price level. Groups B and C neither showed their highest importance for the price, nor did they show the highest utilities at the lowest price level but for the moderate price level. Therefore, two groups were formed to investigate the factors, which were filtered from a literature review, which helped to distinguish between these two groups.

4 Results and discussion

In the first step, we examine the segments of latent class analysis. In the next step, we analyze the results of the discriminant analysis and the influence of the variables that contribute to a distinction between the two price preference groups indicated by the assigned part-worth utilities.

4.1 Consumer segmentation through latent class analysis

Segmentation took place in two to ten groups. The six-group solution was chosen because it had a comparatively well-fitting CAIC value (24,975.22) and related chi-squared value (138.22). The latent class analysis performed on the basis of the CBC thus shows six segments formed on the basis of the respondents' preferences. Table 4 shows the average importance of each attribute together with the part-worth utilities of the attribute levels and their dedicated cluster. Cluster A aggregates respondents for whom price is of high importance. The 'None' option displays a high negative part-worth utility, which strongly indicates that respondents of this cluster would rather choose functional clothes made of bioplastic, although other

attributes apart from price revealed relatively low importance values. Cluster B aggregates respondents attributing moderate importance to price and relatively high importance to the origin of the biogenic resource. This cluster has the highest part-worth utility for a price of 109 €, with woodchip produced in the EU as the preferable biomass. Respondents of cluster C show a higher preference for certified functional bioplastic apparel and a moderate importance assigned to price as well. They also display the highest utility for a price of 109 € and express a strongly negative part-worth utility for the 'None' option. The clusters D, E and F all indicate a high price importance, and all show a strong preference for the lowest price of the rain jacket as well as positive part-worth utilities for the 'None' option. Smaller differences can be found between clusters D, E and F, particularly in relation to the evaluation of the plant origin or the location of production of the biogenic resource. Kurka (2012) found similar results, showing that participants who preferred non-bio-based plastics also preferred low prices.

Furthermore, cluster B shows a higher relative importance value for the 'Origin of biogenic resource' attribute compared to the 'price' attribute, while cluster C shows a higher relative importance value for the 'percentage of bioplastic in the fabric' attribute compared to the 'price' attribute. Scherer et al. (2018b) found similar effects, whereby the attributes 'contains bio-based plastic' and 'of vegetable oil origin' or 'contains softeners' showed higher average importance values than the 'price' attribute. Hustvedt and Bernard (2008) showed that participants in an experimental auction were willing to pay more for socks made of organic fibers, which can be regarded as a green attribute and is comparable to the 'percentage of bioplastic in the fabric' attribute in this study.

Table 4: Clusters of the latent class analysis

Cluster	A	B	C	D	E	F
Cluster size	18.1%	11.4%	27.7%	21.5%	14.0%	7.4%
Part worth utilities rescaled for comparability						
Percentage of bioplastic in the fabric						
100 %	26.9	18.4	61.3	42.6	34.2	-1.7
50 %	4.5	2.4	-2.9	1.2	-24.7	5.1
20 %	-31.4	-20.8	-58.4	-43.8	-9.5	-3.4
Biogenic resource						
Potatoes	5.2	-12.8	-1.3	-8.1	13.4	-4.2
Woodchip	-1.7	49.2	-2.9	3.2	-3.6	0.1
Sugar cane	-2.5	-29.0	8.5	6.6	22.5	-2.2
Maize	-0.9	-7.4	-4.2	-1.8	-32.3	6.2
Origin of biogenic resource						
South America	-0.9	-25.7	-17.1	-11.2	-23.8	-6.5
EU	18.6	111.2	58.1	26.1	72.8	4.2
USA	-6.2	-16.3	-6.0	-5.4	-11.3	-1.0
Asia	-11.5	-69.2	-35.1	-9.6	-37.6	3.3

Certificates						
Free of pollutants	4.8	11.9	45.0	26.9	30.5	-0.1
Climate protection	13.3	25.5	25.1	24.3	11.4	3.8
Fair production	15.9	14.7	43.6	19.4	-6.4	8.1
No certificate	-34.1	-52.1	-113.7	-70.5	-35.6	-11.8
Price						
349 €	-190.2	-74.1	-68.3	-149.0	-98.1	-277.2
239 €	-70.4	-1.0	4.0	-53.6	-74.9	15.9
109 €	97.0	50.7	47.4	87.5	61.2	88.1
69 €	163.6	24.3	16.9	115.2	111.8	173.2
None option						
None option	-98.9	93.8	-262.9	93.8	283.8	118.0
Attribute importance						
Percentage of bioplastic in the fabric	11.7	7.8	24.0	17.3	11.8	1.7
Biogenic resource	1.5	15.6	2.5	2.9	11.0	2.1
Origin of biogenic resource	6.0	36.1	18.6	7.5	22.1	2.1
Certificate	10.0	15.5	31.7	19.5	13.2	4.0
Price	70.8	25.0	23.1	52.8	42.0	90.1

4.2 Discriminant analysis

Preferences for bio-based apparel were investigated by the CBC, and respondents were segmented through a latent class analysis. A preference for low-price products was apparent in the clusters A, D, E and F, while in the two clusters B and C, respondents indicated lower utilities for the lowest price and preferred the price of 109 € for the rain jacket. The respective clusters were aggregated for further analysis into two classes, with a distinction made between the groups indicating a 'preference for a low price' and 'acceptance of a moderate price'. A discriminant analysis was conducted to determine the influence of psychographic traits on price preferences in these two groups. Table 5 shows the independent variables and their significance in the separability of the two groups. The sociodemographic variables show no contribution to the discrimination, whereas all other variables are significant to the differentiation between the two price preference groups.

Table 5: Test of univariate separability of the independent variables in the discriminant analysis

Independent variables	**Wilks-Lambda**	**F**	**Significance**
Age	0.999	2.069	0.151
Gender	0.999	2.043	0.153
Education	1.000	0.700	0.403
Altruism	**0.975**	**43.425**	**0.000 ***
Subjective norms of bio-based apparel	**0.966**	**59.374**	**0.000 ***
Innovativeness	**0.974**	**43.936**	**0.000 ***

Green consumer values	0.964	61.517	0.000 *
Attitude towards bioplastics	0.992	13.571	0.000 *
Product-experience	0.980	33.642	0.000 *
Interest in bioplastics	0.986	23.888	0.000 *
Purchase intention for bio-based products	0.948	90.768	0.000 *

* significant at 99.9% level (p < 0.001)

The test parameters of the discriminant function analysis reveal low separation by the variables, as indicated by a Wilks' Lambda of 0.919. Still, the groups can be separated with a probability of error of 0.0001, checked by the chi-square test.

Table 6: Parameters of the discriminant analysis

Eigenvalue	Wilks'-Lambda	Chi-Square	Canonical correlation	df	Significance
0.088	0.919	139.961	0.284	11	0.000

The structure matrix shown in Table 7 describes the contribution of the variables to the separation of the two groups, starting with the variable with the strongest group-separating effect. The purchase intention for bio-based apparel is the strongest separating variable, followed by GCV and subjective norms of bio-based apparel. Moreover, Scherer et al. (2018b) conclude that GCV plays a major role in separating the classes of consumers who are interested in bio-based products from those who are not. Innovativeness, altruism, product experience with bio-based products and attitude towards bioplastic are variables with a comparatively moderate influence on distinguishing between the groups. Scherer et al. (2018b) also found that innovativeness had an influence on the separation of consumers into those interested and those not interested in bio-based products, although in the same study, no influence could be determined by product experience with bio-based products. Hustvedt and Dickson (2009) could not find that altruistic behavioral beliefs differed between two segments of organic cotton apparel consumers, but they did find an influence on separation as a result of environmental and apparel attitudes. Interest in bioplastics reveals a comparatively low significant influence towards the separation of price preference classes. A general interest in bio-based products was also found in previous studies by Kurka (2012), Kainz (2016), Behe et al. (2013) and Yue et al. (2010). As in studies by Tanner and Wölfing Kast (2003), Hess et al. (2013) and Diamantopoulos et al. (2003), this study has shown that socio-demographic characteristics have no relevance in the separation of the defined consumer groups.

Table 7: Structure matrix of discriminant analysis

Independent variables	Function
Purchase intention for bio-based products	0.787

Green consumer values	**0.648**
Subjective norms of bio-based apparel	**0.637**
Innovativeness	**0.548**
Altruism	**0.544**
Product experience	**0.479**
Attitude towards bioplastics	**0.404**
Interest in bioplastics	**0.304**
Age	0.119
Gender	0.118
Education	0.069

(bold = shown by testing to be significant for the separation of the groups)

4.3 Limitations and future research

As with all empirical investigations, this study also has its weaknesses. A familiar weakness of surveys on environmental issues is that respondents' answers can be biased by social desirability (Grimm 2010), and this cannot be ruled out here either. However, there are indications from Kaiser et al. (1999) and Milfont (2009) which suggest that the results of surveys are still representative, the aspect of social desirability notwithstanding. We were not able to test all potential separation variables. It is therefore possible that previously less prominent variables might have a greater influence than assumed. However, the selection was based on an extensive literature review, in which variables were found to be highly relevant for these purposes. In addition, we chose product attributes and levels that gave a realistic view of existing and emerging products that may possibly rise in importance in the future. Nevertheless, it is hardly possible to consider all product attributes in a CBC.

This study was conducted in Germany and is representative of the population of this country. Other countries might have different socio-economic conditions, so it is important to carry out comparative studies and to check transferability to other societies. The same applies to transferability to apparel in general; this study concerned an outdoor rain jacket, and whether the same influencing factors also apply to other garments with environmental benefits needs to be investigated.

Furthermore, the number of levels may have an effect, as not all attributes had the same amount of levels within the CBC. This can cause a bias in the estimation of relative importance, whereas attributes with more levels could result in an artificially higher estimate (Eggers and Sattler 2011). However, in this case, only the attribute 'percentage of bioplastic in the fabric' was set with fewer levels. The consequence of this would be that all other attributes would be overestimated or the opposite 'percentage of bioplastic in the fabric' would be underestimated. The level of error that affects the relative importance of the price attribute can therefore be considered very low or non-existent.

Although the discriminant analysis separation is validated as significant, Wilk's-Lambda shows a low discriminant function separation force. This may be due to the low separating force of the independent variables versus the dependent variable. However, it is much more likely that it is because consumers are not yet able to accurately assess the product and its attributes because they still lack experience with bio-based apparel. Only when consumers have formed precise preferences can this be reflected in their price preference. Until the market for bio-based apparel has undergone further development, future research will be needed to reveal more sensitive factors for the classification of price preference towards bio-based apparel or to further test and compare the factors used in this study.

4.4 Future implications and conclusions

The aim of this study was to determine relevant influencing factors for the price preference of bio-based apparel. We were able to show the important separating variables characterizing the two groups. The variables GCV, purchase intention for bio-based products, and subjective norm bio-based apparel were found to be the most suitable for separating the two groups into those with a 'preference for a low price' and those showing 'acceptance of a moderate price'. This study contributes further insights towards the understanding of consumer decisions in the context of bio-based apparel. In addition to assessing the relevance of the attributes and influencing variables, the focus of this study was on the significance of price preference. Since products always have different attributes, it is important to understand the relevance of the products and the psychographic characteristics and, if necessary, to link them to a price perception. In this way, companies are also able to understand the economic relevance of various attributes. Furthermore, a CBC does not represent a study of real behavior. This could be considered in future studies and implemented in a field experiment or in the observation of real purchase behavior.

This study supports the development of new green apparel based on consumer preferences (e.g. with respect to type and content of fiber, origin of the biomass, certificates) and in particular, pricing of bio-based apparel. It shows that almost 40% of German consumers would make compromises with respect to the prices of bio-based apparel. However, it is highly relevant that the factors supporting assignment to price preference groups are also taken into account when marketing such products. These findings also relate to other articles by the authors (Hustvedt and Bernard 2008; Scherer et al. 2018b).

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Publication bibliography

Ajzen, Icek; Fishbein, Martin (1980): Understanding attitudes and predicting social behavior. Englewood Cliffs, N.J: Prentice-Hall.

Austgulen, Marthe Hårvik (2016): Environmentally Sustainable Textile Consumption—What Characterizes the Political Textile Consumers? In *Journal of Consumer Policy* 39 (4), pp. 441–466.

Backhaus, Klaus; Erichson, Bernd; Plinke, Wulff; Weiber, Rolf (2000): Diskriminanzanalyse. In : Multivariate Analysemethoden: Springer, pp. 145–224.

Balster, Trisha (2019): Grüner Knopf – Was bringt das Siegel für nachhaltige Mode? Wird es damit leichter, nachhaltige Mode zu kaufen? In *www.welt.de*, 8/16/2019 (online). Available online at https://www.welt.de/icon/mode/article198598723/Gruener-Knopf-Was-bringt-das-Siegel-fuer-nachhaltige-Mode.html, checked on 8/23/2019.

Batson, C. Daniel; Powell, Adam A. (2003): Altruism and prosocial behavior.

Behe, Bridget K.; Campbell, Benjamin L.; Hall, Charles R.; Khachatryan, Hayk; Dennis, Jennifer H.; Yue, Chengyan (2013): Consumer preferences for local and sustainable plant production characteristics. In *HortScience* 48 (2), pp. 200–208.

Blesin, J. M.; Klein, F.; Emberger-Klein, A.; Scherer, C.; Menrad, K.; Möhring, W. (2017): Bevölkerungsrepräsentative Online-Befragung in Deutschland zu Biokunststoffen. Arbeitsbericht Oktober 2017. Edited by University of Applied Sciences Hannover, University of Applied Sciences Weihenstephan-Triesdorf. University of Applied Sciences Hannover, University of Applied Sciences Weihenstephan-Triesdorf. Hannover, Germany, Straubing, Germany. Available online at http://biokunststoffe-nachhaltig.de/files/Downloads/BiNa%20Working%20Paper%20zur%20Bevoelkerungsbefragung%202016.pdf, checked on 12/25/2019.

Borin, Norm; Cerf, Douglas C.; Krishnan, Ragi (2011): Consumer effects of environmental impact in product labeling. In *Journal of Consumer Marketing* 28 (1), pp. 76–86.

Buxel, Holger (2010): Akzeptanz und Nutzung von Nährwertkennzeichnung auf Lebensmitteln durch Konsumenten. Ergebnisse einer empirischen Untersuchung unter Berücksichtigung der GDA- und Ampel-Nährwertkennzeichnung. University of Applied Sciences Münster. Internet, Münster. Available online at https://www.vzbv.de/sites/default/files/downloads/naehrwertkennzeichnung_studie_fh_muenster_03_2010.pdf.

Casimir, Gerda; Dutilh, Chris (2003): Sustainability: a gender studies perspective*. In *Int J Cons Stud* 27 (4), pp. 316–325. DOI: 10.1046/j.1470-6431.2003.00323.x.

Chekima, Brahim; Wafa, Syed Azizi Wafa Syed Khalid; Igau, Oswald Aisat; Chekima, Sohaib; Sondoh Jr, Stephen Laison (2016): Examining green consumerism motivational drivers. Does premium price and demographics matter to green purchasing? In *Journal of Cleaner Production* 112, pp. 3436–3450.

Chrobot, Pauline; Faist, Mireille; Gustavus, Lori; Martin, Amanda; Stamm, Annabelle; Zah, Rainer; Zollinger, Michèle (2018): MEASURING FASHION. Environmental Impact of the Global Apparel and Footwear Industries Study. Full report and methodological considerations. Edited by Quantis. Quantis. Internet. Available online at https://quantis-intl.com/wp-content/uploads/2018/03/measuringfashion_globalimpactstudy_full-report_quantis_cwf_2018a.pdf, checked on 12/5/2019.

CO Data (2018): Volume and Consumption: How Much Does The World Buy? Available online at https://www.commonobjective.co/article/volume-and-consumption-how-much-does-the-world-buy.

Diamantopoulos, Adamantios; Schlegelmilch, Bodo B.; Sinkovics, Rudolf R.; Bohlen, Greg M. (2003): Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. In *Journal of Business Research* 56 (6), pp. 465–480. DOI: 10.1016/S0148-2963(01)00241-7.

Eggers, Felix; Sattler, Henrik (2011): Preference Measurement with Conjoint Analysis. Overview of State-of-the-Art Approaches and Recent Developments. In *GfK Marketing Intelligence Review* 3 (1), pp. 36–47. DOI: 10.2478/gfkmir-2014-0054.

Englis, Basil G.; Phillips, Diane M. (2013): Does Innovativeness Drive Environmentally Conscious Consumer Behavior? In *Psychol. Mark.* 30 (2), pp. 160–172. DOI: 10.1002/mar.20595.

Euratex (2019): Data & Statistics. THE Euratex, the EUROPEAN APPAREL AND TEXTILE INDUSTRY. Internet, Brussels. Available online at https://euratex.eu/eu-apparel-textile-sector/statistics/.

Evans, Joel R.; Mathur, Anil (2005): The value of online surveys. In *Internet research* 15 (2), pp. 195–219.

Fashion United (2017): Global fashion industry statistics. International apparel. Edited by Fashion United. Amsterdam, The Netherlands. Available online at https://fashionunited.com/global-fashion-industry-statistics/.

Fuhr, Lili; Buschmann, Rolf; Freund, Judith (2019): Plastikatlas. Daten und Fakten über eine Welt voller Kunststoff. Berlin: Heinrich-Böll-Stiftung.

German Federal Statistical Office (2015): Mikrozensus. Edited by Statistisches Bundesamt. Statistisches Bundesamt (Mikrozensus). Available online at https://www.destatis.de/, checked on 5/14/2018.

Grimm, Pamela (2010): Social desirability bias. In *Wiley international encyclopedia of marketing*.

Hartmann, Patrick; Apaolaza-Ibáñez, Vanessa (2012): Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern. In *Journal of Business Research* 65 (9), pp. 1254–1263. DOI: 10.1016/j.jbusres.2011.11.001.

Haws, Kelly L.; Winterich, Karen Page; Naylor, Rebecca Walker (2014): Seeing the world through GREEN-tinted glasses: Green consumption values and responses to environmentally friendly products. In *Journal of Consumer Psychology* 24 (3), pp. 336–354. DOI: 10.1016/j.jcps.2013.11.002.

Hefner, Dorothée (2013): „Wie kriegen wir sie ins Boot?" Eine Typologie zur Entwicklung von Kommunikationsstrategien zur Förderung umweltschützenden Verhaltens. In *M&K* 61 (3), pp. 387–405. DOI: 10.5771/1615-634x-2013-3-387.

Hess, Stephane; Shires, Jeremy; Jopson, Ann (2013): Accommodating underlying pro-environmental attitudes in a rail travel context: application of a latent variable latent class specification. In *Transportation Research Part D: Transport and Environment* 25, pp. 42–48.

Hustvedt, Gwendolyn; Bernard, John C. (2008): Consumer willingness to pay for sustainable apparel: the influence of labelling for fibre origin and production methods. In *Int J Cons Stud* 32 (5), pp. 491–498. DOI: 10.1111/j.1470-6431.2008.00706.x.

Hustvedt, Gwendolyn; Dickson, Marsha A. (2009): Consumer likelihood of purchasing organic cotton apparel. In *JFMM*.

IBM Corp. (2015): IBM SPSS 23 Statistics for Windows. Version Version 23.0. Armonk, NY, USA: IBM Corp. Available online at https://www.ibm.com/support/pages/downloading-ibm-spss-statistics-23, checked on 12/26/2019.

Jansson, Johan (2011): Consumer eco-innovation adoption: assessing attitudinal factors and perceived product characteristics. In *Bus. Strat. Env.* 20 (3), pp. 192–210. DOI: 10.1002/bse.690.

Kainz, Ulla (2016): Consumers' Willingness to Pay for Durable Biobased Plastic Products: Findings from an Experimental Auction: Technische Universität München.

Kaiser, Florian G.; Ranney, Michael; Hartig, Terry; Bowler, Peter A. (1999): Ecological behavior, environmental attitude, and feelings of responsibility for the environment. In *European psychologist* 4 (2), p. 59. DOI: 10.1027//1016-9040.4.2.59.

Klein, Florian; Emberger-Klein, Agnes; Menrad, Klaus; Möhring, Wiebke; Blesin, Julia-Maria (2019): Influencing factors for the purchase intention of consumers choosing bioplastic products in Germany. In *Sustainable Production and Consumption* 19, pp. 33–43. DOI: 10.1016/j.spc.2019.01.004.

Klein, Florian Felix; Emberger-Klein, Agnes; Menrad, Klaus (2020): Indicators of Consumers' Preferences for Bio-Based Apparel: A German Case Study with a Functional Rain Jacket Made of Bioplastic. In *Sustainability* 12 (2), p. 675.

Klein, Hanna (2019): Nachhaltigkeit: Mode-Wahnsinn zerstört Umwelt - wie wir das ändern. In *FOCUS-Online*, 7/27/2019 (online open access). Available online at https://www.focus.de/perspektiven/nachhaltigkeit/nachhaltigkeit-mode-wahnsinn-zerstoert-umwelt-wie-wir-das-aendern_id_10964545.html, checked on 8/23/2019.

Koszewska, Małgorzata (2013): A typology of P olish consumers and their behaviours in the market for sustainable textiles and clothing. In *Int J Cons Stud* 37 (5), pp. 507–521.

Kurka, Stefan (2012): Biomasse-basierte Produkte aus Konsumentensicht. Ausgewählte europäische Länder im Vergleich.

Laroche, Michel; Bergeron, Jasmin; Barbaro-Forleo, Guido (2001): Targeting consumers who are willing to pay more for environmentally friendly products. In *Journal of Consumer Marketing* 18 (6), pp. 503–520. DOI: 10.1108/EUM0000000006155.

Lee, Yung-Jaan; Young, Raymond de; Marans, Robert W. (1995): Factors Influencing Individual Recycling Behavior in Office Settings. In *Environment and Behavior* 27 (3), pp. 380–403. DOI: 10.1177/0013916595273006.

Leinfelder, Barbara; Regensburger, Florian (2019): Jugendliche aus Friedberg erfindet Filter für Mikroplastik. Edited by BR24. Bayerischer Rundfunk. Internet (Mittags in Schwaben). Available online at https://www.br.de/nachrichten/bayern/jugendliche-aus-friedberg-erfindet-filter-fuer-mikroplastik,RVcMGgf.

Louviere, Jordan J.; Woodworth, George (2018): Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data. In *Journal of Marketing Research* 20 (4), pp. 350–367. DOI: 10.1177/002224378302000403.

Lusk, Jayson L.; Nilsson, Tomas; Foster, Ken (2007): Public Preferences and Private Choices: Effect of Altruism and Free Riding on Demand for Environmentally Certified Pork. In *Environ Resource Econ* 36 (4), pp. 499–521. DOI: 10.1007/s10640-006-9039-6.

McDonald, Seonaidh; Oates, Caroline; Thyne, Maree; Alevizou, Panayiota; McMorland, Leigh-Ann (2009): Comparing sustainable consumption patterns across product sectors. In *International Journal of Consumer Studies* 33 (2), pp. 137–145. DOI: 10.1111/j.1470-6431.2009.00755.x.

Milfont, Taciano L. (2009): The effects of social desirability on self-reported environmental attitudes and ecological behaviour. In *Environmentalist* 29 (3), pp. 263–269. DOI: 10.1007/s10669-008-9192-2.

Mishra, Deepti; Akman, Ibrahim; Mishra, Alok (2014): Theory of Reasoned Action application for Green Information Technology acceptance. In *Computers in Human Behavior* 36, pp. 29–40. DOI: 10.1016/j.chb.2014.03.030.

Morrison, Donald G. (1979): Purchase Intentions and Purchase Behavior. In *Journal of Marketing* 43 (2), p. 65. DOI: 10.2307/1250742.

Muthu, Subramanian Senthilkannan (2014): Roadmap to sustainable textiles and clothing: Eco-friendly raw materials, technologies, and processing methods: Springer.

Nam, Changhyun; Dong, Huanjiao; Lee, Young-A (2017): Factors influencing consumers' purchase intention of green sportswear. In *Fash Text* 4 (1), p. 179. DOI: 10.1186/s40691-017-0091-3.

Niinimäki, Kirsi (2010): Eco-clothing, consumer identity and ideology. In *Sust. Dev.* 18 (3), pp. 150–162.

Osburg, Victoria-Sophie; Strack, Micha; Toporowski, Waldemar (2016): Consumer acceptance of Wood-Polymer Composites: a conjoint analytical approach with a focus on innovative and environmentally concerned consumers. In *Journal of Cleaner Production* 110, pp. 180–190. DOI: 10.1016/j.jclepro.2015.04.086.

Pfattheicher, Stefan; Sassenrath, Claudia; Schindler, Simon (2016): Feelings for the Suffering of Others and the Environment. In *Environment and Behavior* 48 (7), pp. 929–945. DOI: 10.1177/0013916515574549.

Price, Linda L.; Feick, Lawrence F.; Guskey, Audrey (2018): Everyday Market Helping Behavior. In *Journal of Public Policy & Marketing* 14 (2), pp. 255–266. DOI: 10.1177/074391569501400207.

Rana, Sohel; Pichandi, Subramani; Parveen, Shama; Fangueiro, Raul (2014): Biosynthetic Fibers: Production, Processing, Properties and Their Sustainability Parameters. In Subramanian Senthilkannan Muthu (Ed.): Roadmap to Sustainable Textiles and Clothing, vol. 46. Singapore: Springer (Textile Science and Clothing Technology), pp. 109–138.

Rumm, Stefanie (2016): Verbrauchereinschätzungen zu Biokunststoffen: eine Analyse vor dem Hintergrund des heuristic-systematic model. München. Available online at http://mediatum.ub.tum.d.

Rumm, Stefanie; Klein, Agnes; Zapilko, Marina Annette; Menrad, Klaus (2013): Labelling for bio-based plastics. In : First International Conference on Resource Efficiency in Interorganizational Networks : ResEff 2013 ; November 13th - 14th, 2013, Georg-August-Universität Göttingen ; Papers. Göttingen: Univ.-Verl. Göttingen, pp. 403–414.

Šajn, Nikolina (2019): Environmental impact of the textile and clothing industry. What consumers need to know. European Parliamentary Research Service. Available online at http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/633143/EPRS_BRI(2019)633143_EN.pdf.

Sanad, Reham Abdelbaset (2016): Consumer Attitude and Purchase Decision towards Textiles and Apparel Products. In *World Journal of Textile Engineering and Technology* 2, pp. 16–30.

Sawtooth (2015): SSI Web 8. Version 8.4.8. Orem, Utah, USA: Sawtooth Software Inc., checked on 12/26/2019.

Sawtooth Software, Inc. (2004): The CBC Latent Class. Version 3. Edited by Inc. Sawtooth Software (TECHNICAL PAPER SERIES). Available online at https://www.sawtoothsoftware.com/support/technical-papers/sawtooth-software-products/cbc-latent-class-technical-paper-2004, checked on 8/23/2019.

Scherer, Christoph; Emberger-Klein, Agnes; Menrad, Klaus (2017): Biogenic product alternatives for children: Consumer preferences for a set of sand toys made of bio-based plastic. In *Sustainable Production and Consumption* 10, pp. 1–14. DOI: 10.1016/j.spc.2016.11.001.

Scherer, Christoph; Emberger-Klein, Agnes; Menrad, Klaus (2018a): Consumer preferences for outdoor sporting equipment made of bio-based plastics. Results of a choice-based-conjoint experiment in Germany. In *Journal of Cleaner Production* 203, pp. 1085–1094. DOI: 10.1016/j.jclepro.2018.08.298.

Scherer, Christoph; Emberger-Klein, Agnes; Menrad, Klaus (2018b): Segmentation of interested and less interested consumers in sports equipment made of bio-based plastic. In *Sustainable Production and Consumption* 14, pp. 53–65. DOI: 10.1016/j.spc.2018.01.003.

Schleenbecker, Rosa; Hamm, Ulrich (2013): Consumers' perception of organic product characteristics. A review. In *Appetite* 71, pp. 420–429.

Stern, Paul C.; Dietz, Thomas; Kalof, Linda (1993): Value Orientations, Gender, and Environmental Concern. In *Environment and Behavior* 25 (5), pp. 322–348. DOI: 10.1177/0013916593255002.

Straughan, Robert D.; Roberts, James A. (1999): Environmental segmentation alternatives: a look at green consumer behavior in the new millennium. In *Journal of Consumer Marketing* 16 (6), pp. 558–575. DOI: 10.1108/07363769910297506.

Tanner, Carmen; Wölfing Kast, Sybille (2003): Promoting sustainable consumption: Determinants of green purchases by Swiss consumers. In *Psychol. Mark.* 20 (10), pp. 883–902.

Tarkiainen, Anssi; Sundqvist, Sanna (2005): Subjective norms, attitudes and intentions of Finnish consumers in buying organic food. In *British Food Journal* 107 (11), pp. 808–822. DOI: 10.1108/00070700510629760.

Tellis, Gerard J.; Yin, Eden; Bell, Simon J. (2009): Global Consumer Innovativeness: Cross-Country Differences and Demographic Commonalities. In *SSRN Journal*. DOI: 10.2139/ssrn.1335551.

Teng, Yi-Man; Wu, Kun-Shan; Liu, Hsiao-Hui (2015): Integrating Altruism and the Theory of Planned Behavior to Predict Patronage Intention of a Green Hotel. In *Journal of Hospitality & Tourism Research* 39 (3), pp. 299–315. DOI: 10.1177/1096348012471383.

Textile Exchange (2017): What are biosynthetics? Textile Exchange. Internet. Available online at https://aboutbiosynthetics.org/.

UNECE (2018): UN Alliance aims to put fashion on path to sustainability. Available online at https://www.unece.org/info/media/presscurrent-press-h/forestry-and-timber/2018/un-alliance-aims-to-put-fashion-on-path-to-sustainability/doc.html, checked on 12/5/2019.

UNFCCC (2018): Fashion Industry, UN Pursue Climate Action for Sustainable Development.

Untaru, Elena-Nicoleta; Ispas, Ana; Candrea, Adina Nicoleta; Luca, Marcela; Epuran, Gheorghe (2016): Predictors of individuals' intention to conserve water in a lodging context: the application of an extended Theory of Reasoned Action. In *International Journal of Hospitality Management* 59, pp. 50–59. DOI: 10.1016/j.ijhm.2016.09.001.

Young, Raymond de (2000): New Ways to Promote Proenvironmental Behavior: Expanding and Evaluating Motives for Environmentally Responsible Behavior. In *J Social Isssues* 56 (3), pp. 509–526. DOI: 10.1111/0022-4537.00181.

Young, William; Hwang, Kumju; McDonald, Seonaidh; Oates, Caroline J. (2009): Sustainable consumption: green consumer behaviour when purchasing products. In *Sust. Dev.* 37 (2), n/a-n/a. DOI: 10.1002/sd.394.

Yue, Chengyan; Hall, Charles R.; Behe, Bridget K.; Campbell, Benjamin L.; Dennis, Jennifer H.; Lopez, Roberto G. (2010): Are consumers willing to pay more for biodegradable containers than for plastic ones? Evidence from hypothetical conjoint analysis and nonhypothetical experimental auctions.

Appendices

Table 8: CBC introductory text

First, please put yourself in the following situation:

You want to buy a new rain jacket. You are looking for a high-quality product from a brand you know in an outdoor clothing store. After a short search, you will find what you are looking for and have the choice between different alternatives. The size, color, cut and function of the jacket meet your expectations. The seller points out that some jackets are made from bioplastics. He goes on to say that various renewable raw materials were used for its production instead of petroleum, but that no impairment of product quality is to be expected. He advises you further that the raw materials come from different countries of origin and that there are also various certifications on the rain jackets, which give information on the production and material of functional apparel.

Table 9: Choice set (example for random task)

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 3**
Percentage of bioplastic	100 %	20 %	50 %	*NONE:*
Raw material	Sugar cane	Potatoes	Indian maize	*I would not choose any of these.*
Origin of resource	USA	Asia	EU	
Certification	Free of pollutants	No certificate	Fair production	
Price	239 €	349 €	109 €	
	○	○	○	○