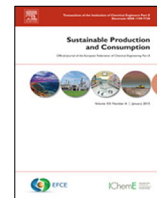




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## Research article

## Segmentation of interested and less interested consumers in sports equipment made of bio-based plastic

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## ABSTRACT

Currently only few products are made of bio-based plastic instead of conventional plastic, whose production and use is causing many environmental problems. Bio-based product alternatives could have a positive impact in consumer sectors relating to nature, such as the outdoor sporting equipment sector. For this reason, consumers' interest in bio-based sports equipment, their product preferences and the factors which influence their interest were analyzed. Using choice-based-conjoint experiments and latent class analysis, consumer groups who are interested in these products could be differentiated from those who are less or not interested. Respondents with interest in bio-based sports equipment prefer a high bio-based plastic content, a large reduction in potential CO<sub>2</sub>-emissions and the use of regionally grown raw materials. Respondents with less interest in bio-based plastic products prefer low-priced products made of conventional plastic. To enable a more precise differentiation between these consumer groups, a discriminant analysis was also conducted. Above all, personal attitudes such as environmental awareness and nature relatedness differentiated the interest groups. With regard to Short-Schwartz-Values, only universalism and benevolence sufficiently differentiated between the interested and less interested respondents. Considering environmentally friendly behavior in other areas, interest in bio-based plastic seems to correlate with preference for organic food. Socio-demographic data did not explain the differences between the two interest groups. Finally, respondents who were interested in bio-based products had more positive expectations and stricter requirements regarding the cultivation of raw materials.

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## 1. Introduction

Plastic is a basic material with great importance to modern society because of its advantages over other materials. It is lightweight and can be made to be both flexible and rigid, depending on its desired application (Philp et al., 2013). Every year 300 million tons of plastic are produced globally (Plastics Europe, 2015), with much of this plastic being used only once before disposal (Hopewell et al., 2009). The production and use of plastic is accompanied by various negative environmental impacts. In addition to using finite crude oil resources and producing CO<sub>2</sub>-emissions, the use of plastic, which often contains toxic substances, causes a lot of waste and environmental pollution. These plastic substances can persist in the soil and waterbodies for more than 100 years (Moore, 2008; Rochman et al., 2013). This problem is increasing in its magnitude

as many countries do not have adequate disposal and recycling systems for plastic.

An investigation by the United Nations Environment Programme dealing with the use of plastic in the consumer goods industry showed that sectors producing toys, athletic goods and durable household goods use the most plastic in products per \$1 million revenue (Raynaud, 2014). In recent years, the sports equipment industry has been characterized by a rapid diffusion of new products combined with shorter product life cycles. This trend has resulted in the increased accumulation of plastic waste (Subic et al., 2009). As a consequence, sports equipment manufacturers are now interested in strategies aimed at reducing waste as well as emissions. Sustainability seems to be of increasing importance within this industry (Subic, 2010). According to Subic et al. (2009), the majority of environmental pollution caused by sports equipment is determined by decisions made during the design phase. Promising strategies for the reduction of pollution include recycling products and the use of environmentally friendly materials.

Conventional plastic can partly be replaced by bio-based plastic, which is produced from renewable raw materials and may be

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either biodegradable or non-biodegradable (Endres and Siebert-Raths, 2011). Bio-based plastic can be produced from different raw materials such as bioethanol made from sugar cane, starch made from potatoes or corn, cellulose or different plant oils (Barker and Safford, 2009). Because of the variety of different plant raw materials, regional cultivation is possible in many parts of the world, although sugarcane from South America or Asia, corn from North America or plant oils from Asia are currently often used for that purpose (Institute for Bioplastics and Biocomposites, 2016). The use of renewable raw materials can have a positive impact on the environment, depending on the source of the raw plant materials, cultivation methods used and the former land use (Piemonte and Gironi, 2011; Álvarez Chávez et al., 2012; Hottle et al., 2013). The use of biomass for plastic production may contribute to a reduction of CO<sub>2</sub>-emissions and lower global warming effects (Hermann et al., 2007). An additional ecological advantage is the reduced depletion of fossil fuels (Khuo et al., 2010). Otherwise negative implications for soil and water result from the large-scaled cultivation of renewable raw materials due to monocultures, the usage of pesticides, fertilizers as well as genetic engineering in agricultural production (Pawelzik et al., 2013). Finally consequences of direct and above all indirect land use changes have to be considered in ecobalances of bio-based plastic materials (Piemonte and Gironi, 2011).

However, currently worldwide less than 2 million tons of bio-based plastic are produced each year compared to the 300 million tons of conventional plastic produced annually (European Bioplastics e.V., 2015). There are biodegradable as well as durable bio-based plastics depending on application. Important fields of application are bottles, packaging, catering utensils and technical applications (e.g. in cars, building materials) (Institute for Bioplastics and Biocomposites, 2015). Market forecasts indicate an above average growth of products made of durable bio-based plastic (Institute for Bioplastics and Biocomposites, 2016). Today's small production scales and industry's lack of experience with the production of bio-based plastic result in higher prices for these plastics. Furthermore, marketing of products made of bio-based plastic is hampered by consumers' lack of knowledge of bio-based plastic and scarce availability on the demand side (Iles and Martin, 2013).

According to Karana (2012), the application of bio-based plastic is particularly meaningful for products that emphasize the advantages and characteristics of bio-based plastic. Polymers made of biomass can be advantageous compared to conventional polymers due to the reduced levels of toxicity and the associated health hazards (Mülhaupt, 2013). A reduction of the negative impacts on human health and the environment from chemical products is generally desirable (Mohajan, 2011). In particular, products with contact to skin and foodstuff could benefit from the use of more natural, less toxic materials. Products which facilitate close contact with nature also seem to be appropriate for the use of natural materials. Consumers who regularly practice outdoor activities have a close relationship with nature (Maller et al., 2006). Dunlap and Heffernan (1975) first recognized that environmental concern is positively related to outdoor activities. According to Overvliet et al. (2016), consumers believe that natural materials are healthier and more environmentally friendly, which results in a preference for natural materials over synthetic materials. In this context, sports equipment made of bio-based plastic might be regarded as an alternative to products made of conventional plastic and therefore have the potential to reduce environmental pollution when compared to sporting equipment made of conventional plastic.

Due to the very limited use of bio-based consumer products, there have been few scientific studies about consumers' interest in such products. Sijtsema et al. (2016) investigated consumer perception of bio-based products and concluded that consumers

were unfamiliar with these products. However, consumers were still found to have positive as well as negative associations with bio-based products. Conducting focus group discussions in different European countries respondents mentioned environmentally friendly aspects of renewable resources. In addition, bio-based products were connected to naturalness and positive health aspects were mentioned in relation to fewer toxic chemical substances. On the other hand higher product prices were seen as a barrier and some respondents were skeptical about the absence of chemicals and toxins. The environmental advantages of bio-based plastics were also questioned to some extent and some respondents were worried about durability of bio-based products. Rumm (2016) also identified positive as well as negative associations regarding the environmental impact of bio-based plastics. Respondents generally believe that bio-based plastics are environmentally friendly, but they criticize cultivation of monocultures, competition with food crops and genetic engineering.

There are several studies from Germany and the US which have analyzed consumers' acceptance of various products made of bio-based plastic including e.g. cell phone cases, toothbrushes, sunglasses, plastic bags, plant pots and sand toys (Yue et al., 2010b; Barnes et al., 2011; Kurka, 2012; Behe et al., 2013; Kainz, 2016; Rumm, 2016; Scherer et al., 2017). None of these studies focused on sports equipment, despite the potential suitability of this industry for the substitution of products made of conventional plastic with those made of bio-based plastic. This substitution would address the discrepancy between the environmental concerns of consumers of sporting equipment and the lack of sustainability within the sports equipment industry.

In this study, consumers' interest in two sports equipment products made of durable bio-based plastic produced from plant oil was analyzed. Consumers who are interested in such products were distinguished from consumers who were less interested using two choice-based-conjoint (cbc) experiments and latent class analysis. A drink bottle made of bio-based plastic and a running shoe with a bio-based sole were selected as these products which have some connection with outdoor activities and nature. In the case of the drink bottle, the use of natural materials could potentially alleviate concern about toxicity resulting from the contact between conventional plastics and beverages. The selected products should embody the expected advantages of bio-based plastic. It was also analyzed which factors are suitable for differentiating between both groups, since this information is important for the promotion of sports equipment made of bio-based plastic and can be used by manufacturers to better target appropriate consumer groups. The following research questions were asked in this study:

- Are there consumer groups with different preferences for a drink bottle made of bio-based plastic or a running shoe with a bio-based plastic sole?
- Which preferences show those consumers who are interested in bio-based sports equipment, and those who are less interested?
- Which factors, including personal attitudes, values, environmentally friendly behavior in other areas, socio-demographic data and expectations of bio-based plastic, can be used to differentiate between these groups of consumers?

In the following chapter, the theoretical background of consumers' purchase decisions is summarized, with a focus on decisions relating to environmentally friendly products. In Section 3, the survey methods of this study and the statistical methods used for data analysis are presented. The results are reported in Section 4. The final chapter includes a discussion of the results, a comparison of these with the results of previous studies, a reflection on the applied methods and suggestions for future research.

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