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Biogenic product alternatives for children: Consumer preferences for a set of sand toys made of bio-based plastic

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ABSTRACT

Bio-based plastic is a potentially environmentally friendly alternative to conventional plastic, which is responsible for the exploitation of fossil fuel resources and environmental pollution. Currently, the market supply of bio-based plastic consumer products is very limited, largely due to higher prices for these plastics. Parents could be a promising target group for bio-based products, as it is assumed that they are specifically interested in environmentally friendly products and natural materials with less toxic substances. Thus, a choice based conjoint analysis was conducted to identify important product attributes and the preferred characteristics of a set of bio-based sand toys for children. 521 members of an online panel in Germany, who have children aged two to eight years, were interviewed. The number of pieces in the set of sand toys, the origin of raw biomass materials, the additives contained, price and three ecologically relevant product attributes were included in the choice experiment. The product price was the most important attribute with a contribution of 30% to the overall importance. Respondents clearly preferred products with environmentally friendly cultivated raw materials and did not accept biomass imports from outside of Europe. Additionally, a latent class cluster analysis was conducted in order to search for consumer heterogeneity. Four segments with eco-sensitive, price sensitive, origin sensitive and conventional plastic preferring respondents could be identified. The preference structure of the eco-sensitive and origin-sensitive respondents could be distinguished from the other respondents due to the greater importance they placed on ecologically relevant attributes and the origin of raw materials. Altogether, nearly two-thirds of all respondents belonged to these two consumer clusters who also accepted higher prices for bio-based products. Analysis of the attitudes of these clusters revealed a connection between ecological consumption and environmental awareness, nature relatedness, health consciousness and innovativeness, which confirms the findings of previous studies.

Keywords: Bio-based plastic; Biogenic toys; Consumer preferences; Choice experiment

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1. Introduction

The global consumption of more than 300 million tons of plastic every year has negative effects on the environment. The production of conventional plastics is associated with CO₂ emissions and relies on finite crude oil resources, which

is the raw material base. Additionally, the disposal of plastic products is linked to environmental pollution, as functional recycling systems for plastic waste have not been implemented in many countries. Therefore, plastic waste is polluting rivers, lakes and the oceans, and the negative impacts of micro-plastic substances in the soil is also an emerging issue (Moore, 2008; Rochman et al., 2013). These problems

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are aggravated by the fact that discarded plastic persists in natural ecosystems for often more than 100 years and contains a lot of toxic substances (Philp et al., 2013).

An alternative to petroleum-based plastic is the usage of bio-based plastic. According to European Bioplastics e.V. (2015b), bio-based plastic is partly or completely derived from biomass. The property of biodegradation is not preconditioned, meaning that 100% bio-based plastic materials may be not biodegradable. The raw material base of bio-based plastics can consist of a variety of different plants. Bioethanol made from sugar cane, starch from corn or potatoes, cellulose and plant oil are all possible alternatives to mineral oil presently used on the industrial scale. The environmental impact of bio-based plastics is mainly influenced by the cultivation of the plants that are used as raw materials. In this context, cultivated plant species, cultivation intensity and above all former land use play a decisive role. Piemonte and Gironi (2011) showed that land use changes to cultivate raw materials for the production of bio-based plastic can have an extremely negative impact on the environment, which clearly outweighs ecological advantages of bio-based plastic over plastic made of petroleum. Moreover, Álvarez-Chávez et al. (2012) concluded that bio-based plastics are not environmentally friendly by itself as cultivation intensity and cultivating genetically engineered plants as well as the usage of additives to improve characteristics of bio-based plastic negatively influence related products. Thus, the entire life cycle of these materials has to be considered evaluating the environmental impact of existing and new developed bio-based plastics. Barker and Safford (2009) summarized the different sources of plant raw materials and the environmental advantages and disadvantages of bio-based plastics derived from them.

In 2014, less than 2 million tons of bio-based plastic were produced globally (European Bioplastics e.V., 2015a). Considering that 300 million tons of conventional plastic are produced annually, the production of bio-based plastic accounts for less than 1% of the overall plastic production worldwide (Babu et al., 2013). Due to the advantages and widespread application of plastic, plastic production is expected to increase further in the future (Philp et al., 2013). As bio-based plastic currently has a very small market share, its production is predicted to increase at a greater rate. However, exact future estimations of production are difficult because important barriers like the high costs, small production scales and lack of information need to be overcome before bio-based plastics can further penetrate the market. In addition to that, bio-based plastics have to fulfill the same performance specifications as conventional plastic and those bio-based plastics, which cannot meet these performance specifications, are not promising considering an intensified substitution of conventional plastic (Shen et al., 2009).

The current demand for bio-based plastic is limited as consumers are not familiar with these materials because there is only a small range of products already on the market. Iles and Martin (2013) identified scarce availability and lack of product information as being problems for consumers who look for bio-based plastic products. This study investigates consumer preferences regarding a bio-based set of plastic sand-toys. A potential benefit of using natural materials for a product like this is that parents seem to be particularly interested in ecologically friendly products, especially if they are in contact with their children (Laroche et al., 2001). This might be due to the fact that in recent years there were some scandals in the media and product recalls due to toxic substances

in toys (Becker et al., 2010). As a consequence, it is assumed that the usage of more natural materials is preferred for products that are in close contact to children. The importance of individual product attributes and consumers' utilities of product characteristics is analyzed for the sand toys using conjoint analysis within this study. Although currently there are not many products made of bio-based plastic on the market, there are a lot of options to produce bio-based plastic considering e.g. biomass raw materials used, cultivation of these raw materials and the usage of additives. Furthermore, pricing is a relevant issue from a consumer perspective as bio-based plastic is more expensive than conventional plastic. A potential substitution of conventional plastic by bio-based plastic and a further market penetration of such products will be influenced by consumers' preferences amongst other factors. To learn about consumers' expectations with regard to product concepts of bio-based sand toys, we simulate a buying decision and analyze their preferences for differing product characteristics. In this context choice based conjoint analysis is an appropriate method to analyze preferences for individual attribute characteristics including different product price levels of actual or hypothetical products. This methodology was used in previous studies for similar targets (Bask et al., 2013; Rokka and Uusitalo, 2008; Sammer and Wüstenhagen, 2006; Sonnenberg et al., 2014).

In a further step individual consumer segments with similar preferences are identified within the scope of this study as consumers' preferences in particular to new product concept often tend to be heterogeneous. Thus, the identification of individual consumer groups with similar preferences and the size of these groups can contribute to identify appropriate target groups and to estimate the market potential of sand toys made of bio-based plastic.

Section 2 gives an overview about the findings of previous studies concerning pro-environmental behavior of parents. Section 3 describes the development and implementation of the choice based conjoint analysis. In Section 4, the results of the conjoint analysis and latent class cluster analysis are presented. Finally, the results are discussed in Section 5 including a critical reflection on the method applied and some suggestions concerning future studies.

2. Literature overview (Pro-environmental behavior of parents)

Some studies have been conducted which investigate parents' preferences and willingness to pay for eco-friendly products. Above all, consumers with young children seem to be sensitive to environmental issues and to worry about toxic ingredients of products. Laroche et al. (2001) identified consumers, who were willing to pay more for environmentally friendly products, specifically consumers with children. Women were overrepresented in this group. Larsson et al. (2010) argued that the children's influence on their parents' decisions is neglected in the discussion about ecological consumption. They emphasized that children have an influence on their parents' purchases decisions in relation to products made for children.

Gam et al. (2010) analyzed the willingness of mothers to purchase organic cotton clothing for their children. The authors concluded that there was not a general willingness to pay premium prices for organic cotton clothes, whereas some consumer groups preferred organic cotton clothes. These consumers were influenced by their environmental concerns

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