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Consumer acceptance of Wood-Polymer Composites: a conjoint analytical approach with a focus on innovative and environmentally concerned consumers

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ABSTRACT

Wood-Polymer Composites (WPCs) can contribute towards resource efficiency as they mainly consist of wood by-products and/or waste materials. The eco-innovative materials represent a hybrid solution on the 'two-evils' continuum' constituted by the competing materials of wood and plastics; the former being too expensive and resource consuming in mass consumption, the latter cheap but environmentally hazardous. However, consumer acceptance of WPCs is questioned due to the merger of components consumers perceive as being contradictory (wood and plastics). Additionally, it is discussed whether consumers' innovativeness enhances WPC acceptance, while eco-friendly consumers may reject WPCs because of environmental concerns related with the synthetic components.

To determine the potential market for products made of eco-innovative materials, two German-language online studies (n = 198, n = 357) were created to examine consumer acceptance of WPCs in relation to the competing materials. Study 1 introduced a 3 (material: wood, WPC, plastics) × 2 (appearance: wooden or synthetic) within-subject design. Consistent with the expectations, study 1 showed a clear preference for wood over plastics based on a convenient sample. WPCs remained in the centre position, even for environmentally concerned consumers. Study 2 was conducted to replicate the findings with a representative sample. It additionally considered consumer innovativeness and included further product categories. WPCs only slightly deviated from the centre position in study 2. Mostly important, study 2 proved that the higher the environmental concern and the innovativeness of consumers, the more WPCs were accepted. When taken together, the results point to a greater WPC market than previous research had indicated. In general, premature concerns about innovative materials can be prevented by consumer acceptance studies examining the new materials' position in a surrounding 'multi evils' continuum'.

1. Introduction

As raw materials and energy resources become scarce, innovative strategies realising efficient raw material use are required (Crabbé et al., 2013). Within the past few years, suppliers and retailers have significantly invested in the development of green products[1] (Crabbé et al., 2013; Gleim et al., 2013; Lin et al., 2013). These products are commonly referred to as eco-innovations, meaning innovative products which are more eco-friendly than conventional alternatives (Jansson, 2011). Eco-innovations carry various potentials: Besides a diverse range of environmental benefits and cost-savings because of less resources being used, eco-innovations can function as a differentiation strategy and are linked to competitive advantage (Crabbé et al., 2013; Lin et al., 2013; Medeiros et al., 2014). This implies that the identification of target groups that are interested in eco-innovations and the strategies for how to address these segments become important for the marketing of eco-innovative products.

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[1] The terms 'green' and 'eco-friendly' are used interchangeably throughout the article.

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An important precondition of eco-innovations' market success seems to be consumer awareness of eco-friendly purchase behaviour as a means of (ensuring or contributing towards) environmental protection, human health, and the responsible allocation of resources (Chao et al., 2012; Crabbé et al., 2013; Gleim et al., 2013; Grimmer and Bingham, 2013; Kanchanapibul et al., 2014). However, green products still represent a comparatively lower market share than optimists had suggested (Gleim et al., 2013; Lin and Huang, 2012; Rex and Baumann, 2007; Tseng and Hung, 2013). Given that attitudes do not necessarily translate into behaviour, it is essential to empirically examine consumers' purchase intention for eco-innovations (Ozaki, 2011).

Wood-Polymer Composites (WPCs) are such a group of eco-innovative materials, showing the potential to contribute towards more efficient resource utilisation (Teuber et al., 2015). WPCs exhibited a worldwide market growth in the last decade, which is predicted to further increase within the next few years (Carus et al., 2008; Eder and Carus, 2013). When investigating eco-innovations such as WPCs, the pro-environmental attitudes and the innovativeness of consumers can be the most important moderators of acceptance (e.g. Jansson, 2011; Lin and Huang, 2012). Nonetheless, this group of materials is unknown to many customers and the consumer acceptance is nearly unexplored (Haider and Eder, 2010; Weinfurter and Eder, 2009). The present article analyses consumer acceptance of WPCs in relation to two traditional materials. On the one hand, WPC acceptance is compared with solid wood, which is more expensive than WPCs for several applications and also resource consuming in mass consumption. Many by-products emerge during the production of goods consisting of solid wood which also require a material utilisation to improve resource efficiency, however, these by-products are still often directly used for energy (Carus et al., 2008). On the other hand, traditional full plastics are perceived as a cheap material but environmentally hazardous if they are based on fossil fuels.

2. Literature review

2.1. Consumers' green purchasing behaviour

A considerable amount of literature has been published on green consumer behaviour, primarily investigating consumer acceptance of fast-moving consumer goods (FMCG). Numerous studies in this domain refer to consumers' intention to buy organic food (e.g. Marette et al., 2012; Onozaka and McFadden, 2011; Vermeir and Verbeke, 2008; Yue et al., 2009). The acceptance of detergents and cosmetics (e.g. Lin and Huang, 2012; Luchs et al., 2010), green energy (e.g. Diaz-Rainey and Ashton, 2011; Hartmann and Apaolaza-Ibáñez, 2012; Ozaki, 2011; Scarpa and Willis, 2010), and recycled and remanufactured products (e.g. Essoussi and Linton, 2010; Michaud and Llerena, 2011) has been explored. Most of the studies suggest an overall consumer acceptance of green FMCG. Thereby, various drivers of eco-friendly consumer behaviour are analysed with (environmental) attitude (e.g. Diaz-Rainey and Ashton, 2011; Hartmann and Apaolaza-Ibáñez, 2012; Leonidou et al., 2010; Ozaki, 2011; Vermeir and Verbeke, 2008), values (e.g. Lin and Huang, 2012; Urien and Kilbourne, 2011; Vermeir and Verbeke, 2008) and socio-demographic characteristics (e.g. do Paço and Raposo, 2009; Park et al., 2012) as the most often considered determinants. Attitude and values turn out to be better predictors than socio-demographic characteristics, with the latter showing contradictory findings (Diamantopoulos et al., 2003; Diaz-Rainey and Ashton, 2011; Rex and Baumann, 2007; Zhao et al., 2014). The value that consumers attribute to eco-friendly products is often assessed by the additional willingness to pay (WTP), i.e. the surcharge consumers would spend for a green product compared to a conventional alternative. While some studies reveal the existence of a marginal or even non-existent WTP (Michaud and Llerena, 2011; Scarpa and Willis, 2010), others suggest a substantial surcharge for green products (Krystallis and Chryssohoidis, 2005; Marette et al., 2012).

Nonetheless, the drivers of green consumer behaviour and the WTP can vary between different product categories and even within a category (Essoussi and Linton, 2010; Krystallis and Chryssohoidis, 2005; Luchs et al., 2010; Yue et al., 2009). While many studies investigate consumer acceptance of everyday products, only a few consider durable goods characterised by high purchase involvements (Achabou and Dekhili, 2013; Davies et al., 2012) such as wood-based products. The few existing consumer studies about wood-based products mainly examine the effects of sustainable forest management certification and suggest that consumers prefer buying certified wood products and show an additional WTP for them (e.g. Aguilar and Vlosky, 2007; Anderson and Hansen, 2004; Cai and Aguilar, 2013b; Husted et al., 2014; Thompson et al., 2010; Vlosky et al., 1999). Also for certified wood products, attitudes are identified as important drivers of the purchase decision, whereas socio-demographic characteristics have low predictive power (e.g. Husted et al., 2014; Kalafatis et al., 1999; Thompson et al., 2010). Overall, studies about green consumer behaviour suggest that empirical investigations are not superfluous as consumer acceptance of green products is dependent on product category and the investigated materials. Additional studies are therefore required to assess consumer acceptance of new, eco-friendly materials and products. For identifying the predictors of consumer acceptance, the focus should be on attitudes and personality characteristics.

2.2. Consumer acceptance of WPC products

Research about consumer acceptance of wood-based products primarily concerns solid wood. Innovative composite materials such as WPCs must be examined as well, because they become increasingly important for efficient resource utilisation. The concept of WPCs shows the timber industry a new way for a production with almost no waste: WPCs allow for new fields of application for the material utilisation of by-products and waste materials from the wood processing and agricultural industry (Carus et al., 2008; Teuber et al., 2015). These fields of applications which, for example, rely on the material's three-dimensional formability, cannot be covered by traditional materials relying on wood by-products such as particle boards and pulp and paper. As wood is mostly the main component of WPCs (up to more than 80%) (Carus et al., 2008; Klyosov, 2007), WPCs have a potential to minimize wood waste and prevent a direct energetic utilisation of by-products. Additionally, the wood components of a WPC could also be part of a later stage of cascading utilisation. For example, wood-based products (solid wood products, flake boards, fibre boards etc.) can be recycled and used for WPC production (Krause et al., 2013). The wood component not only influences the physical and mechanical properties of the material, but also the visual properties (Carus et al., 2008): Products consisting of WPCs could exhibit a surface similar to wood or to plastic products.

In addition to the potential of fostering resource efficiency, evaluating the eco-friendliness of WPCs primarily depends on WPC composition and on a comparison with the material(s) replaced by WPCs. WPC composition highly impacts the eco-friendliness so that WPCs may be considered as fully environmentally sound materials if all WPC components show a high eco-friendliness (Teuber et al., 2015). Based on the review of life cycle assessments (LCA), Teuber et al. (2015) conclude that for most applications, WPCs have a higher environmental impact compared with

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