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COMPARING CONSUMERS' PRODUCT CARE IN ACCESS AND OWNERSHIP MODELS

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Abstract

Product-service systems are circular business models that can potentially extend product lifetimes and reduce resource consumption. However, consumer product care is crucial in these business models. We explore consumer product care of newly bought, second-hand, and accessed bicycles and washing machines through an online survey (n = 212). Our analysis shows lower consumer product care of accessed products compared to ownership. Three strategies could address this; design for care, design to reduce the need for care, contractual conditions to stimulate care or penalise the lack thereof.

Keywords: business models, circular economy, design for sustainability, product-service systems (PSS), sustainable consumer behaviour

1. Introduction

Sustainability has emerged as a major theme and aim in the design field. This can be understood as a response to the current sustainability crisis and an acknowledgement of the role of design in it. Significant research effort has been spent on designing sustainable products (e.g., [Lofthouse, 2006](#); [Boks and McAlloone, 2009](#); [Cooper, 2017](#)). Soon it transpired that consumers have a huge impact on the sustainability of products through their use and behaviour patterns. Consequently, strategies to design for sustainable behaviour were developed (e.g., [Wever et al., 2008](#); [Bhamra et al., 2011](#)). Researchers then realised that focusing on products alone missed many sustainable solutions and the focus shifted towards the design of sustainable product-service bundles ([Roy, 2000](#); [Mont, 2004](#)). Currently, the circular economy integrates these approaches and aims to deliver a sustainable economic system through circular business models. However, even well-designed business models can fall short of their potential because of rebound effects; consumers might use products or services differently or more than intended ([Hertwich, 2005](#); [Zink and Geyer, 2017](#)).

Product care describes all activities initiated by consumers that prevent shortening of products' lifetimes and thus influence the length of the useful life of products. It thus influences the sustainability of consumption through circular business models and rebound effects ([Tukker, 2004](#); [Agrawal et al., 2012](#); [Bardhi and Eckhardt, 2012](#); [Kjaer et al., 2019](#)). For example, access-based product-service systems (AB-PSS) are business models that allow consumers to use products' functionalities without purchasing the products. The providing organisation allocates and maintains the products, thereby potentially increasing products' utilisation and lifetimes. The level of consumer product care in AB-PSS is unclear despite frequently being noted as important consideration in previous literature. Some authors suggest that consumers are more careful with accessed product because they feel more restricted in their use or

are worried about potential consequences of usage signs (Tukker, 2015; Cherry and Pigeon, 2018). Other authors found that consumers behave more recklessly with accessed products as they do not bear the responsibility and risk of wear and tear, and hidden damages (Bardhi and Eckhardt, 2012; Schaefer et al., 2016).

We elucidate consumers' product care of owned and accessed products by addressing the following research question: How do circular business models influence consumers' product care levels? To explore this, we conducted an online survey on owned and accessed washing machines and bicycles. These two products both have a high functional value and were selected because product care can extend their lifetimes. Further, both products can be bought new, second-hand, and accessed in the Netherlands, where we collected the data. Our findings demonstrate that product care is strongly influenced by the chosen business model and that it is significantly higher in ownership than in AB-PSS. Therefore, we provide a deeper understanding of the mechanisms between consumers, products and business models in a circular economy. Product and service designers can use the insights of this study to design AB-PSS and other circular business models.

2. Background

2.1. Product care

Product care is defined as activities initiated by consumers that prevent shortening of products' lifetimes or even extend products' lifetimes (Ackermann et al., 2018). It includes activities such as repair and maintenance, but also careful handling, and the use of adequate accessories. So far, research of product care has mainly focused on the design of everyday products, for which several design strategies have been proposed and evaluated (Ackermann et al., 2019). Some of these strategies focus on the facilitation of product care by informing and enabling the consumer. However, prior research has shown that the ability alone does not lead to product care. Instead, a value-action gap can be observed; consumers realise the necessity to take care of their products, yet they fail to include these activities in their daily lives (Ackermann et al., 2018).

Due to this observation, the design strategies for product care include approaches that focus on increasing consumers' motivation. For example, social connections that are based on shared experiences of product care can increase consumers' motivation. Shared ownership has also been mentioned as a motivator for care activities, because people experience social pressure to take care of the products. Although this strategy refers to products being owned by multiple consumers at the same time, such as a coffee machine in a shared flat, it might also be relevant for AB-PSS, where consumers might at least consider that other people will use the product later. The next two strategies, appropriation and reflecting, concern the consumer-product relationship; if a product is highly adapted to a consumer's needs or is associated with cherished memories, the consumer will probably take better care of it. However, personalisation is currently limited in AB-PSS and it is unclear to what extent users perceive psychological ownership or emotional attachment (see e.g., Mugge, 2007) to accessed products (Tunn et al., 2019). The design strategies control and awareness are both serving as triggers to make consumers aware of the need for product care. While awareness is a subtler approach, such as push notifications or a slow decrease in performance, the product takes the initiative within the control strategy. For instance, a coffee machine could automatically open the coffee grounds tray when it needs to be emptied or stop working entirely until maintained appropriately. The final strategy describes the communication of positive consequences that can be expected by taking care of the product and negative consequences if it is not being cared for.

Product care research so far has focused on products that consumers own, or that are shared in a very defined environment, such as a shared flat. Research on how a lack of ownership influences product care and which design strategies could promote product care in alternative business models is still missing.

2.2. Design of sustainable AB-PSS

AB-PSS are services that grant consumers access to products' functionalities for a fee, such as leasing, renting, and commercial sharing (Mont, 2002; Tukker, 2004). These services have a sustainability

potential and therefore AB-PSS design has attracted interest during the last two decades. Roy (2000) distinguished between AB-PSS that maximises product utilisation during products' lifetimes and AB-PSS that extend products' lifetimes. The sustainability potential of AB-PSS has been intensely discussed and researched (e.g., Roy, 2000; Tukker, 2004; Cook, 2004; Matschewsky, 2019).

Agrawal et al. (2012) argued that leasing of durable products, such as washing machines, only contributes to sustainability if product durability is improved compared to ownership. Tukker (2004) largely followed this line of argumentation and emphasised that consumers' careless use of non-owned products might outstrip the benefits of professional maintenance and repair in AB-PSS. An often referred to example is bicycle sharing, although it could in theory reduce the need for cars and encourage use of public transport by solving the last mile problem, in practice these systems might increase impacts if they substitute walking and use of public transport (Fishman, 2016). In addition, shared bicycles are frequently abused by users as well as non-users. This can result in extremely short product lifetimes and thus reduce sustainability compared to ownership. Overall, it is now widely agreed that AB-PSS have a sustainability potential but need to be purposefully designed, assessed, and adjusted to realise their sustainability potential (Mont, 2004; Kjaer et al., 2019).

2.3. Product care in AB-PSS

AB-PSS differ from ownership in the consumer-product relationship and in the rules that shape this relationship (Bardhi and Eckhardt, 2012). For example, it has been suggested that using products through AB-PSS does not lead to product attachment (Catulli et al., 2017a). We study long-term use AB-PSS because product care falls into the use phase which is highly relevant when consumers obtain exclusive access to a product for a long period (Tunn et al., submitted). In AB-PSS, the consumer-product relationship is generally based on accessing the functional value of products; the relationship between users, products and AB-PSS provider is governed by contracts rather than mutual trust. Standard maintenance and repair are generally part of the service of the AB-PSS provider; however, AB-PSS users are usually expected to take a reasonable level of care of the accessed products and to report issues. For example, the Dutch companies Swapfiets (2019) and Homie (2019) offer long-term access to bicycles and washing machines respectively. While the companies are responsible for repair and maintenance of the provided products in these long-term use AB-PSS, users are also expected to take care. The Swapfiets (2019) terms and conditions state the expectation that "the Rental Customer makes normal use of the Bicycle and takes due care of the Bicycle" and the service contract of Homie (2019) demands customers "to take good care of the washing machine".

Baxter and Childs (2017) argued that the frequent dispossessing of products in AB-PSS hinders consumers to perceive psychological ownership and prevents product care. Consumers frequently encounter contamination caused by careless or even reckless behaviour of other AB-PSS users (e.g., Bardhi and Eckhardt, 2012; Durgee and O'Connor, 1995). Indeed, many car-sharing users admitted abusing the cars and stated they felt no responsibility for potential long-term damages as those were the car sharing providers' responsibility (Bardhi and Eckhardt, 2012; Schaefers et al., 2016). In stark contrast, a few studies suggest that consumers treat accessed products more carefully than owned ones (e.g., Ozanne and Ozanne, 2011; Baumeister and Wangenheim, 2014) or worry more about accessed products (Lidenhammar, 2015; Catulli et al., 2017b; Cherry and Pidgeon, 2018). However, this might be to avoid financial repercussions rather than because of a feeling of responsibility for the state of the product (Ozanne and Ozanne, 2011). Product care in AB-PSS has been largely explored through qualitative studies, and literature so far is inconclusive about actual levels of product care.

2.4. The relationship between consumers, business models and product care

In this study, we take a business models perspective on consumer product care. For consumers, the relationship with the product is the main difference between access and ownership models. We compare consumers' product care in these models and further differentiate ownership by whether products were bought new or second hand. Second-hand products and long-term access are both consumption modes based on circular business models and facilitate product reuse. While consumers can purchase second-hand products through different business models, we assume that these lead to similar product care behaviour during the use phase. We found no quantitative study that provides a

detailed understanding of consumers' product care or the lack thereof across different business models. We thus address the research question: How do circular business models influence consumers' product care levels?

Based on extant literature on consumer product care and AB-PSS, a conceptual model was developed to explain levels of consumer product care for a) owned products that were bought new, b) owned products bought second-hand, and c) long-term accessed products (see Figure 1). In addition to the effect of business models on product care (1), the model also includes product-related and person-related variables. Product-related variables comprise characteristics of the product and the consumer-product relationship. These include consumers' perception of the quality, satisfaction, attitude, involvement, and usefulness of the product as well as the disposal tendency and (emotional) attachment to the products. These variables were included because previous research has shown that the more positive a product is perceived by a consumer, the more he/she will take care of it (Mugge et al., 2005). Person-related variables describe attitudes and characteristics of the consumer that motivate him/her to consume in a conscious and environmentally friendly way. It includes frugality, environmental concern, long-term orientation and use innovativeness, which describes the tendency to use and alter products in a creative way. As previous research (Ackermann et al., 2018) has shown, people vary greatly in their product care behaviour, and these individual traits seem to play a crucial role. However, we assume that these person-related variables might not only affect product care directly, but might also influence the decision to buy a product new or second-hand or to select a long-term access model. Therefore, our model includes the effect of business models on product-related variables (2) and the effect of product-related variables on product care (3). Further, the impact of person-related variables on business model choice (4) as well as on product care (5) are included in the model.

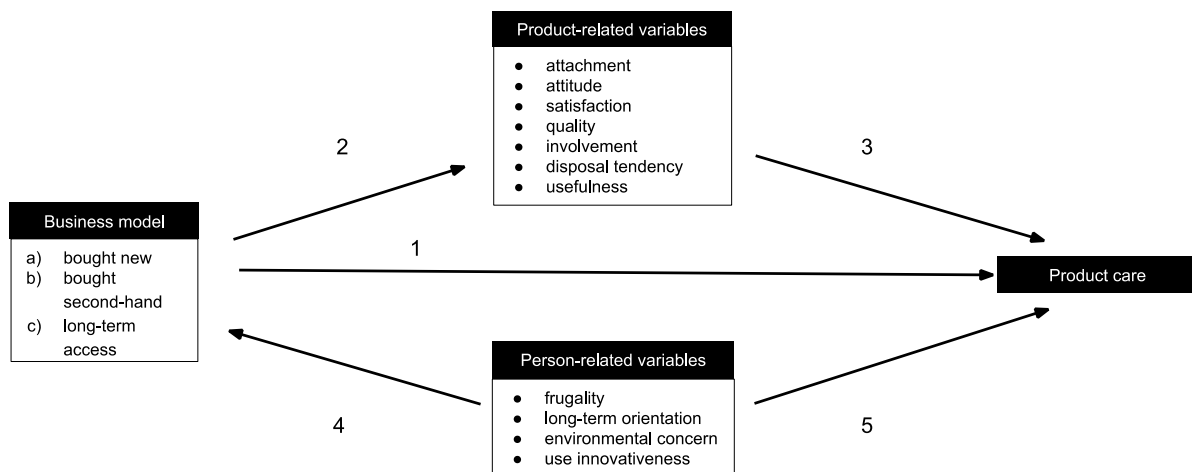


Figure 1. Conceptual model of factors influencing consumers' product care

Based on these assumptions, we defined the following hypotheses:

- H1: The business model influences the level of product care.
- H2: The business model influences the product-related variables.
- H3: The product-related variables influence the level of product care.
- H4: The person-related variables influence the choice of business model.
- H5: The person-related variables influence the level of product care.

3. Method

3.1. Survey

One survey with two versions focussing on respondents' everyday bicycle or washing machine was created. First, respondents were asked about their mode of consumption of that product; whether they bought it new, second-hand, use it through a long-term AB-PSS, or another mode of consumption. Subsequently, several established scales were used to measure respondents' values, their perception of

the product, and their level of product care for the products under investigation. The product care scale is based on extensive research by one of the authors (Ackermann et al., submitted). We further included and tested 6 items from the environmental concern scale (Kilbourne and Pickett, 2008), 8 items from the frugality scale (Lastovicka et al., 1999), 9 items from the use innovativeness scale (Girardi et al., 2005), 8 items from the long-term orientation scale (Bearden et al., 2006), 5 items from the attitude scale by Ahluwalia and Burnkrant (2004), 3 items from the usefulness scale by Cox and Cox (2002), 3 items from the satisfaction scale (Crosby and Stephens, 1987), 4 items from the attachment scale (Schifferstein and Zwarthuis-Pelgrim, 2008), 4 items (as used in Bower and Landreth, 2001) from the involvement scale (Zaichkowsky, 1985), 3 items from the quality scale (Grewal et al., 1998), 4 items from the disposal tendency scale (Mugge, 2007), and 10 items from the product care scale. For the attitude, usefulness and satisfaction scales, a 7-point semantic differential was applied. All other variables were assessed with 7-point scales (1 = strongly disagree to 7 = strongly agree).

3.2. Participants

The implementation and adoption of AB-PSS is still rare (e.g., Tukker, 2015; Tunn et al., 2019) which makes it difficult to reach a large number of users. We thus resorted to recruiting a non-probability sample through social media (Stern et al., 2017). Links to the survey were posted in social media groups for housing, second-hand furniture, and bicycles to reach consumers using the business models under investigation. Business models for both products were defined as bought new ($n = 52$), bought second-hand ($n = 94$), and long-term access ($n = 66$). The sample comprises Dutch respondents and expats living in the Netherlands. However, the sample composition should not impact our results because the researched products primarily provide functional value and are both widely used in the Netherlands, irrespective of cultural background. Of the 306 started surveys 166 were completed (54%) and 212 surveys were sufficiently completed to be included in the analysis. Of the respondents 75% were aged 30 or younger, with 58% female respondents. Respondents could enter a prize draw to win a €10 gift voucher.

4. Results

The analysis showed that the frequency of care activities correlates with product care measured by the product care scale on a high level ($r = .51, p < .01$). The frequency in which respondents conduct product care activities differs among the three business models. For example, 14% of respondents who bought new bicycles, 23% of respondents who bought second-hand bicycles, and 69% of respondents with long-term access to bicycles, indicated that they never oil the bicycle chain. Similarly, 25% of respondents who bought new washing machines, 20% of respondents who bought second-hand washing machines, and 59% of respondents with long-term access to washing machines, reported that they never change the filter.

A Wilcoxon rank sum test revealed that product care for bicycles and washing machines does not differ significantly ($W = 5669, p = 0.5678$). In addition, a one-way ANOVA for dependent samples demonstrated that the chosen business model predicts product care for bicycles ($F = 5.936, p < .05$) as well as for washing machines ($F = 4.109, p < .05$), with the lowest product care level for the accessed products and the highest level for products that were bought new. This result was explored in more detail by dividing the participants according to the business models. In these three groups product care also did not differ significantly between the two products. Thus, we decided to combine the data of bicycles and washing machines for the subsequent analyses. For the analysis of the product-related and the person-related variables, we calculated the means for each scale, with disposal tendency being recoded so that a high value represents a low tendency to dispose of the product. The hypotheses were tested through regression analysis, using the psych package of RStudio 1.1.463. The three business models were represented by dummy variables. The results are presented below and summarised in Figure 2.

H1: The business model influences the level of product care.

A one-way ANOVA revealed that the business model has a significant influence on product care ($F = 11.01, p < .01$). Subsequent planned contrasts demonstrated that buying second-hand products or using access products significantly decreased product care ($t(209) = -2.15, p < .05$) compared to products that were bought new. Further, product care for access products is significantly lower than for second-hand products ($t(209) = -3.10, p < .01$). Overall, accessed products are taken care of the least ($M_{\text{access}} =$

3.78±1.44), while products that have been bought new ($M_{\text{new}} = 4.56 \pm 1.34$) are being cared for the most. Product care for second-hand products ($M_{\text{second-hand}} = 4.43 \pm 1.31$) lies in between these values.

H2: The business model influences the product-related variables.

Our data shows that the business model has a significant effect on attachment ($t(165) = -2.73, p < .01$) and disposal tendency ($t(165) = -2.18, p < .05$). This means that consumers have a high tendency to dispose products they do not own ($M_{\text{access}} = 4.71 \pm 1.00$); consumers might quit the access model, or exchange the accessed product. Consumers' tendency to discard second-hand products ($M_{\text{second-hand}} = 4.89 \pm 1.28$) is slightly lower than for accessed products and even lower for products they bought new ($M_{\text{new}} = 5.24 \pm 1.19$). Further, consumers are more attached to washing machines and bicycles they bought second-hand ($M_{\text{second-hand}} = 4.05 \pm 0.97$) than to those they bought new ($M_{\text{new}} = 3.66 \pm 0.95$) or to which they have long-term access ($M_{\text{access}} = 3.16 \pm 0.99$). The evaluations of quality, attitude, involvement, satisfaction and usefulness are not significantly influenced by the business model, which means that a positive evaluation of products is also possible for second-hand and accessed products.

H3: The product-related variables influence the level of product care.

All tested product-related variables influence product care on a significant level (attachment: ($t(165) = 4.84, p < .01$); attitude: ($t(168) = 3.99, p < .01$), disposal: ($t(165) = 3.10, p < .01$), involvement: ($t(168) = 4.74, p < .01$); quality: ($t(165) = 2.35, p < .05$); satisfaction: ($t(168) = 4.61, p < .01$); usefulness: ($t(168) = 2.53, p < .05$)). In general, the more positive a product is perceived by the consumer, the more he/she will take care of it. This holds true for more objective variables such as quality and usefulness, but also for emotional variables such as attachment, which is in accordance with previous research (Mugge et al., 2005).

H4: The person-related variables influence the choice of business model.

Effect estimates for the person-related variables on the business models were on a significant level for environmental concern ($t(172) = 3.05, p < .01$) and for frugality ($t(172) = 2.08, p < .05$), but not for long-term orientation ($t(172) = 0.08, p = .94$) and use innovativeness ($t(172) = 1.29, p = .20$). This means that consumers decide to use a long-term access model for reasons of sustainability, but also because they expect a financial advantage of this business model compared to buying the product.

H5: The person-related variables influence the level of product care.

Long-term orientation ($t(187) = 3.95, p < .01$), frugality ($t(187) = 3.07, p < .01$), and use innovativeness ($t(187) = 4.58, p < .001$) have a significant effect on product care. Use innovativeness describes the tendency to use products in a creative way, to find new purposes for existing products and to change products according to one's needs. The relevance of use innovativeness can be explained by Fogg's (2009) behaviour model; to conduct a certain behaviour, motivation and ability are needed. Consumers with a high level of use innovativeness are often very hands-on, and experienced in craftsmanship, product care activities are thus easy to conduct for them. Long-term orientation on the other hand serves as a strong motivator for product care as one part of a more sustainable way of consumption.

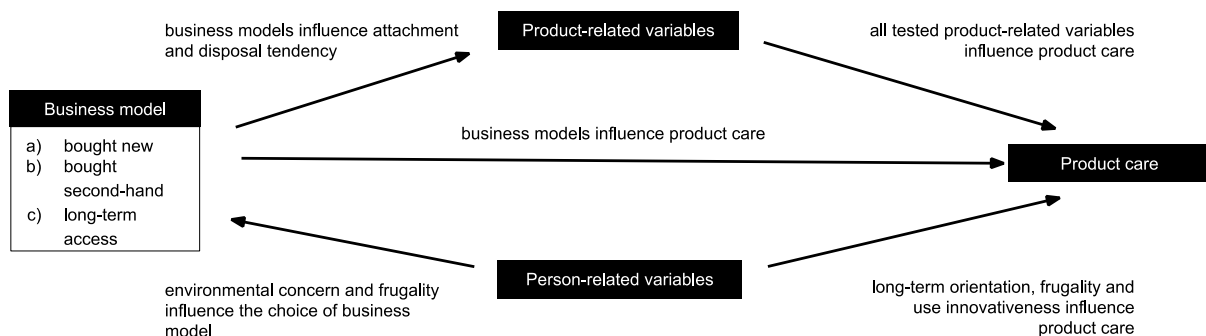


Figure 2. Overview of the significant effects found during the regression analysis

Following the regression analysis, a path analysis was conducted. The model was built with product care as the dependent variable and the choice of business model as the independent variable. The product-related variables as well as the person-related variables were tested as moderator and mediator variables. However, no significant moderator or mediator effects were found. We can thus conclude that the above-mentioned direct effects estimates are suitable to describe our model.

5. Recommendations for designers

Our results show that consumer product care differs significantly between business models that provide ownership and access. Although care levels for products bought second-hand were slightly lower than for products that respondents had bought new, this difference was not significant. From the results we deduct insights and recommendations for product and service designers. Three strategies could help address lower levels of product care in AB-PSS, namely design for care, design to reduce the need for care, and contractual conditions to stimulate care or penalise the lack thereof.

First, products placed in long-term AB-PSS should be designed to increase consumer product care. This could be achieved by transferring the design strategies to stimulate product care for owned products introduced earlier in this paper to AB-PSS. For example, the informing and enabling strategies could be used to make product care easy for AB-PSS users and appropriation could be stimulated by designing elements into AB-PSS to create attachment, for instance, temporarily customising the products (Tunn et al., 2019). These strategies could increase product care and might also discourage frequent replacement of accessed products, thereby mitigating potential rebound effects and helping AB-PSS providers to ensure that the AB-PSS are financially viable. In general, providers of long-term AB-PSS should make it as easy as possible for users to maintain and repair the products. This might be realised through an accompanying service so that consumers do not have to organise care activities themselves or by providing users with the appropriate tools and means. However, it is again important to ensure that offered repair and maintenance services are not overused or lead to abuse of the products.

Second, product designers should consider the business model through which the products will be used in the design phase and design for the anticipated level of product care. For example, products for long-term AB-PSS should be designed to be especially durable, easy to repair, and maintain (see e.g., van Nes and Cramer, 2005), of high quality, sturdy, and long-lasting to withstand poor care. Thereby, designers can ensure that AB-PSS actually improve sustainability (see Agarwal et al., 2012; Kjaer et al., 2019). These sustainability benefits should be communicated to consumers because environmental concern significantly influences consumers' business model choice.

Third, consumer product care should also be considered when developing business models. Business models can be implemented and designed to encourage consumers to take care of products. For example, by offering incentives such as a financial refund if the consumer returns the product in a good state. Alternatively, the expected level of product care can be specified in the contract between the AB-PSS provider and the users, penalising users if they do not take sufficient care of the products.

6. Discussion and conclusions

6.1. Summary of findings and contribution

The analysis of the collected consumer survey data showed that the levels of consumers' environmental concern influence their choice of business model. Business models impact consumers' attachment to products which in turn influences product care. Further, consumers' long-term orientation and use innovativeness positively influence product care. In addition, the business model influences consumers' disposal tendency which influences the sustainability of long-term use AB-PSS. If AB-PSS encourage consumers to use the service more or increase the frequency of product replacement this can lead to rebound effects outweighing the sustainability benefits (Hertwich, 2005; Zink and Geyer, 2017), in this case impacts of logistics, cleaning and potentially remanufacturing of products for the next user can. AB-PSS may even heighten consumers' expectations regarding the state of the product so that no traces of use are acceptable and products and components become obsolete sooner than in ownership. Business models influence the product-consumer relationship.

Circular business models such as AB-PSS change the consumer-product relationship often preventing product attachment (Baxter and Childs, 2017) and as our findings demonstrate result in lower levels of product care. Our results suggest that the ‘soft’ benefits of ownership that enhance product care, such as product attachment, are lacking in AB-PSS. However, this is not the case for all circular business models; consumers were even more attached to products they bought second-hand than to products bought new and levels of consumer product care were nearly the same.

So far, research on product care in AB-PSS has been largely qualitative (e.g., Bardhi and Eckhardt, 2012) or conceptual (e.g., Tukker, 2004). While Agarwal et al. (2012) contrasted the sustainability of leasing and sales business models and Schaefers et al. (2016) conducted a consumer survey to assess behaviour in a hypothetical car sharing service, we are not aware of previous research that quantitatively compared the levels of product care of actual users of circular and traditional business models. We are contributing a quantitative study of consumer product care in different business models that elucidates antecedents of product care and business model choice. Our findings demonstrate that consumer product care varies among business models; being highest for products that consumers bought new and lowest for accessed products. Therewith, these results quantitatively confirm what Tukker (2004) theorised and Bardhi and Eckhardt (2012) found qualitatively.

Our research adds to the field of AB-PSS by explicating the relationship between business models, consumer traits, product characteristics, and product care. We translated the findings into design recommendations to stimulate product care in AB-PSS, which has so far only been done for owned products (Ackermann et al., 2019). While the existing design strategies have often focused on the relationship between consumers and products, design recommendations for AB-PSS also include communication and aspects of the contract design, such as incentives.

6.2. Generalisability, limitations and future research

We found that consumer product care did not significantly differ between washing machines and bicycles. Both products are durable, provide primarily functional value and product care is not complex, the findings can thus be generalised for products with similar properties, such as dishwashers. While the findings might not be applicable to products primarily providing emotional value, previous literature has suggested that these products are generally unsuitable for AB-PSS (Schrader, 1999; Stahel, 2010). Further, we can extrapolate from our findings that consumers’ product care levels are likely to be even lower in short-term AB-PSS because damages are harder to retrace and can also be the result of vandalism by non-users. On top of that, consumers do not rely on one specific product to obtain the desired functionality when using short-term AB-PSS; if one accessed product is broken, consumers can easily access another one [see Schaefers et al. (2016) for more insights into consumer product care in short-term AB-PSS]. Consumers are thus likely to feel even less responsible for products accessed for a short time than for those used through long-term AB-PSS.

There are several directions for future research. On the one hand, we recommend future studies with larger, representative samples to allow for structural equation modeling, this could help to understand the relations between the variables even better. This approach would also allow to explore additional variables and constructs that might influence product care, such as the product’s price, social control or other “soft” factors (e.g., psychological ownership). The effects of social connections and awareness as well as consumer acceptance of products that take over control to ensure product care are also interesting topics for future research. On the other hand, qualitative research could be added in future studies to understand consumers’ decisions better and to inform the improvement of existing AB-PSS. Finally, conducting a similar study in another cultural context where AB-PSS are perceived differently (Iran et al., 2019) could show whether culture also impacts consumer product care in AB-PSS.

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