GREEN PRODUCT PERSONALITY: DEVELOPING A PRODUCT CONCEPT MADE OF RECYCLED OCEAN PLASTIC BASED ON THE COLLECTION OF CONTEXT-RELATED PERSONALITY TRAITS

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ABSTRACT

The replacement of conventional material with recyclates affects product personality, particularly regarding sustainability aspects influencing consumer behaviour. A definition of personality for products made of recyclates is missing in literature. As these products require appropriate aesthetics based on material origin to communicate the advantage concerning sustainability, there is a need for research in this regard. This paper aims to develop an adequate personality of a reusable water bottle made of ocean plastic by collecting personality traits that evoke associations related to the material's origin and sustainability. We conducted two quantitative field studies. Study 1 collected associated visual perceived attributes and context-related personality traits in order to develop and visualize a preliminary design. Study 2 evaluated the design regarding associated personality traits. The overall outcome was a product personality scale consisting of 23 items plus a concrete design recommendation for a water bottle made of recycled ocean plastic. The assessment of degree of sustainability was strongly influenced by participants' associations with personal use, familiarity with usage and the factor of stability and resilience.

Keywords: Sustainability, Ecodesign, Industrial design, Recycled materials identity, Psychology of Design

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1 INTRODUCTION

The recyclate obtained from ocean plastic waste can be used for product manufacturing to foster a circular economy, thus promoting sustainable consumption (Magnier et al., 2019). Given the importance of the deferral of the product's replacement and the market potential, designers need to look for new ways to create products with longer life spans (Mugge et al., 2005). Optimizing the current throwaway society by extending the ownership of durable products has been highlighted as a concept that can help aid in the evolution of the development to an environmentally friendly future (Veelaert et al., 2020a). In terms of understanding how to foster sustainable consumption through design, psychology plays a significant role. Without psychological knowledge, designers cannot understand what attributions are made and with which impressions and evaluations consumers are coming up while perceiving or handling a consumer product. Therefore, *Psychology of Design* should be the basis of all design tasks (Carbon, 2019). Attachment to a product is defined as the emotional bond a consumer experiences with a product (Mugge et al., 2005; Schifferstein and Zwartkruis-Pelgrim, 2008). The product is assigned a symbolic meaning which goes beyond functional utility (Govers and Mugge, 2004; Norman, 2004; Govers and Schoormans, 2005).

Numerous researchers have promoted an emotional bond through design, specifically in relation to product personality (Govers and Schoormans, 2005; Mugge et al., 2008; Orth et al., 2018). The product personality is the entirety or the high-level description of an individual product and is influenced by its appearance (Janlert and Stolterman, 1997). The word *personality* refers to the fact that human personality characteristics are used to describe the impression of a product (Govers, 2004; Carbon, 2019). The impression can only arise when it is perceived through sensory modalities, e.g. the *sensorial level* (Giaccardi and Karana, 2015). Ortlieb at al. (2020) stressed that the attribution of meaning occurs by triggering associations to personality traits, things, knowledge, people, and experiences; Giaccardi and Karana (2015) refer to this as the *interpretative level*, which includes the interaction with the product (see also Janlert and Stolterman, 1997; Norman, 2004; Carbon, 2019). In psychology, personality is most popularly described by abstracting it into the five dimensions, the so-called Big Five (Goldberg, 1993), which are typically termed *openness* (to novelty), *conscientiousness* (tidiness, perfectionism), *extraversion* (need for communication of self), *agreeableness* (in dealing with other people) and *neuroticism* (emotional lability). Congruence with the user's personality can foster the attachment and lead to a longer product life (Govers and Mugge, 2004; Govers and Schoormans, 2005; Veelaert et al., 2020a). The set of personality traits can be used to distinguish it from others (Janlert and Stolterman, 1997; Mugge et al., 2008). Designers can use the concept of product personality to make a particular inference in terms of the product's functional attributes (Mugge, 2011). The product personality scale presented by Govers (2004) consists of a collection of personality traits and is helpful to design a predefined personality, as it can be used for designing and evaluating a product personality as well as for the comparison of two product variants within a product category; information about how product personality is perceived provides designers a basis for tailoring the product variant to the consumer's desires.

The use of certain materials, which have their own character and identity, has an impact on the appearance and, therefore, on the product personality (Ashby and Johnson, 2002). Visual elements are the first to be processed by consumers and help to attract attention. In addition, they can promote the recognizability of recycled materials, e.g. through a particular pattern or a specific texture (Polyportis et al., 2022). Highlighting the material's original identity and history increases the demand for recycled products, and consumers are willing to pay a higher price for them (Kamleitner et al., 2019; Magnier et al., 2019). The material's identity is created, among other things, by the associations to experiences that are triggered during the interaction with the product (Veelaert et al., 2020b). Thus, congruence between personalities can also be promoted by a user identifying with the corresponding material (Veelaert et al., 2020a). The bipolar listing consisting of pictograms and rating points presented by Karana (2012) is useful to evaluate perceptible sensory attributes of a specific material in relation to triggered associations. Recycled materials rather evoke the idea of a substitute material, which is why they are more likely to be avoided for the design of high-end products (Rognoli et al., 2011; Veelaert et al., 2020b). Therefore, this meaning is attributed to products made of recycled materials and influences the perception of sustainability in this regard, which in turn can negatively influence the consumer's behavior concerning the product's purchase or long-term usage.

Current research in the field of perception of sustainability concentrates on the perceptible attributes of materials, including those of recycled plastics (Veelaert et al., 2020b; Du Bois et al., 2021). Veelaert et al. (2020b) deal with the importance of understanding how recycled materials are perceived by stakeholders for a successful application in practice; the authors found that there are differences between recycled plastics in terms of sensory and interpretative attributes and that they affect the identity of the recycled material in question. Du Bois et al. (2021) recognized that the perception of recycled materials could positively impact the perception of sustainability and that it is also influenced by the lifetime and reusability of the product. Consequently, present studies concentrate on the definition of a recycled material's identity, however information contributing to the definition of a personality of products made of this kind of material is missing in literature. As these products need to have an appropriate personality based on the material's origin to communicate the advantage concerning sustainability, there is a need for research in this regard.

1.1 Aim and objectives of the study

The presented work aims to investigate how recycled material influences a product's personality through visual perception. Based on the aforementioned literature highlighting that the personality of a product can make a particular inference in terms of its functional attributes, thus influencing the assessment of the degree of sustainability, we added the factor *functional attributes* to *form*, *colour and pattern*, and *texture* for the visual perception of the material. Based on the above-mentioned research highlighting that the material's original identity and history increases the demand for recycled products, we focused on the well-known social issue topic of ocean plastic waste, thus addressing people's conscience concerning their consumption behaviour. Moreover, as the aforementioned literature highlighted that the material's identity is strengthened by associations to experiences that are triggered during the interaction with the product, we chose a water bottle, thus helping prime and proliferate associations concerning the ocean with water. These considerations helped us formulating our quest:

What character traits contribute to the association of a water bottle with the context of sustainability and ocean plastic through visual perception?

This research question led to the formulation of our objectives as a) to develop a product personality consisting of character traits triggering associations with ocean plastic and the context of sustainability; b) to implement the developed product personality into an exemplary concept of a reusable bottle for user evaluation; and c) to evaluate the exemplary implementation of the concept regarding associated character traits from the identified listing.

This work is expected to highlight the relevance of psychology in product design to foster sustainable consumption. It should provide useful information contributing to the development of products made of recycled ocean plastic according to the original identity of the material, ultimately promoting the design of durable products.

2 METHODS

In light of the aforementioned objectives, two field studies and one concept development were carried out, Figure 1.
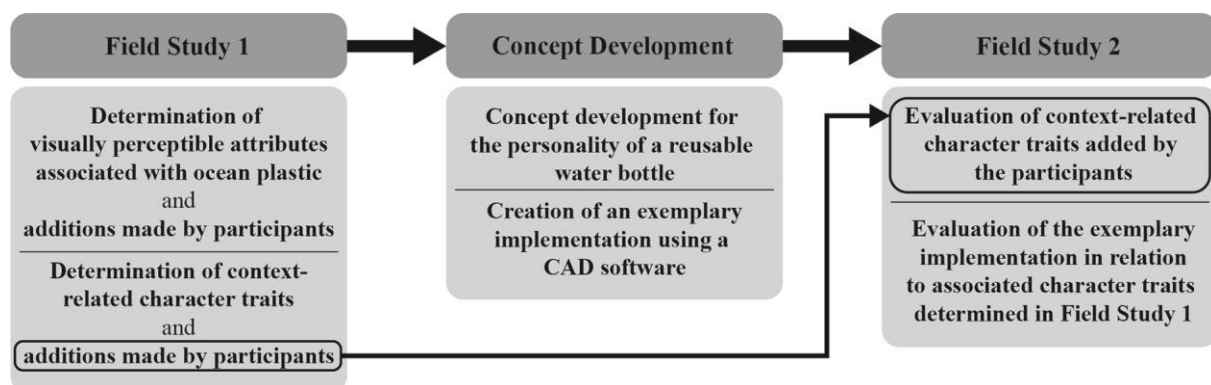

Figure 1. Pictorial representation of the proposed methodology

The first field study was based on the past research mentioned in the introduction. It dealt with the determination of visually perceptible attributes associated with ocean plastic and of context-related personality traits. Based on these results, the concept was developed and exemplary visualized. The second field study was conducted to evaluate the use of additional context-related items resulting from the first study (see the circled texts in the graphic) as well as to evaluate the exemplary design in relation to the associated character traits.

2.1 Field Study 1: Determination of the visually perceptible attributes associated with ocean plastic and the context-related personality traits

The first study involved 90 participants which were recruited from the pool of Bachelor's and Master's students at Reutlingen University, University of Bamberg, and University of Design Schwäbisch Gmünd in Germany. Finally, we achieved to recruit 56.7 % female, 42. 2 % male and 1.1 % non-binary. The participants ranged from 19 and 43 years, with a mean age of 23.9 years (SD 3.9). The data of the field study were conducted in an anonymized way and there were no restrictions regarding the participants' gender, the count of participants as well as their age. We employed a quantitative online survey using a survey software (QuestionPro GmbH). The study was conducted between June 20 - 26, 2022. A mix of open and closed questions was used. The results were analysed in terms of the distribution of responses and illustrated graphically. After a short introduction, the participants were asked to rate visually perceptible attributes which they associate with ocean plastic. The rating scale developed by Karana (2012) was used for this purpose. The following attributes were excluded: *elasticity*, *flexibility*, and *breakage resistance* as these are more functional attributes, and *transparency and colour*, as the grade of transparency is given by the material and the colour of the recyclate should be adapted to the context. Subsequently, a survey was conducted regarding which character traits should be expressed by products made of recycled ocean plastic.

Based on the scale developed by Govers (2004), we added specific items to include the aspect of communicating sustainability. We added the item *Extroverted* (communicative) to explore the relevance of design cues with a huge expressiveness, like colourfulness or dynamic forms. The item *Down-to-earth* (not aloof or elitist) was included to investigate the relevance of communicating that the product is not only for high-profile people. The item *Authentic* was added to investigate if the design must show the material and origin as what it is. *Stable* was used to investigate if long-lasting products should withstand physical impacts during usage. We used *Durable* to explore if the product can be used for a long time. *Environmentally friendly* was chosen to investigate the perceived impact on the environment. Finally, the items *Sustainable* (long lasting) and *Natural* (not artificial) were included as they were used by other authors to describe a sustainable product or material (Landau et al., 2013; MacDonald and She, 2015).

The evaluation took the form of a Likert scale. The character traits which are suitable for the development of a scale for sustainable products were assigned to the categories *unsuitable* (variable 1 and 2), *neutral* (variable 3), and *suitable* (variables 4 and 5). To take into consideration that further character traits could be associated with the context, the participants had the possibility to complete the list by answering an open question.

2.2 Concept development for the personality of a water bottle made of recycled ocean plastic

Based on the results of the first field study, a concept was developed for the personality of a reusable water bottle, which could be used in the long term. As the focus of the concept was on product personality, other product requirements such as technical feasibility were not considered. The bottle should have been refillable so that the purchase of single-use plastic bottles could be avoided. The product should have been visually different from other product variants in the category, as it was expected to attract attention with regard to the issue of marine litter. Therefore, it had to fulfil a normal water bottle's function as well as having a symbolic meaning. Both the intended usage of the bottle and the personality had to trigger associations to the sustainability's and the ocean littering's context to achieve long-term use. The identified character traits were assigned to categories of *form, colour and pattern*, *texture*, and of *functional attributes*, depending on the possibility of translation into visually perceptible attributes. Subsequently, the actual translation of the properties into attributes, which were defined by the categories, took place. The collected attributes were summarized in an

exemplary design of the product personality and visualized as a three-dimensional rendering using a CAD software.

2.3 Field Study 2: Evaluation of the exemplary implementation

The second study involved 120 participants which were, like in the first study, Bachelor's and Master's students recruited from the same universities. We achieved to recruit 34.2 % female and 65.8 % male people. The participants ranged from 18 and 54 years, with a mean age of 24.4 years (SD: 4.7). The data of the field study were conducted in an anonymized way and there were no restrictions regarding the participants' gender, the count of participants as well as their age. Like in the first field study, we employed the quantitative online survey using the same survey software. The study was conducted between July 18 - 24, 2022. A mix of open and closed questions was used. The results were analysed in terms of the distribution of responses and illustrated graphically. A previous participation in the first field study was not required. After a short introduction, the participants were asked to rate the contextual character traits added in the first survey using a Likert scale in terms of how much they should be present in ocean plastic products. The character traits were assigned to the categories *unsuitable* (variable 1 and 2), *neutral* (variable 3), and *suitable* (variable 4 and 5). According to the survey results, these were added to the new scale. Subsequently, the participants were asked to rate on a Likert scale to what extent the identified character traits from the first field study were reflected in the visualization of the exemplary design. The previously evaluated, supplemented character traits were included in this process. Evaluation variables 1 and 2 were categorized as *unapplicable*, variable 3 as *neutral*, and variables 4 and 5 as *applicable*. The results were visualized as a standard benchmark depiction. Finally, the participants could leave comments on the exemplary implementation through an open answer. Depending on the content, the comments were classified into the categories *usefulness*, *personal impression*, and *other*.

3   RESULTS

3.1 Results of field study 1

From the survey regarding the visually perceptible attributes associated with recycled ocean plastic, the following attributes emerged: *roughness* (50.6%), *matting* (61.8%), *absorption* (59.8%), *lightness* (53.4%), *coldness* (48.2%), and *hardness* (46.6%), Figure 2.
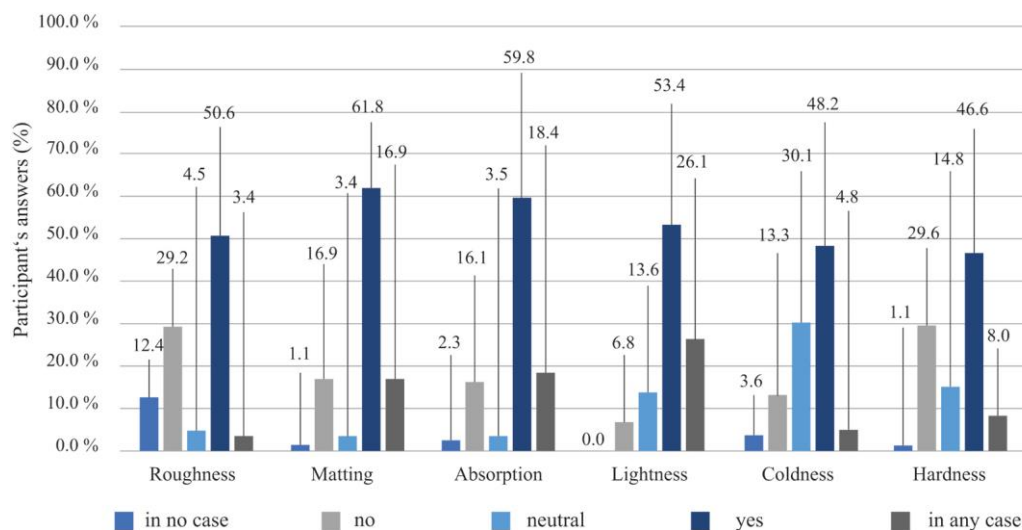

Figure 2. Visually perceptible attributes associated with recycled ocean plastic

The attributes mentioned by the participants which should be added to the listing were *colour*, *colour intensity*, *smell*, *texture*, *pattern*, *flexibility*, and *breakage resistance*.

From the data regarding the personality traits that should be reflected in ocean plastic products, a differentiation between *unsuitable*, *neutral*, and *suitable* ones emerged. The *unsuitable* items were *cute*, *idiosyncratic, provocative, dominant, obtrusive, untidy, childish, silly, boring, aloof, serious*, and *modest*. The *neutral* ones were *cheerful*, *open*, *relaxed, easy-going*, and *extroverted*. The *suitable* ones

were *pretty, interesting, lively*, *honest, down-to-earth*, *authentic, stable, sustainable, durable, environmentally friendly*, and *natural*, Table 1.

Table 1. Unsuitable, neutral, and suitable personality traits

Item	Unsuitable (%)	Neutral (%)	Suitable (%)
Cheerful	14.3	48.1	37.7
Open	11.5	44.9	43.6
Relaxed	16.5	44.3	39.7
Pretty	5.0	27.5	67.5
Easy-going	23.4	42.9	33.8
Cute	67.1	28.8	4.1
Idiosyncratic	70.8	25.0	4.2
Provocative	65.7	22.9	11.4
Interesting	8.8	18.8	72.5
Lively	13.2	36.8	50.0
Dominant	66.7	24.6	8,7
Obtrusive	90.9	6.1	3.0
Untidy	89.4	9.1	1.5
Childish	76.6	21.9	1.6
Silly	86.9	9.8	3.3
Boring	93.4	6.6	0.0
Aloof	89.2	9.2	1.5
Serious	60.9	26.1	13.0
Honest	15.8	21.1	63.2
Modest	41.1	26.0	32.9
Extroverted	44.1	44.1	11.8
Down-to-earth	27.0	36.5	36.5
Authentic	9.0	19.2	71.8
Stable	7.6	16.5	76.0
Sustainable	2.4	7.2	90.4
Durable	1.3	18.8	80.0
Environmentally friendly	3.6	10.7	85.7
Natural	16.7	11.7	71.7

Other traits which were added by the participants were *calming*, *refreshing*, *timeless*, *plain*, *high quality*, *useful*, and *elegant,* and they are picked up again in Section 3.3.

3.2 Exemplary concept development

The following product usage emerged: the water bottle should always be carried around to avoid buying disposable or reusable bottles on the go. To differentiate it from other drinking bottles in terms of its product personality and use, it should differ from conventional ones to communicate a statement concerning the context of ocean garbage.

The context-related personality traits were summarized in four categories as follows.

- *Form*: it included *homogeneous forms*, *context-related symbols*, *slight dynamics*, and *asymmetry*.
- *Colour and pattern:* it included a *material dependent colour*, *context-related colours*, *cold colours*, and *irregular patterns*.
- *Texture:* it included the *recognizability as a recycled product*, *roughness*, *matting* and *absorption*.
- *Functional attributes:* it included the *reusability*, *stability*, *lightness, breakage resistance, hardness* and a *long-term usage*.

Considering the visually perceptible attributes of ocean plastic and the translation of the personality traits, the exemplary implementation of the reusable water bottle was obtained. the basic horizontal form of the bottle was intended to radiate a sense of calm and balance. The transparent part should have created a sense of lightness. The lying position of the bottle should have triggered the association of its form with ocean waves. Combined with the asymmetry in the side view, the bottle should have also evoked a shell form, i.e. associations with the ocean. Moreover, the tip at the end of the bottle

should have evoked the shape of a drop, thus contributing to add dynamicity in the form of the bottle. The recycled material was designed according to the collected attributes from the first field study. Uneven colour gradients, as well as uneven pattern and texture, and a blue tone should have conveyed that the material had been fished from the ocean and recycled. The lower, darker section of the bottle was meant to enhance the blue colour of the upper section by contrasting it. An additional transparent material should have made the liquid contained in the bottle visible and, hence, a part of its design, Figure 3.
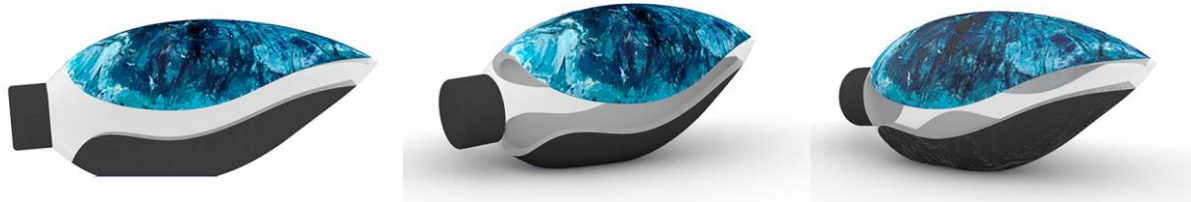

Figure 3. Exemplary implementation of the water bottle's personality

3.3 Results of field study 2

The results of the personality traits' evaluation that should have been added to the list according to the participants are shown in Table 2.

Table 2. Suitability of the items added by the participants

Item	Unsuitable (%)	Neutral (%)	Suitable (%)
Calming	24.6	35.1	40.4
Refreshing	18.6	23.0	58.4
Timeless	11.8	18.5	69.8
Plain	12.3	26.3	61.4
High-quality	5.2	24.1	70.7
Elegant	34.2	45.1	20.7
Useful	3.4	9.2	87.4

For the evaluation of the exemplary design, the previously supplemented items were also considered and added to the final list of contextual traits, Figure 4.
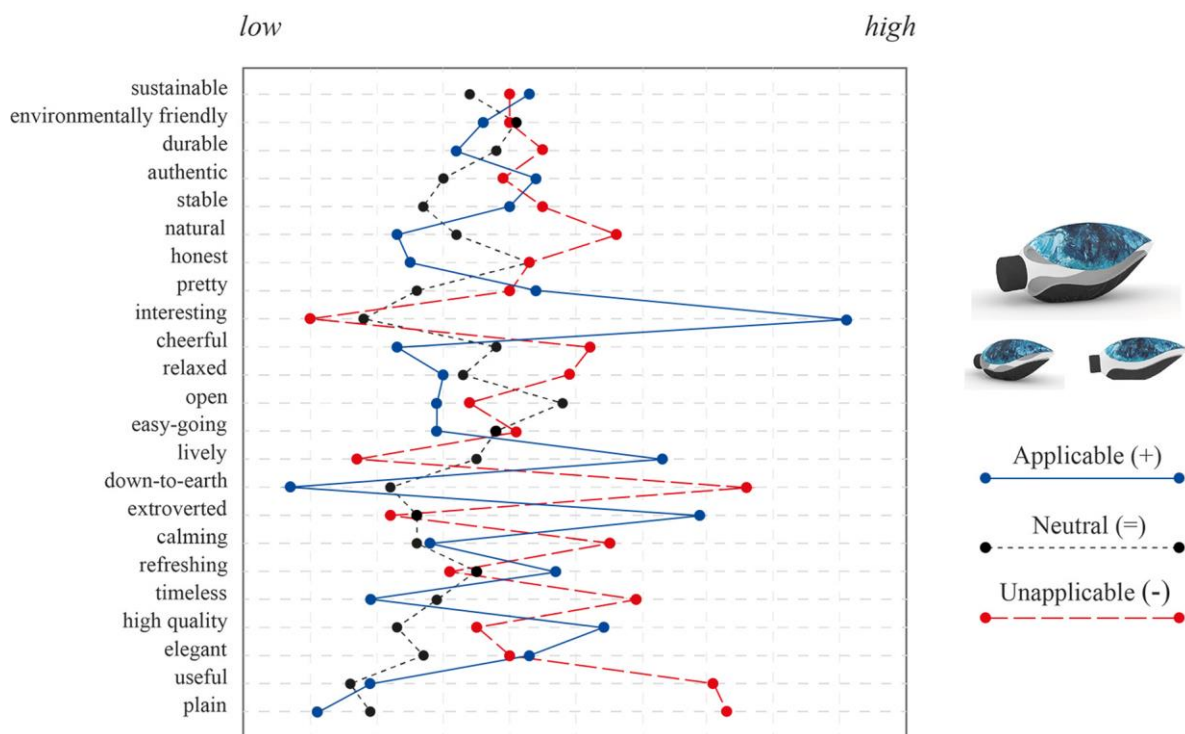

Figure 4. Revised product personality scale based on Govers (2004) used for concept evaluation

The survey showed that many of the items that should be present in ocean plastic products were not recognized. *Unapplicable* traits were *durable*, *stable*, *honest*, *natural*, *cheerful*, *relaxed*, *easy-going*, *down-to-earth*, *calming*, *timeless*, *useful,* and *plain*. *Neutral* ones were *environmentally friendly*, *honest*, and *open*. *Applicable* traits were *sustainable*, *authentic*, *pretty*, *interesting*, *lively*, *extroverted*, *refreshing, high quality* and *elegant*.

The participants' comments regarding the exemplary implementation were divided into three categories, Figure 5.
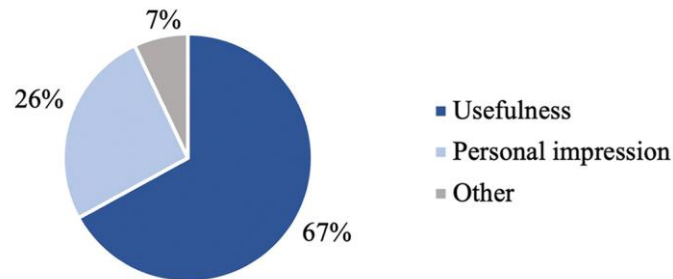

Figure 5. Participants' comments regarding the presented water bottle

- Usefulness, 67%: it included comments regarding the functionality, ease of use, and the water bottle's usage. In this regard, comments were mainly made about the bottle's lying position. This would take up a lot of space and, in addition, the water bottle could leak. The bottle's shape was often described as "unhandy".
- Personal impression, 26%: this category included comments regarding the individual effect of the water bottle and the participants' personal opinions.
- Other, 7%: it included comments concerning the task and suggestions for improving the design.

4 DISCUSSION

In the following, the context of the product personality scale and the evaluation of the developed concept are discussed along with some limitations.

As far as the first topic is concerned, the final listing of character traits (Figure 4) developed in this study shows differences compared to the items originally used by Govers (2004) that are listed in Table 1 along with the added items communicating sustainability. In this study, limiting the range of product variants to a specific recycled material was beneficial to achieve the full potential of the material's identity. However, as the revised scale presented in this work is only suitable for designing and evaluating the personality of products made of a specific recycled material, the scale cannot be used to design, describe, and compare the product personality of all product variants within a product category. The collected items represented in Figure 4 that communicate sustainability should be suitable for every product made of recyclates, as they contribute to the perception of sustainability. However, recycled material comes in many variations with different historical backgrounds. Since the participants were exposed to the context of ocean plastic in Field Study 1 (Figure 2), their evaluation was influenced by associations with this subject matter, and subsequently other context-related character traits emerged (Table 2). The listing would therefore prove inappropriate in a context of a different origin of the recyclate. Finally, only German universities were involved in collecting data for the field studies. Therefore, the results refer to the western cultural area. If the studies were conducted in another cultural area, the listing of context-related character traits would differ from the present results due to the culture-related associations with the topic *sustainability*.

As far as the evaluation results of the developed concept (Figure 4) show, associations to most of the personality traits were not triggered. Despite the effort to translate all character traits into the design (Figure 3), they were not sufficiently communicated. In this regard, usefulness proved to be a key issue for participants (Figure 5), as the intended use of the water bottle appeared to be impractical and not useful. Above all, the aspect that the bottle was not conceived to stay in a vertical position was seen by most of them as a reason not to purchase the product in the first place. Therefore, the conception of a new way of using the product to differentiate it from other variants proved to be inefficient. While a new way of using the product may attract attention, it may also have a negative

impact on the purchase decision and use of the product. If the product is not trusted, it will not be used out of sheer caution (e.g. a laying water bottle might leak).

5 CONCLUSIONS AND OUTLOOK

This study aimed to investigate how recycled material influences a product's personality through visual perception. Within two studies, a revised product personality scale consisting of character traits triggering associations with ocean plastic and the context of sustainability was determined and the exemplary implementation of a water bottle's design was visualized for evaluation.

Considering our research question, the implications of this work are that product personality scales should be developed based on the sensory perceptions and contextual associations of the respective material, thus highlighting the original material identity of a recyclate, and culturally specific scales should be developed. Moreover, the lack of familiar design elements and functionalities in a design can decrease user perception of the character traits contributing to the association with the context of sustainability and ocean plastic. Consequently, users' associations with personal use of a product category, familiarity with the usage of the product and the factor of stability and resilience strongly influence the assessment of the degree of sustainability.

Among the implications for future work, the results of this study show the challenges linked with the successful translation of pre-defined character traits into a product, thus highlighting the importance of psychology when designing a product personality. In the context of this work, the focus was on the visual modality. In light of the participants' comments mentioning the importance of the perceptible attributes *texture* and *smell*, future work should address the inclusion of further perceptual modalities for product evaluation with the use of physical objects.

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