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Using proximity in sustainable product design

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This research examines proximity as a new interesting strategy to include in the design of more sustainable products. Drawing from the construal level theory, we posit that the environmental sustainability of a product embedding a form of proximity to an environmental solution in its design will be perceived as more concrete and will trigger higher prosocial product experience. To test this assumption, we used spatial proximity by manipulating the location from where the recycled plastic of a bottle of dishwashing soap was reclaimed. Based on the responses of 130 individuals recruited from a panel of consumers, we found that product environmental sustainability is perceived as more concrete and prosocial product experience is higher when proximity is embedded in product design than when far distance or no distance are embedded in the product design. This paper contributes by investigating how product design itself can help to enhance the acceptance of more sustainable products and by applying the Construal Level Theory to the field of product design.

keywords: sustainable product design; proximity; concreteness; prosocial product experience

Introduction

Prior research demonstrated that people can experience difficulty understanding the added value of sustainable product innovations because their benefits for the environment are often too abstract (Jensen, 2011) and people have difficulty understanding information that is not perceptible.

Therefore, a major challenge for designers is to design sustainable products that bring a concrete solution to an environmental issue in order to enhance people's choice.



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To encourage individuals to choose more sustainable alternatives, research has so far focussed on policies and nudging programmes that trigger selfish benefits such as social status (Griskevicius, Tybur, & Van den Bergh, 2010) or promote money savings (Camilleri & Larrick, 2014). Strikingly, very little is known on how the sustainable design of the product itself and precisely how the concreteness of the solution to the environmental issue influences responses to the product.

To design more concrete products, the construal level theory and the concept of psychological distance can be of great value. Psychological distance can be temporal, spatial, social and probabilistic and is related to the construal level (abstract vs. concrete) of individuals. Psychological proximity refers to individuals' perception of being close to an object/event/person on these four dimensions of distance. Research has demonstrated that the more an object is perceived as close (far), the more it is construed at a concrete (abstract) level (Trope & Liberman, 2010). However, such a relationship has not been tested in the context of sustainable product design. More environment-friendly products are different from other objects as environmental problems are generally seen as global and complex. It is therefore relevant to test whether psychological proximity to an environmental solution participates in making product environmental sustainability more concrete to individuals.

Next, research has demonstrated that individual's construal level influences their attitudes and behaviours. Precisely, it has been demonstrated that reducing the psychological distance between individuals and a target object has a significant influence on behaviours in different contexts. For example, research showed that people are willing to pay more for local products (Carpio & Isengildina-Massa, 2009).

In this paper, we will test whether embedding proximity in sustainable product design represents a good strategy to improve consumers' experience of the product. Will psychological proximity have an effect on prosocial product experience? Assessing this effect is of major importance as unselfish or prosocial benefits represent an important motivation for consumers' to choose more sustainable products because it expresses their ethical values and their interest for the common good (Thøgersen, 2011). We define prosocial product experience as the positive feeling one experiences when using a product derived from actions that benefit "others" but are not obligatory by moral standards. Although product environmental-friendliness may lead to positive egoistic benefits (e.g. perceived healthiness of organic products), prosocial benefits are even more important for individuals when considering a sustainable alternative (Thøgersen, 2011). As a result, prosocial product experience can be recognized as an important competitive factor for companies commercializing environment-friendly products.

In the domain of sustainability, literature in environmental psychology has started to examine, mostly theoretically the influence of psychological distance on perception of and actions against climate change (McDonald, Chai, & Newell, 2015; Spence & Pidgeon, 2010; Spence, Poortinga, Butler, & Pidgeon, 2011; Spence, Poortinga, & Pidgeon, 2012). However, the influence of psychological distance embedded in sustainable product design on consumers' responses has received less attention.

The paper is organised as follows. First, we describe the relationships between psychological distance, construal levels, attitudes and behaviours. Next, we describe how

the construal level theory could be applied in the field of sustainable product design and develop our hypotheses. These hypotheses are tested in a study manipulating spatial distance for a recycled packaging of dishwashing soap. Finally, we discuss the theoretical and managerial implications of the research for the field of design as well as its limitations and avenues for future research.

Psychological distance and the construal level of individuals

Influence of psychological distance on construal levels

Psychological distance refers to the extent to which an object is distant from the self – socially, in time, in space, or in probability of occurrence (McDonald et al., 2015; Trope & Liberman, 2010). According to the Construal Level Theory, psychological distance is associated with different construals of object and events. Precisely, when an object is perceived to be psychologically proximal or close to the self, it tends to be perceived more concretely, on a low level of construal. Conversely, when an object is perceived to be distant from the self, it tends to be perceived in abstract or high level terms.

As mentioned above, psychological distance is composed of four dimensions (Trope & Liberman, 2010). Spatial distance refers to the distance in space between a target and a perceiver (Fujita, Henderson, Eng, Trope, & Liberman, 2006). Temporal distance refers to the amount of time that separates the perceiver's present time to a target event (Trope & Liberman, 2000, 2003). Social distance refers to how distinct the social target is from the individual self (Trope, Liberman, & Wakslak, 2007; Zhao & Xie, 2011). Finally, hypotheticality or probabilistic distance refers to the likelihood of an event to happen or in other terms, how close it is to reality as perceived by the individual (Wakslak, Trope, Liberman, & Alony, 2006). These four different dimensions of psychological distance affect mental construals and these construals, in turn, guide prediction, evaluation, and behaviours (Trope et al., 2007).

Attitudinal and behavioural implications of construal levels

The construal level of consumers influences their attitudes and behaviours. Prior research demonstrated that emotions were stronger when individuals construed objects or events at a low or concrete level. For example, it appears that the more an individual is primed with a far distance, the less (s)he reports negative affects when confronted with a violent story (e.g. a violent accident) (Williams & Bargh, 2008). In addition, research has revealed that individuals were more motivated to attain goals with close outcomes (Karniol & Ross, 1996; Loewenstein, 1988). Furthermore, it appears that individuals are willing to pay more for local products (Carpio & Isengildina-Massa, 2009; Feldmann & Hamm, 2015).

Considering that changes in consumers' behavioural patterns with regards to sustainability are urgent, using psychological proximity to encourage sustainable consumption may represent an interesting opportunity.

Psychological distance, construal levels and sustainability.

Much of the research linking the Construal Level Theory to sustainability has been realized in the context of climate change (McDonald et al., 2015; Spence & Pidgeon, 2010; Spence et al., 2012).

It appears that solutions to environmental issues are often perceived as having an effect far in the future (temporal distance), uncertain (probabilistic distance), or as not having results in the direct environment of individuals (spatial and social distance) which could explain why consumers do not always act according to sustainability principles.

For example, in the case of global warming, the effects of an individual's carbon emissions are difficult to allocate to a certain environmental issue. Moreover, the effects of gas emissions reduction are often perceived as distal and uncertain. Considering that distal targets are generally construed at an abstract level, it is likely that consumers consider climate change, as well as other environmental issue, as abstract.

Studies have demonstrated the importance of the influence of psychological distance on climate change mitigation behaviours. For example, spatial distance in the domain of climate change plays an important role in climate change mitigation actions (McDonald et al., 2015). In a study where the effects of climate change were framed to occur either at local or distant locations, it appeared that participants were significantly more positive in their attitudes towards climate change mitigation when the effects were framed as occurring locally (McDonald et al., 2015; Spence & Pidgeon, 2010). Next, personal experience of weather and climate-related events was related to engagement in energy conservation to mitigate climate change (Spence et al., 2011), as well as behaviours aimed at reducing carbon footprint such as recycling (Reser, Bradley, & Ellul, 2014).

These studies suggest that proximity to climate change may work for influencing people to act against it. Our research is different in two ways. These studies manipulate the proximity of the effect of climate change (Spence et al., 2011) while we aim to manipulate the proximity of the sustainable solution in the design of the product. Furthermore, these studies test the effect of the psychological distance of climate change on mitigation behaviours (e.g. energy conservation), while we aim to explore consumers' reaction toward a more sustainable product embedding psychological proximity in its design.

Proximal and concrete solutions in sustainable product design

Including proximity in the design of more sustainable products

Research has demonstrated that sustainable product design can be optimized to convey environmental sustainability to consumers (Magnier & Crié, 2015; Diego-Mas, Poveda-Bautista, & Alcaide-Marzal, 2016) and to trigger benefits related to environmental sustainability (Magnier & Schoormans, 2015). For example, in the context of packaging design, it has been demonstrated that certain materials are more likely to convey environmental sustainability and higher quality (Magnier, Schoormans & Mugge, 2016). However, in some situations, a change of material or a visual alteration of the product may not be possible (e.g. liquid hand soap in a bottle of recycled paper). Yet, a material can be more sustainable while looking conventional (e.g. recycled plastic).

We propose that embedding proximity in the design of more sustainable products may represent an interesting strategy to make product environmental sustainability more concrete to consumers. For example, egg cartons with a QR code that links to a live webcam showing free-range chicken in their environment may promote psychological proximity. Integrating recycled materials reclaimed from a proximal spatial distance in a product may also favour perceptions of proximity. In the case of products made from

ocean plastic, embedding a system that enables to check in real time the amount of ocean plastic collected for the production of the product may reduce probabilistic distance.

In this paper, we aim to test whether psychological proximity embedded in the design of a more sustainable product makes product environmental sustainability more concrete to consumers and triggers higher prosocial product experience.

Influence of proximity on concreteness of product environmental sustainability

As described above and according to the Construal Level Theory, when an object is framed in a proximal (vs. distal) manner, individuals are more likely to construe this object in a concrete (vs. abstract) way. For example, it was demonstrated that consumers tend to construe events that occur far from where they live as abstract whereas they tend to construe events that occur near where they live as concrete (Fujita et al., 2006). In this research, we define the concreteness of product environmental sustainability as the extent to which the environmental benefit of a sustainable product innovation is concrete. A concrete object is usually defined as existing in reality, as being perceptible by the senses or real.

We posit that a more sustainable product that embeds psychological proximity to a sustainable solution in its design will be perceived as more concrete than an object that embeds far distance to a sustainable solution or does not embed any form of psychological distance.

Influence of proximity on prosocial product experience

The literature demonstrates that proximity is often more powerful than far distance to influence positive responses towards a sustainable alternative (McDonald et al., 2015). Research on spatial distance showed that proximity, as opposed to distance, is generally framed in positive terms (Te Vaarwerk, Van Rompay, & Okken, 2015). For example, it has been demonstrated that people who share space and time generally like each other better, and find themselves more attractive than people who are further apart (Festinger, Back, & Schachter, 1950).

In this paper, we aim to examine whether psychological proximity to a sustainable solution influence prosocial product experience. As described above, we define prosocial product experience as the positive feeling one experiences when using a product derived from actions that benefit 'Others' but are not obligatory by moral standards. Prosocial experiences usually relate to or denote altruistic behaviours that are positive and helpful to society in general. Prior literature has revealed that prosocial experience was an important motivation for individuals to consume more sustainable products (Thøgersen, 2011).

We propose that a more sustainable product that embeds psychological proximity to the sustainable solution in its design will convey more prosocial product benefits than an object that embeds far distance to the sustainable solution or does not embed any form of psychological distance. Specifically:

H1: Prosocial product experience will be higher when psychological proximity is embedded in the product design than in a distal condition or when no distance is embedded in the product design.

The mediating effect of concreteness of the product environmental sustainability

We posit that proximity to the environmental solution embedded in product design will positively affect concreteness of product environmental sustainability, which in turn will enhance the prosocial product experience. In other words, we suggest that concreteness of product environmental sustainability can explain the influence of proximity to the environmental solution on the prosocial product experience. More formally:

H2: Concreteness of product environmental sustainability will mediate the influence of proximity on prosocial product experience.

Current research

In order to test whether concreteness of product environmental sustainability and prosocial product experience are higher when psychological proximity is embedded in the design of a product, we performed an experimental study. We used a one factor between-subject design experiment in which we compared the effect of spatial distances integrated in a product design by manipulating the location from where the recycled plastic of a bottle of dishwashing soap was reclaimed (control condition: no distance vs. proximal condition vs. distal condition). The distal location was used in order to ensure that proximity and not only the presence of a location triggered a higher concreteness of product environmental sustainability.

We decided to focus on spatial distance, as it is especially relevant for circular product design. Indeed, circularity implies that raw materials are used and reused efficiently limiting harmful emissions into the environment (MacArthur Foundation, 2016), and it is therefore possible for designers to use recycled materials reclaimed from specific locations.

First, we realized a pretest in order to determine the locations to be used in the study. In the main study, we used the locations that were perceived the furthest apart and that did not differ in terms of attitudes.

Method

Pretest

We asked 19 individuals from the Netherlands to evaluate a series of Western and Central European cities or region (namely, Delft, Amsterdam, the province of Zuid-Holland, Rome, Venice, Paris and Prague). We ensured that these individuals lived in the same region as the participants of the main study.

First, respondents were asked how they perceived the distances between themselves and the locations (*How far do you perceive [location] to be? - Very close / very far*). Next, we measured their attitudes towards the different cities (*How would you describe your attitude towards [location]? – Very negative / Very positive*).

We chose cities of Western and Central Europe in order to avoid potential negative effect caused by the pollution created by the transport of the plastic to be recycled from very far away location to the place of the study.

When comparing cities, most pairs were showing a significant difference in terms of perceived distance. We decided to keep the city of Delft for the proximal condition and Venice for the distal condition because the perceived distance between these two cities was the greatest and because they are comparable in that they are both touristic cities where canals are playing an important role. Paired-samples t-tests were conducted to compare the perceived distances of the locations. Venice ($M = 5.26$, $SD = .99$) was perceived as significantly further than Delft ($M = 1.32$, $SD = .58$); $t(18) = -15.24$, $p < .001$. There was no difference in terms of attitude towards the two locations ($p = .13$).

Participants

One hundred and thirty individuals (Female: 57.7%) recruited from a University-based consumer panel responded to our questionnaire. The sample was diversified in terms of socio-demographics. The average age of the participants was 51.32 years ($SD = 13.40$; *age range*: 22 – 71 years). The number of people in their household ranged from 1 to 6 ($M = 2.7$; $SD = 1.37$). The net monthly incomes in the household were diverse ([<1500€]: 6.3%; [1500€-3000€]: 26.1%, [3000€-4500€]: 28.8%, [>4500€]: 38.7%).

Procedure and stimuli

A bottle of dishwashing soap made from recycled plastic was used as stimuli. In the control condition, no location was displayed on the package. In the proximal condition, the package design communicated that the bottle was made of recycled plastic reclaimed from the canals of Delft (city where participants were recruited from) and in the distal condition the canals of Venice were used (Figure 1). The brand that was used 'Dawn' is not sold in the Netherlands and therefore unfamiliar to the participants.



Figure 1 Stimuli used in the study. From left to right: control condition, proximal condition, distal condition.

Participants were presented with one of the three packages and asked to rate it on several measurement scales.

Measures

Concreteness of product environmental sustainability:

Concreteness of product environmental sustainability is defined as the extent to which the environmental issue tackled by the sustainable product innovation is abstract or concrete.

Participants rated concreteness of product sustainability on one 7-point semantic differential scale (*How would you evaluate your perception of the environmental issue the brand Dawn engaged in with this packaging? Abstract / Concrete*).

Prosocial product experience:

Prosocial product experience was assessed using 3 items measured on 7-point Likert scales (*I would feel good about buying this dishwashing liquid, I would contribute to a better world by buying this product, By purchasing this dishwashing liquid, I have a positive contribution to the environment*; $\alpha = .85$).

Results

Test of the influence of distance on concreteness of product environmental sustainability

In order to check whether the environmental issue in which the brand Dawn engaged in was more concrete for the proximal condition than for the distal condition, we performed a one-way ANOVA (analysis of variance). Results revealed a marginally significant main effect of the distance on the concreteness of product environmental sustainability ($F(2;127) = 2.89$; $p = .06$). Planned contrasts indicated that participants perceived product environmental sustainability in the proximal condition as more concrete than the product sustainability in the distal condition ($M_{\text{proximal}} = 4.90$ vs. $M_{\text{distal}} = 4.11$; $t(127) = 2.07$, $p < .05$). Participants also perceived product environmental sustainability in the proximal condition as more concrete than in the control condition ($M_{\text{control}} = 4.09$; $t(127) = -2.31$, $p < .05$). However there was no significant difference between the control condition and the distal condition ($p > .90$).

Test of the influence of distance on prosocial product experience (H2)

We performed another one-way ANOVA with distance as the independent variable and prosocial product experience as the dependent variable. Results revealed a significant main effect of distance on prosocial product experience ($F(2;127) = 3.82$; $p < .05$). Planned contrasts indicated that the prosocial product experience of participants in the proximal condition was higher than in the distal condition ($M_{\text{proximal}} = 4.64$ vs. $M_{\text{distal}} = 4.04$; $t(127) = 2.22$, $p < .05$). The prosocial product experience of participants in the proximal condition was also higher than in the control condition ($M_{\text{control}} = 3.94$; $t(127) = -2.57$, $p < .05$). These results confirm Hypothesis 2. Moreover, there was also no significant difference between the control condition and the distal condition ($p > .70$).

Table 1 Descriptive statistics (Means and Standard Deviations) for each condition

	Control condition	Proximal condition	Distal condition
Concreteness of product sustainability	4.09 (1.58)	4.90 (1.68)	4.11 (1.97)
Prosocial product experience	3.94 (1.35)	4.64 (1.06)	4.04 (1.47)

Standard deviations in parentheses

Test of the mediating effect of concreteness (H2)

In order to test for the mediating effect of concreteness in the relationship between distance and prosocial product benefits, we used the bootstrapping technique with 5000 iterations (Zhao, Lynch, & Chen, 2010) and the PROCESS macro for SPSS (Hayes, 2013). Considering that our independent variable was multicategorical with a control condition and two experimental conditions (proximal and distal), we followed the procedure of Hayes and Preacher (2014) in which the mediation method for such a case is described. The proximal and the distal conditions were dummy coded and the control condition was used as the reference category. Analyses were run twice. First, we executed a mediation model with the first dummy variable (i.e. the proximal condition) as the independent variable and the second dummy (i.e. the distal condition) as a covariate. Then, we executed the same mediation model with the second dummy (i.e. the distal condition) as the independent variable and the first dummy (i.e. the proximal condition) as a covariate. The two bootstrap confidence intervals were based on the same set of bootstrap samples. The first bootstrapping analysis tested whether concreteness of product sustainability mediated the impact of the proximal condition on prosocial product benefits. Results revealed that concreteness did mediate this relationship. Specifically, a 95% bootstrapped confidence interval for the indirect effect (.0251, .4316) indicated a significant mediation effect at the $p < .05$ level.

Not surprisingly, the second bootstrapping analysis testing whether concreteness of product environmental sustainability mediating the impact of the distal condition on prosocial product benefits was not significant (-.1598, .1484).

General discussion

Theoretical and managerial implications

The need for more research on the role of product design to convey environmental benefits to consumers has been acknowledged in past research (Diego-Mas et al., 2016). Research has shown that different elements of product design such as aesthetics (Luchs, Brower, & Chitturi, 2012), materials (Magnier & Schoormans, 2015) or product attributes (Diego-Mas et al., 2016; Gershoff & Frels, 2015) influence consumers' perception and acceptance of more sustainable products. However, little research has examined how to influence perception and responses to a more sustainable without altering its visual appearance.

In order to fill this gap in the literature, this research examined the influence of psychological proximity to convey concrete product environmental sustainability and trigger higher prosocial product experience. Results revealed that the concreteness of product environmental sustainability was higher when the recycled plastic of a bottle of dishwashing soap was reclaimed from a proximal location than when it was reclaimed from a distal location or than when no location was mentioned. Furthermore, our results showed that prosocial product benefits were also higher in the proximal condition than in the distal and the control condition. Finally, we showed that the concreteness of product environmental sustainability mediated the relationship between the proximal location and prosocial product benefits.

This paper contributes to the literature in two ways. First, it applies the Construal Level Theory to the field of sustainable product design. So far, the Construal Level Theory was used in sustainability to promote climate change mitigation behaviours (McDonald et al., 2015; Spence & Pidgeon, 2010). Results of these studies show that framing the effects of climate change as happening close to individuals influence them to adopt climate change mitigation behaviours. With this study, we extended the use of the Construal Level Theory to the field of product design. Our results represent interesting new insights for the use of psychological proximity in product design to enhance the experience of more sustainable products.

Second, this study complements the literature on improving consumers' acceptance of more sustainable alternatives. As product sustainability is generally complex to grasp, it is important to define strategies that improve consumers' reactions to these products. By making the environmental benefit of a product more concrete to individuals, designers are able to make these products more appealing. Our results also complement literature in design aiming at reducing the environmental impact of product use with design strategies for sustainable behaviours (Lockton, Harrison, & Stanton, 2013). In this research, design strategies aim to enhance the concreteness and the perceived prosocial experience of a product with a reduced environmental impact.

This research has several implications for designers and companies. Many companies consider sustainability as a strategic objective and target environmentally conscious consumers. Yet, most of them adopt a low-hanging fruit strategy that is a moderate position where actions taken are environment-friendlier but also economically beneficial. These companies are often reluctant to develop costly eco-friendly programs. Producing more sustainable products may require large investments for research and development, and may involve a change of business-model (Bocken, Short, Rana, & Evans, 2014). It is therefore important for the industry to know that consumers will respond positively to the product. By doing so, they can create a competitive advantage, as consumers' sensitivity to environmental initiatives is high (Olsen, Slotegraaf, & Chandukala, 2014). The results of this research offer several interesting prospects for the development of proximal solutions in the field of sustainable product design that may improve reactions towards more sustainable products. Designers may use proximity as a principle to design more sustainable products that will evoke positive consumers' responses.

Limitations and Future research

Although our study offers valuable implications for researchers and practitioners, some limitations deserve attention and should be taken into account in further research.

First, in this study, spatial distance is manipulated. Psychological distance also encompasses temporal, social and probabilistic distances. Further research should test the influence of these different forms of proximity on consumers' responses to more sustainable products. For example, a QR code linked to the amount of plastic removed from the ocean framing individuals on short-term or long-term results could be interesting for the case of the temporal distance. By framing the effects of a sustainable consumption behaviour on the short-term, individuals may perceive environmental issues as more concrete and be more motivated to perform the target environmental behaviour. Framing

the type of people (similar vs. different) who would benefit from the environmental initiative could also represent an alternative for the social distance.

Second, the distances could have been manipulated differently. It would be interesting to replicate the results with different proximal and distal locations. It would especially be interesting to uncover how close a location should be to trigger concreteness and enhance the subsequent reactions. This would be especially important to improve the scalability of such an initiative. Moreover, in this study we do not take into consideration the personal experience of the environmental issue. Yet, personal experience seems to play an important role in influencing consumers' mitigation behaviours of climate change (McDonald et al., 2015; Spence et al., 2011).

Third, the dependent variables in the study are related to attitudes. Although prosocial product experience has been described as a motivation to consume more sustainable products (Thøgersen, 2011), further research could focus on behavioural aspects of the influence of proximity to the environmental solution and focus on variables such as choice decision or willingness-to-pay.

Fourth, the experiment reported in this research focusses on the dishwashing soap product category, and our results are possibly limited to some context specificities. In the future, this study could be replicated with the same settings across other product categories in order to enhance the generalizability of our results.

Finally, more sustainable products often come with drawbacks, such as a higher price or a less attractive appearance. Further study could examine how proximity may lower the importance of these drawbacks and ultimately increase choice decision for these more sustainable products.

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