Understanding Everyday Design Behaviour:
An Exploratory Experiment

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Everyday design (ED) involves the reuse of existing products for new purposes. This behaviour can be easily observed in our everyday lives but has hardly been recognized as a means to stimulate sustainable behavior. Although several in-depth studies in this area has been conducted to understand people's behavior, they were mainly focused on theory building. Our study, however, is based on the idea that everyday design is one of the tools for professional designers to inspire users to sustainable behavior. Therefore, the study aims to understand how and what product elements and affordances trigger people to perform everyday design. Everyday design normally happens in a natural situation, but because we wanted to have control on the input variables, we did an experiment, in which four basic everyday products were offered to 27 participants with the task to come up with an ED product for each of those four products. A total of 108 ED products were repurposed, followed by interviews. The results indicate that ED products can be reused for various purposes beyond their original functions. The trigger for those ED products were often form-related product elements. The paper shows how these elements are related to affordances. Although affordances of original products are often the trigger for their ED, almost half of the ED products were triggered by hidden affordances. Although it is an explorative study, the conclusion is that the findings may help design practitioners to increase the sustainability of their products through stimulating their reuse.

Keywords – Everyday Design, Sustainability, Reuse, Product Elements, Affordance.

Relevance to Design Practice – This research presented experiments with the importance of affordances of products and examples of affordance adaptation in a new context. Our results could raise awareness among professional designers who want to increase the sustainability of their products through stimulating their reuse. Knowledge from the data in this study about product elements and affordances as trigger for everyday design, can already be applied in their designing.

Introduction

People interact with diverse products for various purposes in their daily lives. For example, when people feel thirsty, they pour water into a cup. However, a cup may not only be used to hold water, but also utilised as a pencil holder or as a measuring tool when cooking. Thus, a cup is used for various purposes. Whether we use a paper napkin as a notepad or a mug as storage for pens and pencils, we can easily find things in our everyday lives that are used differently from the function intended by designers. As Desjardins and Wakkary (2013) summarized from earlier research, "…once the artifacts leave the designer's drawing table, the design process does not stop: it can be pursued through customization, reuse, appropriation, do-it-yourself (DIY) projects and everyday design processes" (p. 253).

In this paper, users' process of adding new functions and values to existing products is termed everyday design (ED), based on the concept coined by Wakkary et al. to define family members or home dwellers reusing products for new purposes (Kim & Lee, 2014; Maestri & Wakkary, 2011; Wakkary & Maestri, 2008; Wakkary & Tanenbaum, 2009; Wakkary et al., 2015). Evidence of everyday design can be found in the "resourceful appropriation of artifacts and surroundings, the ongoing adaptation of systems and routines through design-in-use that allows emergent properties to arise and addresses individual needs" (Wakkary and Maestri, 2008, p.171). Whereas Wakkary and Maestri's definition of everyday design is rather broad, we limit the concept to the process by which home dwellers create new uses for designed artefacts within given contexts.

The phenomenon of everyday design has received fairly considerable attention in the design world, with amusing examples of the ways in which people react to a world that is not perfectly tailored to their needs. ED has been explained with reference to the concept of unselfconscious design (Alexander, 1964), by which people unconsciously design things for goodness of fit, rather than through a self-conscious process of knowledge acquisition. Other authors refer to ED as intuitive design (Suri & IDEO, 2005), as unintentional behaviour, or as unintended everyday product design (Brandes & Erlhoff, 2006; Wakkary et al., 2015). In the case of a cup that is turned into a pencil holder, what might have stimulated the person to use the cup in such a way?

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If we better understand the phenomenon of everyday design, designers might take advantage of it in their new designs by remaining alert to the possibilities of reusing their artifacts. Therefore, we seek to contribute to the body of knowledge regarding *everyday design* in a way that this knowledge leads to guidelines for designers in order to encourage them to understand the phenomenon of ED and to make use of people's natural tendency to appropriate existing products. Ultimately, this will result in a more sustainable approach to design. Understanding everyday design (ED) can be studied from different perspectives. Previous ED research was mainly characterized by in-depth (ethnographic) studies of the phenomenon of this (often unexpected) re-use and re-design of artifacts both as a creative process by users, as a social event being part of family life, and as a theoretical concept (Kim & Lee, 2014; Maestri & Wakkary, 2011; Wakkary & Maestri, 2008; Wakkary & Tanenbaum, 2009). Some studies described a similar phenomenon as ED without referring to the construct *everyday design*, where the researchers explore the potential of data and machine learning to help elderly to reuse their resources (Giaccardia et al., 2016; Nicenboim et al., 2018). Through ethnographic methods, they were able to understand the everyday design behaviour of the elderly and to create resources, capabilities, and strategies which were used for a design tool.

Although it is an interesting approach, our focus is on a broader application than only on specific user groups. Therefore, our study is practice oriented in a sense that we want ED to become part of sustainable living of any population, which can be stimulated by professional designers.

In an earlier paper (Kim et al., 20172019), the authors proposed a conceptual framework to analyse the process leading to ED based on 264 ED photo cases (see Figure 1).

The framework explains how ED passes through the process from original use of the product as intended by the designer to the user's creative act of everyday design, influenced by the situation, personal characteristics and product characteristics.

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Many researchers are positively aware of the creative appropriation of products for new purposes (Ackermann, 2018; Dix, 2007; Haug, 2018; Selvefors et al., 2019; Wai & Siu, 2003). However, designing for appropriation seems for professional designers like an oxymoron, as Dix stated, when he points out that the unexpected results of users' appropriation cannot be designed by the designer in advance. It is difficult to help designers identify which users may need or want to adapt, and how a product can be designed in such a way that it leads to ED. Although it is a challenge, we believe that through designing adaptable products a designer can have influence on users' behavior. Therefore, we focus in this study on the product itself as trigger for ED and the main question posed in this study is: What product elements and/ or product as a whole trigger everyday design and in what way?

The starting point is an everyday product context whereby the user uses the product according to the designer's intention. When appropriating and re-using the product for a new purpose, the ED context commences. User, context and product are the three factors that influence the probability of ED. The user's knowledge, skills and experience in remaking products, the context in which this occurs—location, economic circumstances and so forth—and the original product and/or elements of that product—defined in terms of visual cues, affordances and symbolic communication— will influence ED. Professional designers have less influence on user and context, but the more so on product, which explains the focus of this study.

Product Elements

If people reuse artefacts for another purpose, what does the artefact trigger in them that it should be reused? In describing an ED action, we assume that users are triggered by one or more elements of the original artefact or by the artefact as a whole, followed by an action to remake or reuse that artefact for alternative purposes. In this way, the artefact enables the user to interact with it and act accordingly.

The notion that product elements influence how the product will be perceived and acted upon is not new. Certainly, it has long been a hallmark of design, as a signal for communication and interpretation between designer and user (Broadbent, 1980; Jung & Stolterman, 2012; Kroes, 2002; Monk et al., 2005; Silva et al., 2015). Designers use well-defined design elements such as form, colour, and material to convey the intended use or message of a product. They utilise familiar product elements to attract consumers' attention to the product (Crillyet al., 2009; Janlert & Stolterman, 1997). Krippendorff (1989) argues that designers use the symbolic elements of products based on their cognitive and social contexts. Moreover, Hekkert and Cila (2015) have emphasised that product metaphors are effective in conveying functional, social and cultural meanings to users. The product elements that convey such metaphors are presented in terms of form, interaction, material and name (Cila, 2013). From the perspective of users, interpretations of products in human-product interaction can be diverse. Well-known forms and cultures can shift people's interpretations in the same direction (Vihma, 2003).
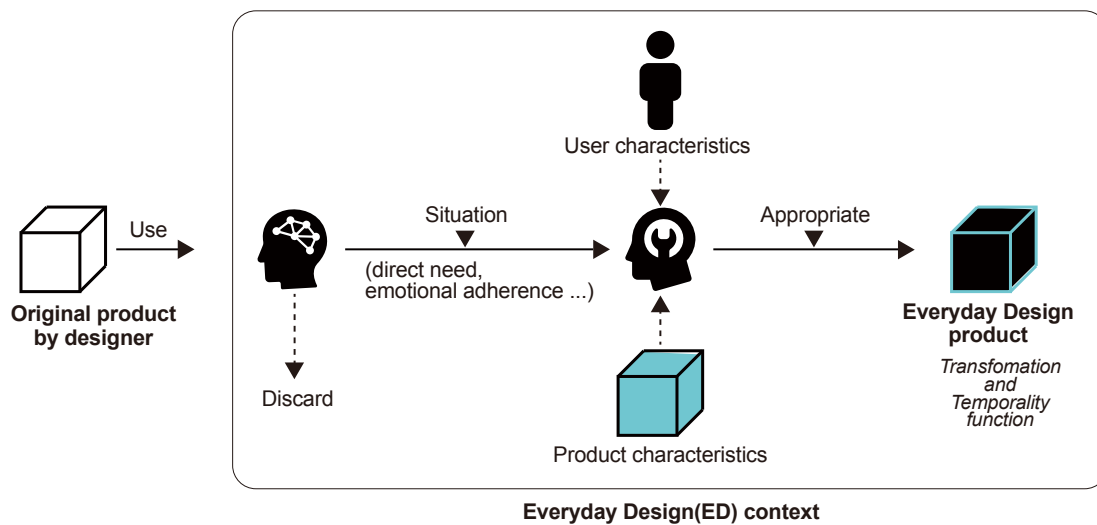
Figure 1. A conceptual framework of the study regarding everyday design behaviour.

In short, triggers for evoking a certain behavior or changing a behavior can be designed through the product and/or it's elements. These triggers are physical or psychological or a combination of both: a physical trigger can have an indirect effect on behavior in that it activates a psychological trigger. Matsumura et al. (2015) showed the example of a trash bin that was made transparent by the designer to encourage people to separate bottles and cans more than a normal, nontransparent trash bin would. This physical trigger elicited pro-social behavior because other people could see if you correctly separated the trash.

Physical and psychological triggers can be defined in different ways (see for example Matsurama et al., 2015). In our study we defined physical and psychological triggers according to Norman's categorization of constraints. According to Norman, constraints "…are examples of the use of a shared and visible conceptual model, appropriate feedback, and shared, cultural conventions." (Norman, 1999, p.41). Symbolic communication is key, having a direct impact on the user's perception of the available behaviour provided in the environment. Norman (1988) suggested four constraints: physical, semantic, cultural and logical. These categories do not only apply to constraints but also to triggers. *Physical* triggers can be based on any visual aspect of the product, further detailed into *form* and *material*. In a previous study (Kim et al., in press) we added *manipulability* as a product element because it shows to play a role as an affordance based on knowledge about how we interact with objects. The theoretical framework of Van Elk et al. (2014) regarding manipulation of objects, is relevant. They assume that interaction with the world relies on learned knowledge, that can be conceived of in terms of both knowing-how (procedural knowledge) and knowing-that (declarative knowledge). In their terminology they use *Action semantics* as knowing-how that consists of the procedural or manipulation knowledge that enables us to grasp objects in a correct fashion and to use objects in a meaningful way. Functional knowledge concerns knowledge about the object's meaningful use and manipulation knowledge involves motor representations regarding the bodily interaction with the object. Relevant for ED is their example of being at a campground

and in need for a hammer to hammer the tent pegs. Because there is no hammer one uses a shoe instead. So, according to their conceptual framework one forms an intention to hammer the tent pegs in the ground, involving a representation of the desired outcome. In the absence of a hammer, one need to select manipulation knowledge to grasp the shoe, but also the functional knowledge about using hammers. They claim that their view is compatible with the idea of affordances, conceived of as possibilities for action that can be acted upon when using the appropriate set of sensorimotor skills.

Following our aim to gather information for professional designers, knowledge about these physical product elements is most close to what they can influence.

Our previous study showed how product elements—subdivided into form, material, and manipulability—operated as triggers for ED. The most frequently used adjectives for form were *flat* and *hollow*, for material were *durable* and *easy to cut/process* and for manipulability were *fix* and fasten (Kim et al., in press).

Regarding the psychological triggers, *Semantic* triggers for ED often start with the archetype of the product inspired by the symbolic form of this original product. For example, reusing a bicycle wheel as a clock reflects the archetype of a round clock. *Cultural* triggers are based on conventions shared by a cultural group. One example would be the design of a low chair without legs in a culture where sitting on the floor is the norm. Thus, cultural information may be influenced by local culture and family culture. *Logical* triggers are based on knowledge and experience of the user. They are often procedural and driven by reasoning. The trigger for ED is based on an understanding of the various elements of the product. For example, aluminum foil can be used as light reflector for a camera.

While our previous study (Kim et al., in press) was based on a database of spontaneously created ED cases in our everyday life, in the study described here we try to identify ED triggering product elements when participants are asked to perform ED on the basis of four products. The focus of the proposed experimental design, therefore, is on controlling how the user recognises ED possibilities in existing everyday products and observing what

role the product, its elements and affordances play as triggers for ED. In ED, the perception of things occurs not only via the direct cognitive effects of the things themselves, but also by indirect perception through (for example) product knowledge and experience, as well as context interpretation.

Affordance and Everyday Design

The phenomenon of being triggered by physical and/or psychological aspects of a product leading to an action comes close to what has been described as *affordance*, a concept originally defined by Gibson (Reed & Jones, 1982) as relationships between the *world and actors (i.e., person or animal)*. In Gibson's theory, all parts of the environment afford some kind of behaviour, such as holding, sitting, eating and so on. Direct perception is key. When we look at objects, we perceive their affordances, not their qualities. Perception is not a reaction to the stimulus, but an active and ongoing process whereby the perceiver—without mental information processes—takes direct advantage of the information that the environment offers.

Norman (1988) also brought the term *affordance* to the attention of designers in his book *The Psychology of Everyday Things*. In slight contrast to Gibson's theory, he viewed the concept as referring "to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction is required" (Norman, 1988, p. 9). Norman employed the term *affordance*, but abandoned Gibson's ecological framework, within which the term was originally developed. Norman distinguished between real and perceived affordances, and assumed that in the design of objects, the former is much less important than the latter. Indeed, perceived affordances tell the user what actions can be performed on an object (Norman, 1999). Gaver's concept of affordance has also been influenced by Gibson's work, referring to the properties of the world with respect to people's interaction with it, with possible actions implicitly related to culture and perception. Gaver (1991) analysed the relationship between affordance and perceptual information and classified them into perceptible affordances, false affordances, hidden affordances and correct rejection.

According to Kannengiesser and Giro (2012), affordances tend to be generalised so that they are no longer described as specific to any individual user, but rather to groups of users or all users. This is apparent in the frequent use of word constructions ending with *-ability* when describing affordances. For example, stairs afford *climb-ability* and shoes *wear-ability*. As such, they can be thought of as general properties of artefacts that may be designed for. In this study, we adopt this way of describing the affordances of the four products used in our experiment and their EDs (see also Figure 2).

Context

Context and situation play an important role in the decision to reuse an existing product for other purposes. Because this study focused on product and product elements, we only took two context variables into account, level of proximity and degree

of appropriation. Proximity is the physical distance between the location before and after ED and will be divided into close, middle, and far. *Close* means that the ED product is used in the same space as the original product. *Middle* means that the ED product is reused in a different location from that of the original product but still in adjacent locations. For example, when the original product was used inside the house and the ED product also but in another room. *Far* means that the ED product is reused in a very remote location, for example moving van inside to outside the house or from home to office. The level of proximity was investigated to consider the effect of spatial alignment on ED product selection (Costantini et al., 2010).

Transformation and appropriation are characteristic for everyday design as it often happens ad hoc in the house with objects that are often present around. In order to study this phenomenon, we looked at the degree in which people tend to appropriate objects for ED. As Desjardins and Wakkary (2013) found that family members are experts at reusing objects as-is to accomplish a different function than the objects' intended ones. Most of the objects and materials used do not need a physical transformation to be appropriated. This *as-is* was, therefore, used as the first category Higher degrees of processing were defined as *remake* and *remanufacture*. *As-is* requires hardly any or no processing. With *remake*, ED products are appropriated in a simple way. With *Remanufactur*e a variety of processing techniques are applied, resulting in major changes. In this study we expect that remake and remanufacture will be more frequent because of the task given to the participants.

Method

In this study, an experiment was designed to enable people to actively undertake ED with four existing products that were provided by the first author.

Participants

A class of 30 students between 20 and 25 years old participated. The main researcher was the teacher of this class. The class comprised three male students and 27 female students. The experiment was part of the XX University art class. The 30 participants were students majoring in visual design, painting, ceramics and animation, but not in industrial design. Data from three participants who did not submit all the cases or who did not answer all of the questions in the questionnaire were excluded. Thus, the results of 27 participants (2 males and 25 females) were included in the experiment results.

Instruments

Products

In the selection of products for our ED experiment, two criteria were adopted based on previous studies (Kim & Paulos, 2011; Sung et al., 2019; Wakkary et al., 2016), complexity of structure and ease of transformation. Structure complexity indicates how

simple or complex a product is in terms of the physical structure. As these studies show, most products used for everyday design were familiar low-tech products often used at home, varying in complexity of structure. The second criterion was ease of transforming an existing product into another product, because as the same studies showed, this was a major factor in the willingness to repurpose products. For structure complexity two values were selected, simple and complex, while for the second criterion easy and hard to transform were chosen. For each of the four values a product was selected. See Table 1 with the products divided over the four values. The limited number of products (four) was motivated by the fact that it was the maximum number to handle for the participants given the time available for the experiment.

Table 1. Selection of products according to complexity of structure and ease to transform.

	Simple structure	Complex structure
Easy to transform	Foil plate	Umbrella
Hard to transform	Plastic bottle	Dustpan

As a disposable product a foil plate is mainly used for camping or outdoor activities. Foil plates have a simple structure, glossy material and are easy to transform. An umbrella has more complicated mechanical features, such as folding and pushing the button, but the umbrella is easy to transform made of flexible steel wire and waterproof vinyl. A plastic bottle has a simple cylindrical shape but is hard to transform because the plastic is not flexible. A dustpan with a broom serves as complex (trapezoidal with a handle) and hard to transform product because of the trapezoidal shape with a handle and the hardness of the material.

Four products were provided to the participants. At the start of the project participants were asked to use all four products for about two weeks. In order to stress its original function and to let the participants intentionally use it the bottle was filled with water. During the project, it rained on 11 out of 50 days, so participants used umbrellas. Participants were asked to create an everyday design (ED) for all four products by re-using it with or without appropriation. Given the number of 27 participants, a total of 108 ED objects were created and used for data analysis.

Reports

Participants were instructed to write a report on a daily basis during the whole project. Reports included written and illustrated text about their inspiration, decisions, experiences, drawings, and photographs of the four existing products and of their created ED products. They also included reporting their satisfaction with the ED products in order to figure out how everyday design behaviour is related to user experience.

Interviews

Two times during the project participants were individually interviewed, and for every interview a standard questionnaire was used. See for a summary of the questions Figure 3.

The first interview was held two weeks after the start when participants had become familiar with the use of the products. In this interview, they were asked about functions and features of each product and their experience with each of them.

The second interview was held at the end of the project. Because this study was mainly focused on product elements and affordances as triggers for ED, the most important questions during this interview regarded participants' reported triggers. See Figure 3 for a summary of the questions.

Product Elements and Affordances

On the basis of previous research, we expected that the detailed physical product elements mentioned would encompass form, material and manipulability.

In order to describe and measure affordances we followed Kannengieter and Giro (2012) in the way they described affordances as general properties, using words ending with *-ability*. In the Introduction we already gave some of their examples like *wear-ability* in case of shoe affordance and *climb-ability* for stairs affordance.

In analyzing the triggers mentioned in the interviews a distinction was made between physical and psychological triggers. Next to the aforementioned physical triggers we categorized the psychological triggers in semantic, cultural, and logical as explained in the Introduction. Two researchers independently defined for each ED product which of these triggers was used. See Figure 2 for an overview.
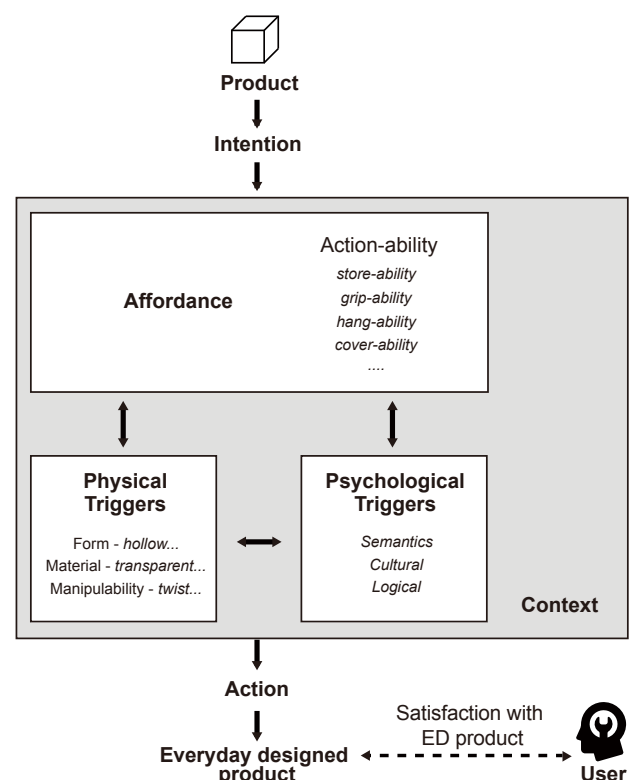
Figure 2. Perceived affordances and perceptual triggers for ED.

Procedure

We employed an empirical approach and proceeded in six steps (Figure 3):

- Step 1: At the start of the project the researcher (first author) informed the participants about the aim and procedure. The idea of everyday design was explained using some examples. Participants were provided the four products and instructed to appropriate them as everyday design products. They were informed that they could process each product using either whole or part and could add whatever they wanted. They were also asked to report during the whole process.

- Step 2: The participants used the four products in their daily life for about two weeks. However, from the beginning they were free to start with ED.

- Step 3: Participants were individually interviewed about the original products. The interview questions focused on the participants' first impressions of the products and their perception of their physical elements.

- Step 4: Participants remade the four products with a new purpose.

- Step 5: Participants used the ED products, which they designed themselves, in a real context.

- Step 6: Based on the participants' final ED products and the reports they created, they were interviewed for 15 minutes about their experiences of product use and the process of reusing products for a new purpose. They were asked to describe what inspired and triggered them in the original product or product

elements and in the situation to come up with this particular ED and to explain how they wanted to use their four ED products. The interview questions also focused on their actual use experience of and satisfaction with the ED products. As can be seen in Figure 3, the entire experiment took 50 days.

Data Analysis

For the analysis interview data, reports and photographs of the participants were loaded in Atlas.ti. This program facilitated the organisation and coding of data from these various sources. To check the Atlas.ti coding scheme's categories for accuracy, two researchers analyzed the 40 interview transcripts and reports. Inter-coder reliability was reasonably high (Cohen's Kappa = .86). Any disagreements were settled in a conference between the two researchers.

A qualitative content analysis (Cho & Lee, 2014; Hsieh & Shannon, 2005) was also used for the transcripts of the interviews and reports. This approach is appropriate when there is a limited existing theory about the topic (everyday design).

On the basis of the first interview, the researchers analysed the usage experience of the four original products provided. Through the second (retrospective) interview and the reports product elements and affordances as triggers for the remake into ED products could be determined.

In order to search for the pattern of qualitative data, the code frequency was counted and aggregated. Qualitative data were used as the underpinning of these quantitative results.
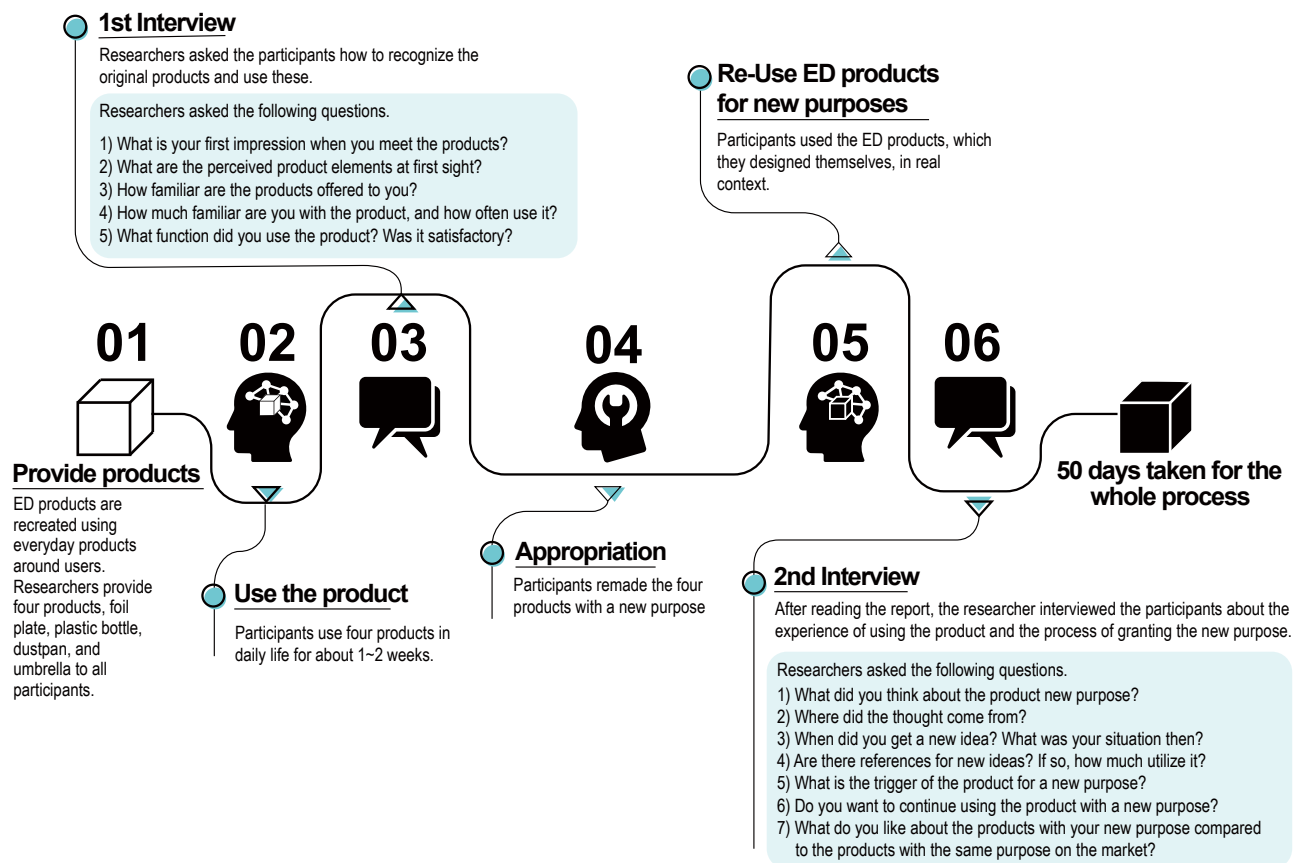

Figure 3. The process of the experiment conducted in the study.

Results

Figure 4 shows an example of a participant's situation and ideas in the course of a participant's ED process. She used a foil plate at an outdoor barbecue, and the ED idea came up from the conversation with her grandmother about the problem of birds ruining the crops in the field. The original foil plate was changed into a scarecrow through simple processing. Context played an important role in the choice of ED while product elements (shiny and sound) were triggers for her idea. In the same way the processes of all participants were analysed.

ED Product Categories

Every participant made four ED products, one for each of the original products: dustpan, foil plate, plastic bottle, and umbrella. Hence a total of 108 ED products were made by the 27 participants. The 108 products were categorised according to the Amazon product classification category, resulting in five categories: (1) home decoration, (2) tool, (3) accessory, (4) hobby and (5) stationery. Unlike the original purpose of the four products provided, home decoration was the most popular with 47%, followed by tool with 28% (Figure 5).
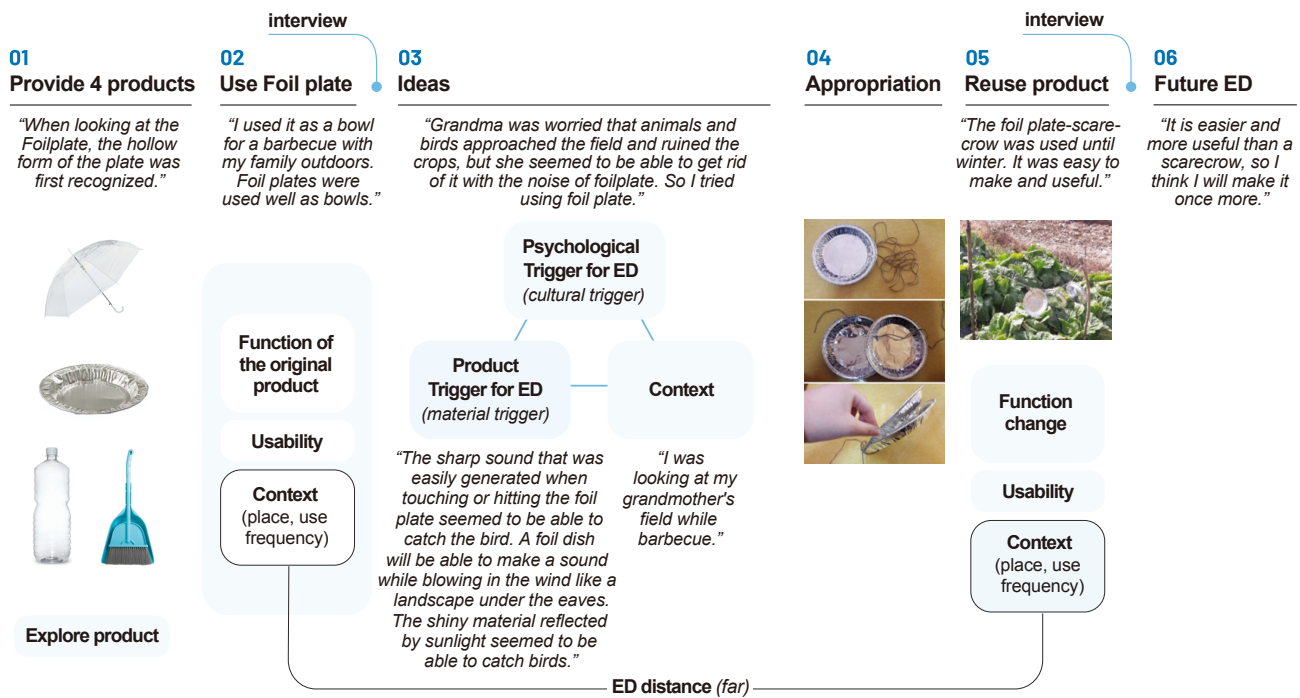

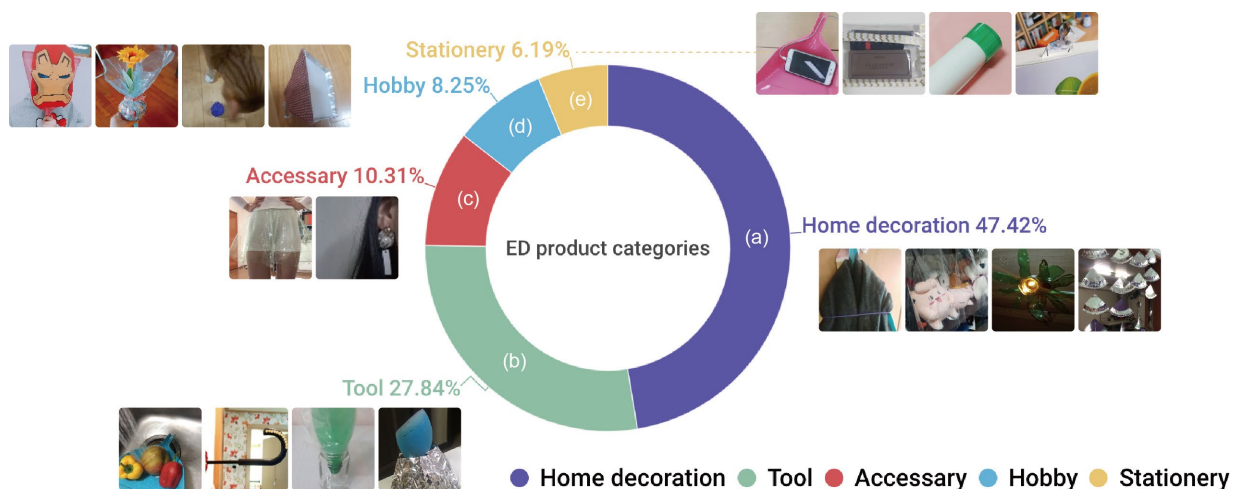**Figure 4. An example of participants' ED production and use process.**

Figure 5. Percentage of ED product categories and examples:
From left, the examples are dustpan, umbrella, plastic bottle, foil plate. (a) organizer, dust cover, lighting, blinds (b) colander, hook, funnel, base (c) skirt, earring (d) mask, wrapping paper, toy, reflector (e) cell phone stand, pouch, paper cover, bookmark.

Product Elements and Affordances

First, we investigated what relation between the two variables which had been used for selecting the four products and the triggers among product elements. The results indicate that product elements as ED trigger are hardly dependent on complexity of structure (Figure 6). Form and material are partly related to the degree to which a product is easy to transform. Among hard-to-transform products form is a dominant trigger, while in easy-to-transform products material is important as trigger. However, we cannot generalize over the two variables, but it depends on the individual product which trigger is used for ED.

Each physical attribute was analysed as a product element that suggested the possible use and action of the product. We divided product appearance into form, material and manipulability, and further detailed it as can be seen in Table 2.

For each of the four products typical form elements have been mentioned, with hardly any overlap between products. The cylinder shape is indeed typical for a bottle, while the frequently addressed trapezium shape for the dustpan is also obvious. Another form element of the dustpan is the hole in the handle, which has often been used in ED. Striking is the lack of form elements for the foil plate as a trigger for ED. The material is here the trigger instead. Manipulability as a trigger can be found for the umbrella with its fold/unfold mechanism.
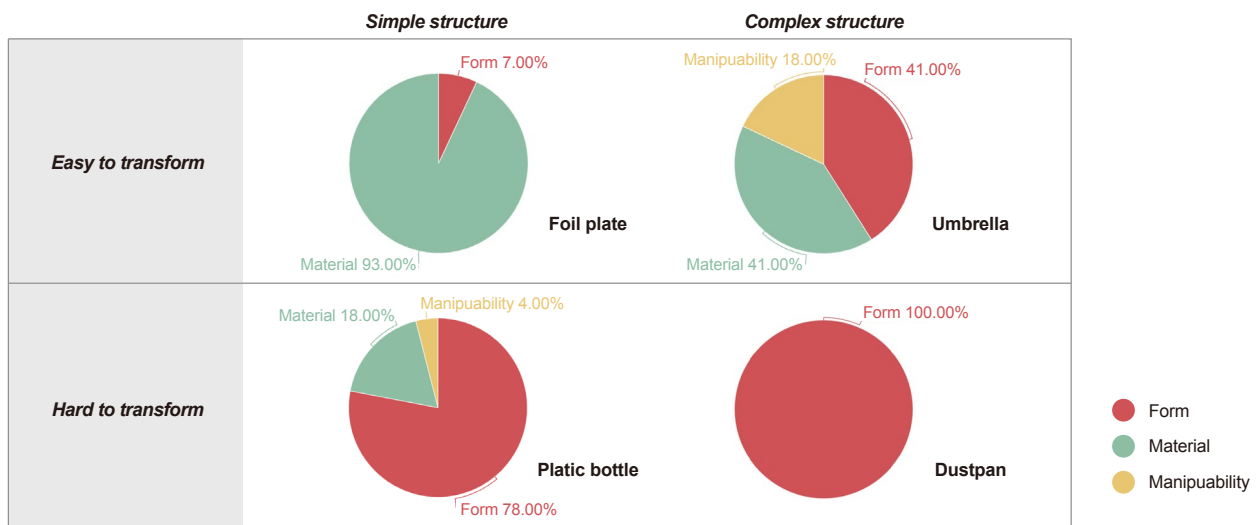

Figure 6. The percentages of product elements as ED trigger according to product selection criteria between products.

Table 2. Frequency of physical product elements mentioned as trigger.

Vocabulary	Dustpan	Umbrella	Plastic bottle	Foil plate	Total Freq.
Form					
Cylinder	-	-	12	-	**12**
Trapezium	10	-	-	-	**10**
Hole	8	-	-	-	**8**
Dome-shaped	-	6	-	-	**6**
Funnel	4	-	-	-	**4**
Flat	4	-	-	-	**4**
Size	2	-	1	-	**3**
Hook-shaped	-	3	-	-	**3**
Frame	-	2	-	-	**2**
Handle-shaped	3	-	-	-	**3**
Circle	-	-	-	1	**1**
Bump	-	-	1	-	**1**
Total	**27**	**11**	**20**	**1**	**59**

Vocabulary	Dustpan	Umbrella	Plastic bottle	Foil plate	Total Freq.
Material					
Transparent	-	5	3	-	**8**
Reflection	-	-	-	7	**7**
Flexible	-	-	1	5	**6**
Waterproof	-	4	-	2	**6**
Easy to process	-	-	1	4	**5**
Sound	-	-	-	4	**4**
Weight	-	-	-	2	**2**
Texture	-	-	1	1	**2**
Durable	-	2	-	-	**2**
Total	**0**	**11**	**6**	**25**	**42**
Manipulability					
Fold–unfold	-	5	-	-	**5**
Twist	-	-	1	-	**1**
Total	**0**	**5**	**1**	**0**	**6**

Affordances have been defined as the general properties of an object that trigger individuals to undertake a particular action as they interact with its perceptual information. In the transformation of an original product to an ED product, we examined the affordances that triggered the creation of these ED products. In Table 3, these affordances are described with words ending with *-ability*, such as *fold-ability* and *control-ability*. The table highlights how affordances varied depending on the product. The dustpan was described in terms of store-ability and hang-ability; the foil plate decoration-ability and sound-ability; the plastic bottle cover-ability and store-ability; and the umbrella cover-ability and hang-ability. The most common affordances among the four products were store-ability with 24 cases and hang-ability with 23 cases.

Contrary to the perception of product elements, affordances are mainly derived from the product as a whole.

There were many creative and fresh instances of ED that utilised a hidden affordance of the original product: plastic bottle was 6 cases (22.2%), foil plate was 23 cases (85%), dustpan was 10 cases (37%), and umbrella 16 (59%). It means that half the ED products were based on hidden affordances (51%).

Figure 7 presents examples of hidden affordances: (a) By using the thickness of the dustpan's handle, one participant measured the amount of spaghetti for a single serving. (b) The aforementioned example of foil plates used as a scarecrow. (c) A plastic bottle as a toy for a cat. The participant made this toy by drilling holes in the plastic bottle and filling it with beads and food. When the cat obtained food from the plastic bottle, the bottle provided fun sounds as well.

In Figures 8-11, the relationships between physical product elements and affordances are presented for each of the four provided products and their ED products. Black hexagons represent affordances and white hexagons the product elements mentioned for the particular product. The colours of the outlines of the white hexagons represent the product element category: green for the category *Form*, orange for *Material* and yellow for *Manipulability*. Associated black and white hexagons are linked to each other. For example, store-ability is associated with the product form element's *size*, *perforated* and *trapezium*. Trapezium is not only associated with store-ability but also with *put-ability, stand-ability* and *scrub-ability* (Figure 8).

Table 3. ED affordances of each product.
The colour of the chart is white when there is no case, and the tone becomes darker as the number of cases increases.

Affordance	Dustpan	Umbrella	Plastic bottle	Foil plate	Total Freq.
Blind-ability	1	0	0	0	1
Channel-ability	2	0	1	0	3
Cover-ability	0	11	3	2	11
Dig-ability	1	0	0	0	1
Decorate-ability	0	1	3	7	11
Fix-ability	0	0	2	1	3
Fold-ability	0	2	0	0	2
Hang-ability	9	11	0	3	23
Mark-ability	1	0	0	1	2
Measure-ability	1	0	0	0	1
Organize-ability	0	0	2	0	2
Put-ability	1	0	0	0	1
Reflect-ability	0	0	0	1	1
Roll-ability	0	0	1	1	2
Scrub-ability	3	0	0	0	3
Sharpen-ability	0	0	0	1	1
Soud-ability	0	0	0	4	4
Stand-ability	3	0	2	1	6
Store-ability	5	2	13	4	24
Heat-resistance-ability	0	0	0	1	1

Figure 7. Examples of using hidden affordance.

Dustpan

The results show that there are many cases of reusing forms of an original product element. For the dustpan there were nine cases in which hang-ability was the trigger, using the hole of the handle. This hole is designed to hang the dustpan, but the participants used it for various purposes. For example, the dustpan could be hung on the door handle and used as a signboard (Figure 8d). The dustpan was also used as a cloth hanger. The store-ability was the second most common affordance, with the form trapezium, size, and hole. The trapezoidal form was designed to contain the garbage collected by the broom (Figure 8b). It was reused in ED as storage for various purposes. Unlike the other products offered, the product elements that led to the new ED in the dustpan were all manifested in terms of form.

Umbrella

The main affordances of the umbrella were cover-ability and hang-ability. These affordances were similar to the original functions: to put up umbrellas and hang them when they are not being used. However, various product elements were mentioned in relation to both cover-ability and hang-ability. Water resistance, durable, dome, and transparent provided cover-ability. For example, one participant used the dome form of an umbrella to make a cover for a turtle house. Other participants used the

umbrella's waterproof materials to cover paper (Figure 9b). Hang-ability was provided by its frame, handle, dome, and durability. For example, one participant used the handle of the umbrella as a hook (Figure 9e).

Plastic Bottle

Compared to the other products offered, store-ability was most frequent (13 cases) which is triggered by the cylinder and funnel form. Participants used the cylinder and funnel form to make a plant pot (Figure 10c) or toothbrush storage (Figure 10d). When starting from the cylinder form a variety of other affordances were attracted, such as cover-ability, decoration-ability and store-ability (Figure 10).

Foil Plate

The main product element of the foil plate that led to ED was its material. Compared to form and manipulability, material was more closely associated with various affordances. For example, participants linked cover-ability, fix-ability, and store-ability to the flexible foil plate material. As shown in Figure 11, various forms were made by using the flexible material. Moreover, the foil plates presented lots of affordances because of hidden affordances. The number of affordances was higher than the product elements of the foil plate for ED.
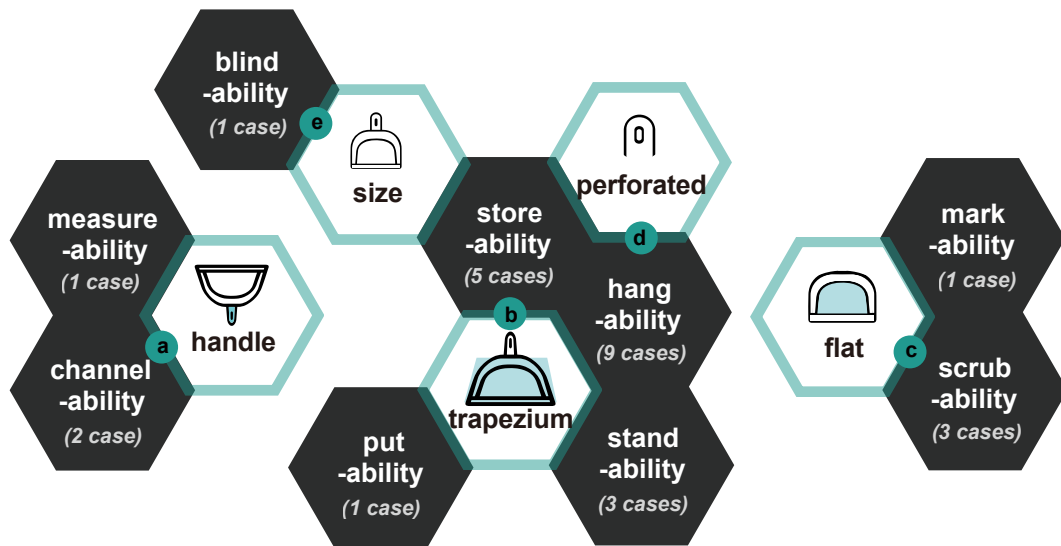
Figure 8. Relationship between the affordance and product elements of the dustpan with examples:
(a) channel-ability was facilitated through the handle; (b) store-ability via the trapezium; (c) scrub-ability through its flatness;
(d) hang-ability via its perforated form; (e) measure-ability via its size.
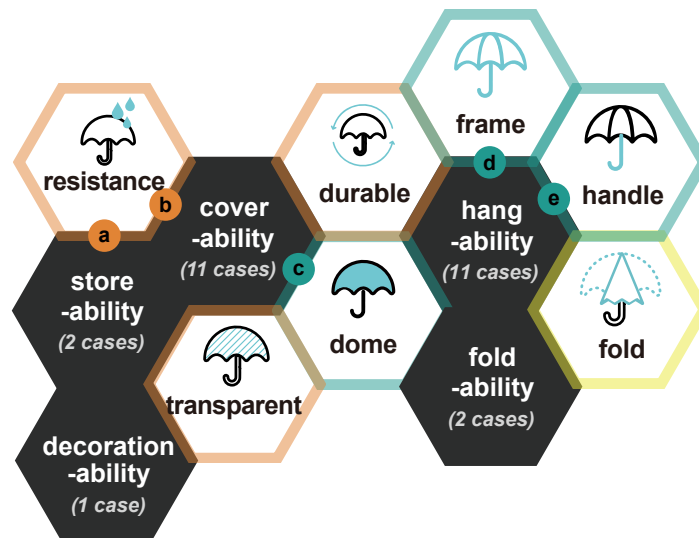
Figure 9. Relationship between the affordance and product elements of the umbrella with examples:
(a) store-ability was provided through water resistance; (b) protect-ability via (water) resistance; (c) cover-ability through its dome shape; (d) hang-ability via the frame; (e) hang-ability via the handle.
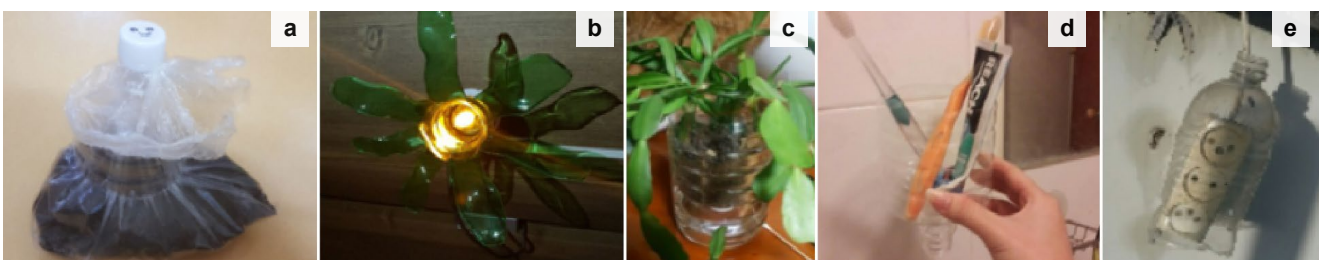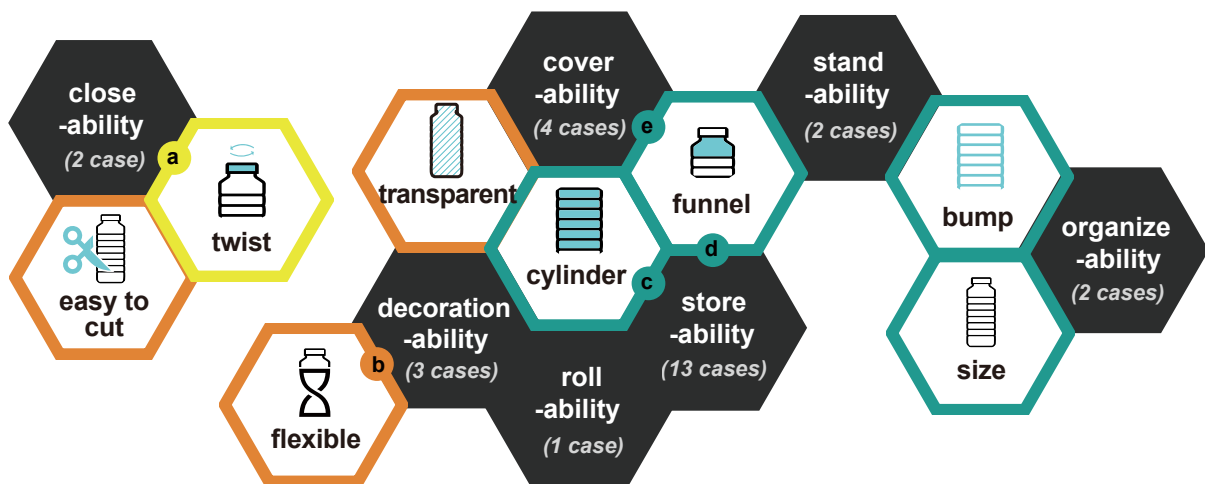
Figure 10. Relationship between the affordance and product elements of the plastic bottle with examples:
(a) close-ability was provided through the twisting cap and top; (b) decoration-ability via its flexibility;
(c) store-ability through its cylinder shape; (d) store-ability via its funnel shape; (e) cover-ability via its funnel shape.

Figure 11. Relationship between the affordance and product elements of the foil plate with examples:
the flexible nature of the foil plate material was associated with affordances. (a) It was also used to hold glasses; (b) to fix strings;
(c) to support cosmetic sponges. The texture of the foil plate was related to (d) its sound-ability and (e) sharpen-ability.

Psychological Triggers and Affordances

The results presented in Table 4 show the psychological triggers that affected the affordance of each of the four products. Looking at the most frequent affordances—store-ability, hang-ability, cover-ability, and decorate-ability, all three psychological triggers play an important role except for decorate-ability where the logical constraint is dominant. With this affordance it is obvious that semantic and cultural triggers hardly play a role because changing a functional object into decoration has more to do with creativity than with the (functional) archetype of the object or with cultural conventions.

Semantic triggers are often based on the archetype of the product. For the dustpan the trigger was not only the form of the pan but also the hole in the handle. "Is the hole in the dustpan trying to hang it? I used the dustpan as a signboard by hanging it on the door." (Participant A, the left one in Figure 11). See also other examples of semantic triggers in Figure 12.

However, semantic triggers also link to hidden affordances. Two participants used the dustpan as a laptop stand (Figure 13). "When I flip the trash can, it looks like a laptop stand. Because of the similar shape, I used it as a laptop stand." (Participant B)

Cultural triggers are mainly related to store-ability and hang-ability. Store-ability is often mentioned in relation to the plastic bottle. Participants had experience using plastic bottles as

storage containers for various purposes. "When I was in elementary school, I remembered that my mother and I put soybeans in a plastic bottle and put water under them to grow sprouts. I started because I could grow plants like sprouts" (Participant E, the left one in Figure 14). "When I was drawing, I cut it and used it as a bucket. I always thought plastic bottles were good things to hold." (Participant F)

Logical triggers seem to have a strong connection with the material of the object. Five participants made an ED product using the characteristics of the shiny Foil plate.

> I tried to make a reflector for my cell phone by using the reflecting point of the silver foil plate. In order to make the reflector more than just reflecting light, I looked for data on the shape of the reflector. (Participant C, the left one in Figure 15)

Logical triggers reconstruct the information the participants have.

> People bake pies with foil plates. So, I thought I could cut the foil plate and bake it in the desired shape. Because the foil plate is easy to cut. So, I tried star-shaped egg fried. (Participant D, the right one in Figure 15)

Surprisingly, when an affordance is mentioned for only one object (see Table 4), and thus very specific for that object, the logical trigger for that affordance is very dominant (10 out of 20 cases).

Table 4. Frequency of affordances with psychological triggers.

Sharing among the four objects	Affordance	Psychological trigger			
		Semantic	Cultural	Logical	Total
Shared by at least two objects	Store-ability	8	9	7	24
	Hang-ability	16	4	3	23
	Cover-ability	6	3	7	16
	Decorate-ability	2	1	8	11
	Stand-ability	4	1	1	6
	Channel-ability	1	-	2	3
	Fix-ability	-	1	2	3
	Mark-ability	-	-	2	2
Only for one object mentioned	Sound-ability	-	2	2	4
	Scrub-ability	2	-	1	3
	Fold-ability	2	1	1	2
	Organize-ability	-	1	1	2
	Roll-ability	-	1	1	2
	Blind-ability	-	-	1	1
	Dig-ability	-	-	1	1
	Measure-ability	-	-	1	1
	Put-ability	-	-	1	1
	Reflect-ability	-	-	1	1
	Sharpen-ability	-	1	-	1
	Heat-resistance-ability	-	1	-	1
Total		41	25	42	108

Figure 12. Examples of semantic triggers using the meaning of the original product elements: hang-ability using the hole of the dustpan (left), cover-ability using the dome-shape of the umbrella (middle), hang-ability using the handle-shaped of the umbrella (right).

Figure 13. The semantic trigger connected stand-ability and trapezium of dustpan:
participant's laptop stand (left) and archetype of a laptop stand (right).

Figure 14. Examples of cultural triggers:
based on the experience of reuse, participants made a plant pot using store-ability (left), and made lighting using store-ability.

Figure 15. Examples of logical triggers:
based on the participants' knowledge, a reflector for cell phones (left) and a mold of egg fryer (right) were made.
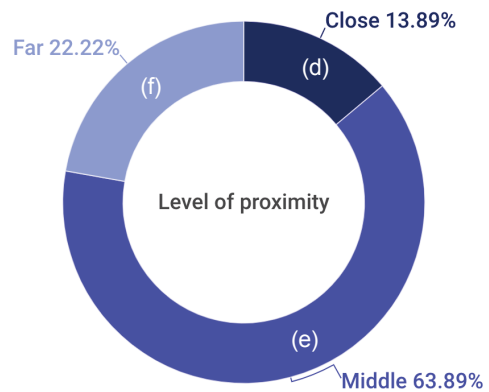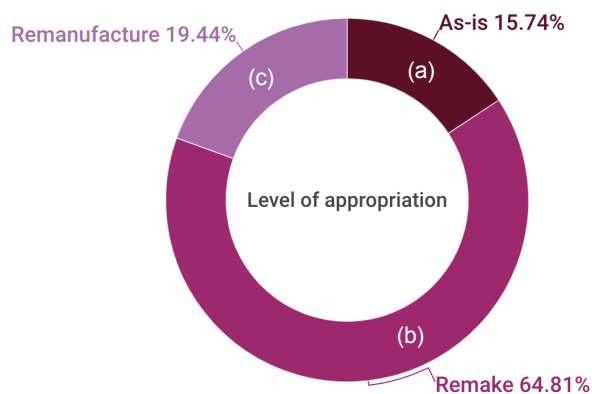
Appropriation and Proximity

The degree of appropriation was categorised as as-is, remake and remanufacture. The use of the dustpan as a colander without any appropriating was an example of as-is (Figure 16a). Cutting a plastic bottle and using it as a funnel was an example of remake (Figure 16b). Creating a lampshade by melting a plastic bottle was remanufacture (Figure 16c). A total of 64.8 % of the ED products was remake, 15.7% was as-is and 19.4 % was remanufacture.

The second context variable we were looked at was the distance of use between the original and the ED product, defined as the level of proximity. Three categories were distinguished: close, middle, and far. With 13.9% close was the smallest category. An example of close was a chair in the bedroom used to hang clothes on: the reuse remained in the same room. Middle distance hold for 63.9% of the ED products, the most frequent one. The use of a dustpan as a scraper (Figure 16e) was defined as middle

because it had moved rooms. 22.2% of the ED products had a far distance to their original products. For example, the foil plate used as scarecrow: from indoor to outdoor (Figure 16f).

Transformation and Temporality of Function

We analyzed the degree of change in function of the ED products. See also Figure 17. Most participants focused on creating new functionality rather than on the existing functionality of the product offered. In 28% of the cases the function of the ED product was an extension of the original function, but 72% of the ED products had a completely new function. Decorated plastic bottles made as candle holder was one example of the plastic bottle's function addition or extension (Figure 17a). On the other hand, the use of the toy that mad sounds by putting seeds in a plastic bottle was an example of a completely different function (Figure 17b). Asking participants if they were going to use their ED products only

Figure 16. Percentages of level of appropriation and ED distance.

temporarily or for a longer time, 79% of them would use them for a longer time. An example of longer use was the umbrella plastic as a cabinet cover (Figure 17d). An ED product for temporary use was using the dustpan as a scraper (Figure 17c).

Satisfaction

Figure 18 shows that participants were in majority satisfied with making and using their ED products. The usage of plastic bottles as ED proved most satisfactory with 89%. Next was the remake of the dustpan with 78%. We can note that the ED of these two products were most reused in accordance with the (functional) affordance of the original product. In particular, the store-ability of the plastic bottle and the hang-ability of the dustpan led to a high satisfaction level. ED, as well as the use of the product, material and process aspects influenced the satisfaction of ED.

Regarding the satisfaction about the making, for three products *easy to make* was a reason. As can be expected, this was not mentioned for the umbrella. Participants also expressed

their proudness about the result of their ED product(s) either as something what they made themselves or addressing the uniqueness and beauty of their design.

Regarding the satisfaction with the use of the ED product, economic benefit was the most often mentioned reason for satisfaction, followed by usability.

Discussion

The many examples of everyday design both from practice and from literature show that this widespread phenomenon needs more attention from professional designers. This and other studies can raise awareness among designers and inspire them to build in triggers in their new designs. While previous research states that affordances are important in triggering ED, our study was systematically focused on these triggers, particularly those generated by visual elements of products and perceived affordances. Hence, the focus of the study was on physical products although we realize that the act of everyday design can be influenced by user characteristics and situation as well.
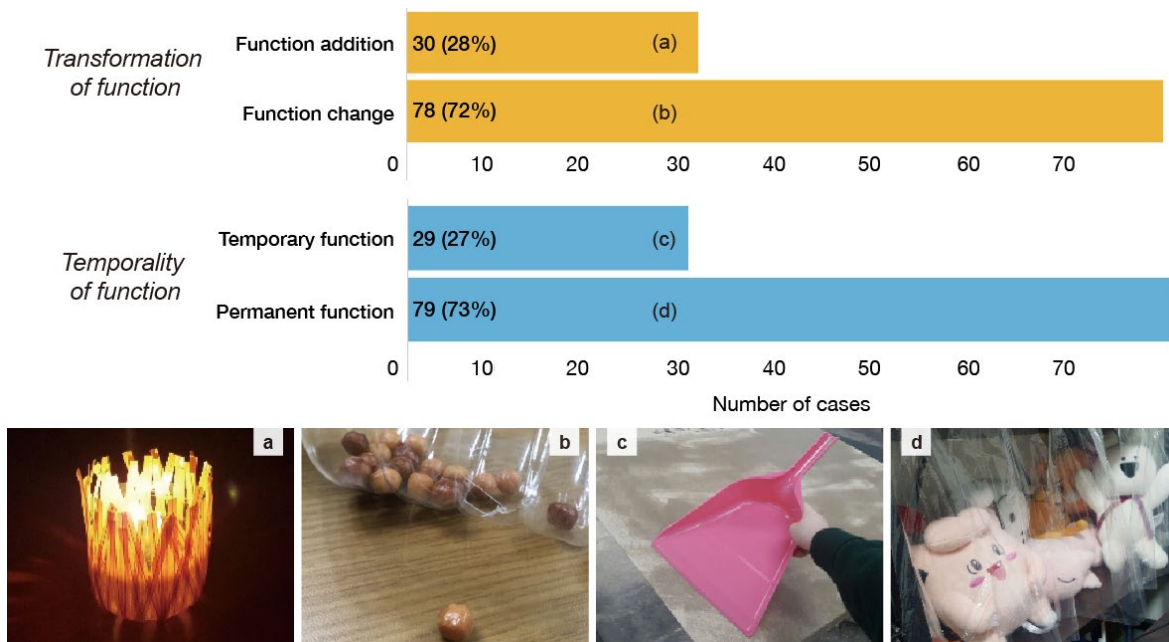

Figure 17. Frequency of ED cases in terms of the temporality and transformation of function.
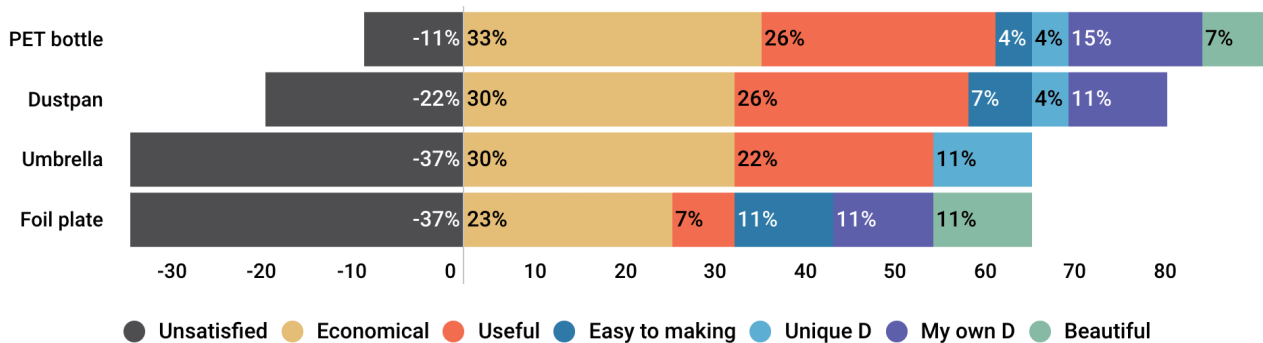

Figure 18. Participants' satisfaction with making and using ED products based on the four original products.

Besides, we have to bear in mind that in this study it is not about spontaneous performed everyday design in a natural setting, but about an explicit task for participants to perform ED in a more or less controlled situation. In reality, it is very hard to investigate the process of ED in a natural setting in detail unless we are at the scene of doing ED next to the user. Considering the constraint, a retrospective interview might have been an alternative method: asking questions to an interviewee who brings in his/her ED product made in the past. However, in retrospective interview people report what they remember (primary effect and recency effect) because it is hard for them to remember in detail the whole experience: the data collected from a retrospective interview might limit a complete understanding of their perception, motivations, and behaviours involved during the ED process, due to the inevitable bias caused by the recalled memory. Therefore, a controlled experiment was employed as an alternative method. Although the study has a character of controlled experiment, we tried to let all participants do ED in a as much natural context as possible. For example, a month was given for the participants to use and get used to all four products as an at-home assignment and also another month for reutilizing the products. In this way, we believe the study might reduce the primary difference between a spontaneous process and a tasked process of ED although the study did not completely reflect the natural spontaneity of the process. Nevertheless, this study has potential drawbacks of employing such a controlled experiment. We may not capture the reality of what occurs in nature. There may be also other parameters that influence the result that we haven't even identified yet. For instance, the findings were based on four products in a home context only, selected by the researcher. In spontaneous ED, we might be able to find more diverse ED cases not only for decoration but also for tools, organization, toys and so on without being limited by the experimental stimuli as well as the nature of forced tasks. Thus, the findings of the study might not generalize to real-world settings. It has a character of a qualitative exploratory study, not meant to directly generalize the findings to the designers' practice, but as a first study to understand the process in ED, and the triggers that lead to ED. The results presented here have to be validated in future research.

The main research question of this study was: What product elements trigger everyday design (ED)? The results of this study show that physical product elements are important triggers for ED. From our study it becomes clear that these elements are partly very specific for each product and cannot be generalized to the elements of other products. However, it is relevant information for designers to be aware that some specific product elements have a higher probability of triggering ED than others. For example, the cylindric form of the plastic bottle has often been reused for ED.

Affordances are closely linked to the physical elements of products. It turns out that the perception of a product leads to multiple affordances. For example, the dustpan can be seen as a container (store-ability) and reused to put fruit on, but it also acquires the function of a display board because of the perceived hang-ability (the hole in its handle). The store-ability of plastic bottles represents a trigger for the reuse of the original product in various ways, such as a flowerpot or a small organiser. For the umbrella the dome shape affords cover-ability, the handle hang-ability and the fold/unfold mechanism the fold-ability. And these affordances provoke different actions with various ED outcomes.

Because affordances are based on the perception of a product, it's elements and the context, they are also quite specific for that specific product. However, the most frequently perceived affordances are found among the four products: store-ability, hang-ability, cover-ability, and decorate-ability.

In sum, the product elements and affordances of these and other products give ample opportunities for creativity, not only as user but also as professional designer.

When comparing the perceived affordance of an original product and an ED product, the results show that in half the cases ED reflects the original intended functional affordance of the original product, but the other half got another function often based on hidden affordances. Again, this high frequency of hidden affordances was partly an effect of the experimental setting. Participants were asked to perform ED and hence were challenged to use their creativity. Because hidden affordances are difficult to predict, consciously designed triggers in new products should therefore be based on functional affordances. Designers communicate information that primarily implies the use of the product through their forms (Blijlevens et al., 2009; Bloch, 1995). Participants' information is presumed to form and develop during their use and adaptation of a product. Perceived as well as hidden affordances are manifested by perceptual experience and active exploration (Dant, 2004; Gaver, 1995; Gibson & Pick, 2000). Take for example the use of the sound of a foil plate to scare off birds in a field. If the affordance were merely presented by direct perception, it would prove difficult for the participant to know how the material of the product sounds. Hence, it is not only the form of the product that evokes an action, but also the experience of manipulating the product, and in this case discovering its material qualities.

For the contemporary designer Everyday Design can be considered as a different way of thinking about how to design objects in such a way that the re-use of those objects will be triggered. The analogy with *Readymade* or *Found object* (objets trouvés) springs into mind, the art form in which everyday objects were inserted into an art context thus transformed from non-art to art.

Although Readymade was already known from the 16th century on, it was Marcel Duchamp who's Readymade invented a new category of artworks composed entirely out of manufactured, pre-made objects that stood on their own as autonomous works of art. He started developing the idea of the Readymade after he placed a bike wheel on a stool one day in his studio, and from there experimented with other forms including either objects he selected on their own or adapted or changed in some small way. For Duchamp, the Readymade is in direct conversation with industry and manufacturing: by taking mass-made objects and elevating them by putting them in new contexts and defining them as art, he questions the very process through which something becomes art in the first place. Duchamp's work was extremely influential in both art theory and practice and influenced many of his contemporaries and recent artists.

Why making this analogy between ED and readymade, while the goal of re-using objects is so different? It has to do with the fact that these artists wanted to rethink the way that humans interact with objects in general, and how through techniques like estrangement or assemblage, new associations could be generated. This is exactly what designers should do, not for the sake of art but to stimulate the creativity of users in the re-use of the designers' original objects.

When participants were asked what made their ED products most satisfactory, they mentioned the economic advantage and the practicality and functional usefulness of ED products. Even more interesting was their satisfaction based on the fact that they were proud of their ED results. Although the satisfaction of the participants is not the main aim of the study because of the artificial situation, it would be an interesting finding in the sense that ED can make people enthusiastic because after they did ED, they are proud that they have done it. In cultures like South Korean this activity, particularly DIY, is not common. This might imply that design practitioners can make people aware through their design that ED (and DIY) is pleasing for users in a way to increase their self-esteem. If designers could only feed this proudness of users, it would already stimulate the internal motivation to perform ED.

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