SAVE A NAPKIN, SAVE A TREE: THE ROLE OF METAPHORS IN PRODUCT DESIGN TO CHANGE BEHAVIOR

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ABSTRACT

In this paper we study the role of metaphorical design concepts in triggering a mindful consumption behavior. Through a retrospective study on persuasive metaphorical designs for behavior change, we identified 7 persuasive heuristics for using metaphors for behavior change. According to the ELM of persuasion and persuasive effect of visual metaphors, we hypothesized that the use of persuasive metaphors in design of a napkin dispenser increases the mindfulness of the users, presumably through a central route and would increase the probability that people make more informed decisions and use fewer napkins. We used persuasive metaphor heuristics to design a metaphorical napkin dispenser to inform people about the consequences of their excessive consumption on the environment and encouraged them to use fewer napkins. In a local coffee shop, we measured napkin consumption using three different napkin dispensers: the original dispenser with no metaphor, one dispenser that shows metaphorical connotations of sustainable consumption, and a dispenser with a non-conservation metaphor . The results suggest effective behavior change in response to the consumption related metaphorical design.

Keywords: design metaphors, persuasive product design, behavior change, sustainable design, design heuristics

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1   INTRODUCTION

Design for sustainability has emerged from technical disciplines, such as mechanical engineering, and has focused mainly on product design and tools such as life cycle analysis (Consolvo et al., 2009). To be effective, technological advances should be accompanied by changes in actual consumer behavior (Derijcke and Uitzinger, 2006). For instance, we install compact florescent bulbs but forget to turn them off when leaving the room, or drive fuel-efficient vehicles but overuse them assuming they have less environmental impact. The challenge is both technical and behavioral. Failure to recognize the role of behavior will prevent us form realizing the full potential of new sustainable technologies. Government policy responses, in the form of educational, economic and legal measures, often aim to address this issue (Lockton et al., 2008), but there is an opportunity for design to influence behavior as well. That is, designed environments can create a demand, an incentive, or a "nudge" (Thaler and Sunstein, 2008) for people to behave in certain ways. This paper argues that "mindful consumption" behavior (De Young, 1996; Badiner, 2002) can be triggered through consumption-related visual metaphors in the design of products. We explore this hypothesis through the design of a napkin dispenser and study the effect on napkin consumption rate in an actual retail location. Before presenting the details and findings of our study we review relevant academic literature.

2   PREVIOUS SCHOLARSHIP

Lilly et al. (2005) define three types of product-led interventions for designers wishing to minimize environmental impact during the use phase, *eco-feedback*, *scripting*, and *forced functionality*. In eco-feedback, product users are informed of the impact of their behavior hoping to encourage behavior that minimizes environmental impact. For example, in the Prius automobile from Toyota Motor Company, an instantaneous fuel consumption gauge displays the current rate of fuel consumption, compares the fuel consumption over contiguous 5-minute intervals, and displays driving behavior (Figure 1a). Scripting refers to triggering sustainable use by either creating obstacles for unsustainable use or by making sustainable behavior relatively easy. For instance, appliances (Ernevi et al., 2007) behave erratically and do not function properly when the user consumes too much energy. Forced functionality refers to intelligent products that adapt to changing circumstances or to product features that prevent unsustainable behavior (e.g., sensor-activated light switches or faucets).

Another approach for behavior change through product design is Volkswagen Corporation's *fun theory* (Volkswagen, 2011) that encourages behavior change by allowing people to see the fun side of mundane, everyday activities. The "world's deepest bin" (Figure 1b) produces a sound resembling an object falling down a very deep pit when a piece of trash is put into the bin and it is a successful example of making a mundane, everyday behavior (throwing out trash) fun.

Figure 1. a: Toyota Prius Fuel Gauge (alternativefuels, retrieved 2012), b: World's Deepest Bin with audio feedback, Stockholm (Volkswagen, 2011)

These strategies are appropriate for specific behaviors, use context, and designer intent. The fun theory seems to be effective while the product is novel and intrigues the users' curiosity. Forced functionality has no educational aspect and people may return to their previous behavior once the intervention is removed. Scripting can be annoying to the user when the product does not function well and can make people stop using the product. Eco-feedback has widely been used and some studies show that

providing users with information about real-time consumption rate encourages them to use less energy (Darby, 2000). An overall assessment from reviewing the literature is that relatively little empirical research has assessed the effectiveness of these strategies at producing the intended behavior change, or at comparing the relative effectiveness of such design strategies.

Designers integrate consumption-related metaphors into their products by implicitly letting the users know when their behavior is wasteful (Kappel and Grechenig, 2009; Vollnik and Meertenz, 2006; Backlund et al., 2006). For example, the *Poor Little Fish* basin offers an emotional way to persuade users to think about saving water, by lowering the water level in the fish tank (containing a live fish) while you wash your hands, Figure 2 left. An electronic withering flower signals you are consuming too much energy by "dying" and changing color, Figure 2 right. The purpose of a metaphor is to make people understand and experience one kind of thing in terms of another (Lakoff, 1980). Metaphors can explain an abstract concept in a concrete way that people can relate to more readily, and they serve as a powerful tool to comprehend the world in different ways.

Figure 2. Little Poor Fish basin (left; (http://www.inewidea.com, accessed 2012), withering flower (right; http://www.goodcleantech.com, accessed 2012).

Application of metaphors into product design is relatively new and sparse (e.g., Cila, Hekkert and Visch, 2010) and available scholarship is largely theoretical, so the empirical evaluation presented here contributes to this new area of investigation.

3   THEORETICAL BACKGROUND

According to the Elaboration Likelihood Model (ELM) of persuasion (Petty and Cacioppo, 1986), there are two routes to persuasion, the *peripheral route* and the *central route*. Through the peripheral route (low elaboration), a person considers outside factors such as the environmental characteristics of the message. The peripheral route is a mental shortcut process that accepts or rejects a message based on cues (attractiveness, credibility, etc.) as opposed to actively thinking about the issue. The central route (high elaboration) process involves careful evaluation of a persuasive communication in which a person considers the merits of the arguments (being reliable, well-constructed, and convincing) behind the message. Although behavior change through the peripheral route is more likely to happen quickly, behavior change through the central route is stronger and more lasting. Central processing requires attention and mindfulness, described as "bringing one's complete attention to the present experience on a moment-to-moment basis" (Marlatt and Kristeller, 1999) and as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (Kabat-Zinn, 1994).

Every day we feel "bombarded" with persuasive communications (Pratkanis and Anderson, 2001), our living space becomes an environment of overwhelming stimulation, and so we grow increasingly insensitive (Milgram, 1970). Attention becomes a scarce resource and mindfulness is required. One strategy to stimulate attention is to create *fascination*. Kaplan and Kaplan (1987) argue that a fascinating process is, in the largest sense, the process of coping with uncertainty. Understanding metaphors involves uncertainty, and thus it might seem fascinating. However, such fascination depends on an individual's personal cognitive responses to the metaphor. Making sense of metaphors also requires careful scrutiny of a persuasive communication and higher cognitive processing, and it is an example of central route processing. Studies show that using metaphors in an argument can be beneficial and more persuasive when compared to just using a literal argument (Sopory and Dillard,

2002). Making the connection between the product being presented and the message being expressed is a complex cognitive process (Jeong, 2008). This complexity might make people more curious about understanding the potential mystery of the communication. Studies on picture superiority effect suggest that visually-oriented messages seem particularly appropriate under conditions where audiences are less motivated or capable of semantic processing (Childers and Houston, 1984). McQuarrie and Phillips (2005) show that attention and motivation to process ads containing visual rhetorical figures will be higher relative to ads that do not contain rhetorical figures (Mothersbaugh, et al. 2002; Toncar and Munch, 2001).

With regards to product design, the effectiveness of the peripheral route in behavior change was documented through the study of the effect of visual salience on recycling behavior (Montazeri et al. 2012), but, overall, the role of the ELM in the design of consumer products has not been studied in depth. In this paper we apply a consumption-related metaphor to the design of a product (napkin dispenser) to encourage mindful consumption of napkins and examine behavioral responses.

4 HYPOTHESIS

We hypothesize that metaphorical design concepts encourage mindful consumption of napkins, presumably through a central route of persuasion. In other words, if we use consumption-related metaphors in the design of a napkin dispenser, we can increase the users' awareness about their behavior and its consequences on the environment. If this argument is congruent with their beliefs (attitude), they are more likely to make a more informed decision about their real need and use fewer napkins. We predict that visual metaphors will elaborate the informative message in a more concrete, succinct, and effective way and encourages people to practice more environmentally cautious behavior. Formally, our hypothesis can be stated as: Visual metaphors in the design of a napkin dispenser encourage mindful consumption of napkins. We assume that the message needs to be congruent with users' attitude (beliefs) but the present study did not elicit attitude information so this assumption cannot be checked.

5 STUDY 1: RETROSPECTIVE ANALYSIS OF PERSUASIVE METAPHORICAL DESIGNS

An extensive literature review was conducted to find a systematic way of generating persuasive product metaphors. Despite the popularity and importance of metaphors in product design, limited research has been done on this topic and there is no evident theoretical framework for explaining the processes underlying persuasive metaphor generation and reception in products. Hence, we conducted a retrospective study on products that use metaphors to convey a persuasive message (in order) to encourage a desired behavior.

5.1 Method

We collected twenty-four (2D and 3D) designs from the Internet in advertising and product design that embody metaphorical connotation and encourage people to behave in a certain way. These designs indicate persuasive connotation for behaviors such as donation, energy conservation, mindful consumption, safe driving, smoking cessation, dieting, and anti-littering (Figure 3 presents three example designs). A coder with background in industrial design was employed to conduct the analysis. For each design, the coder identified the metaphor connotation, the source and the target of the metaphor. Then, the coder analyzed each design to find the apparent strategies the designer has used to make the design more persuasive and effective.

5.2 Results

The seven design strategies most frequently used by designers in the sample of designs were identified and defined as:

1- Give an informative message: All of the studied metaphors connote a persuasive message about a specific behavior. This informative message frames the foundation of metaphor based on which the designer selects the relevant source and target.
2- Use a slogan: In order to help the users understand the meaning behind the visual metaphor, sometimes designers use a slogan to clarify the meaning and control for cultural variation (Figure 4).

3- Create a feeling in the user (reward/punishment): Create reward/satisfaction feelings if their behavior is congruent with design intention or guilt/punishment feeling if otherwise (Figure 4).
4- Exaggerate the scale of impact (Figure 4).
5- Show the final impact of behavior: In most of these designs, designers avoid showing the middle steps in a message and only connect the cause and effect to show the final impact of the behavior (Figure 4).
6- Interactive design: make the design responsive to the behavior (Figure 4).
7- Dynamic (evolving) design: The behavior of the user complements the design (Figure 4).

Figure 3. Examples of persuasive metaphors in donation (left; http://flixnn.blogspot.com), healthy diet (middle; http://hongkiat.com, accessed 2012), and alcohol consumption (right; http://www.designtosell.co.uk/)

Figure 4. Slogan (left; http://politicaladvertising.co.uk, accessed 2012), Feeling, Exaggeration, and Responsive (middle; http://core77.com, accessed 2012), Dynamic and Final impact (right; http://legalexaminer.com, accessed 2012).

We term the seven previously described strategies as *persuasive metaphor heuristics*. Heuristics are defined as "reasoning processes that do not guarantee the best solution, but often lead to potential solutions by providing a "short-cut" within cognitive processing" (Yilmaz and Seifert, 2009). These heuristics work on the premise that giving a designer a selection of focused prompts can lead to a better use of metaphors in designing for behavior change.

5.3 Discussion

In this study, we identified heuristics that designers have used to create persuasive metaphorical designs. However, the individual effects of each heuristic on behavior change are not known. Thus, in the next study, we use these heuristics to design a persuasive metaphorical product and we investigate the effectiveness of the metaphor in triggering behavioral changes.

6 STUDY 2: CASE STUDY OF A NAPKIN DISPENSER

To investigate the role of persuasive metaphorical concepts on behavior change, we conducted a field experiment and compared the consumption rate across three experimental metaphor conditions: no-metaphor, conservation metaphor, and non-relevant metaphor. We studied napkin consumption behavior using a regular box shape napkin dispenser (no metaphor), one dispenser that shows metaphorical connotations of sustainable consumption (conservation metaphor), and a dispenser that shows a non-conservation metaphor (Christmas metaphor). We anticipated that napkin consumption

decreases with the conservation metaphorical design relative to both the regular dispenser and the one with a non-conservation metaphor. The study used a quasi-experiment approach (Shaddish et al, 2001) where the type of napkin dispenser was changed each week.

6.1 Method

We chose a local coffee shop with a diverse customer population (age, occupation, purpose for coffee shop visit, etc.) and with obvious amounts of wasted unused napkins. Inside the coffee shop, there was a condiment station on which a pair of regular box shape napkin dispensers (A) was located (Figure 5).

Figure 5. Regular napkin dispenser (A).

6.2 Design of the stimuli

A graduate student with a background in product design and an undergraduate student in engineering designed and built a napkin dispenser using persuasive metaphorical heuristics. The design of the napkin dispenser encourages users to take fewer napkins and to think about how many they really need by associating the use of napkins to a tree's life. The napkin dispenser features a spruce tree with markings on the side to show how long it takes for a tree to grow to certain heights. The center of the image is a slot that shows the level of napkins in the dispenser. The metaphor compares the use of napkins with consuming a tree (Figure 6). The heuristics that were used in the design are #1, #3, #4, #6, and #7. The new design followed the regular dispenser by dispensing one napkin at time. A second napkin dispenser was also designed to use in the non-relevant metaphor condition, which was visually similar to the conservation design but was appropriate for the holiday season (thus it did not imply conservation).

6.3 Measurement

We measured napkin consumption for six consecutive weeks using three different dispensers, one at a time (A, B, B, A, B, B′), tracked the number of customers (transactions) and counted the number of napkin bundles used (300 napkins per bundle) for each week. During the first week (starting October 11)), we used the coffee shop's regular dispenser (A, Figure 5). For the second and third week, we replaced it with the new dispenser with the conservation metaphor (B, Figure 6). For the fourth week, we used the regular dispenser (A) and during the fifth week we used the persuasive design (B) again. Finally, we used the non-persuasive metaphorical (B′, Figure 6) during the sixth week.

6.4 Results

For each week of napkin measurement, we calculated the average number of napkins per person based on the total consumption and the number of customers (transactions). The baseline measurement (using regular dispenser) during first week was 15 bundles of napkin (n = 3124), which shows an average consumption of 1.4 napkins per person. The result of the next two weeks of measurement (week 2 and 3) shows that, after the regular dispenser was replaced with the persuasive conservation metaphorical design (B), the consumption decreased significantly to 8 and 7 bundles per week, an average of 0.78 (n = 3051) and 0.73 (n = 2873) napkins per person, respectively. During the fourth week (regular dispenser, A), the consumption rate increased significantly to 0.97 (n = 3069) napkins per person. In the fifth week (metaphorical design, B), the consumption dropped to 0.68 (n = 3051). During the sixth, and final week, in which we used the non-persuasive metaphorical design (B′), the consumption rose to 0.84 (n = 3044). Each point in Figure 7 is modeled as a rate parameter of a

Poisson distribution and includes an exact 95% confidence interval rather than a normal approximation (Fay, 2010). Two points in Figure 7 with non-overlapping confidence intervals are statistically significant at $p < 0.001$, even with a Bonferroni correction for multiple tests.

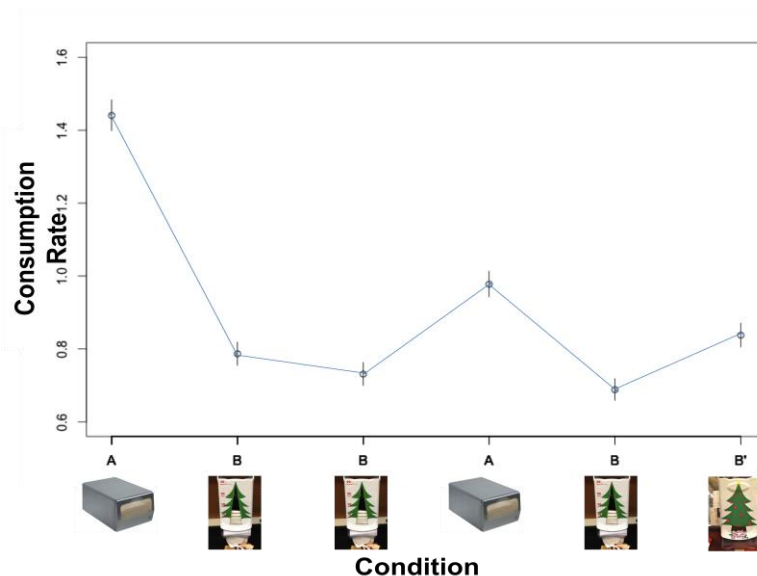Figure 6. Persuasive conservation metaphor (B, left), and metaphorical design (B', right)

Figure 7. Average napkin consumption across six experimental conditions

7   DISCUSSION

We found that using persuasive visual metaphors on products can influence behavior and encourage people to use fewer napkins in a coffee shop. We also observed that although the consumption rate increased after we replaced the persuasive metaphorical design with the regular dispenser (Week 4), it did not reach the initial consumption rate. One potential explanation is the lasting effect of persuasive design on the regular customers' memory and their behavior (Childers and Houston, 1984; Reynolds and Schwarz, 1983).

We are limited in generalization because we used a single coffee shop. We only had access to average consumption rates so we cannot say much about individual differences and factors that may affect different people in different ways. It is also not clear which aspect of the tree metaphor made it more persuasive (i.e., we do not know the "active ingredient" since the conservation metaphor introduced many design changes). For instance, the empty trunk and visible level of napkins, the years of tree growth, or the type of tree (spruce), each could affect the persuasiveness of the design. According to ELM, a message's argument would most likely be accepted through a central processing route when it is congruent with the attitude of the stimulus receiver. Thus, future research can examine individual differences, such as environmental attitudes and their role in moderating the effect of the metaphor-laden product, thus allowing testing important assumptions such as congruence of message and attitude.

As a follow up study, we interviewed a subset of users who interacted with the napkin dispenser to help us understand the way the users interact with the product, how the product influences their attitude and behavior, and how we can transfer the findings of this study to other domains. A next step in this research effort will involve qualitative analysis of the interview data.

8   SUMMARY AND CONCLUSION

The elaboration likelihood model, the picture superiority effect, and research on metaphors were applied to product design for behavior change. Through a retrospective study on persuasive metaphorical designs (2D and 3D) that target behavior change through both advertising and product design, we identified seven persuasive heuristics for designing metaphorical products with behavior change design intent. We hypothesized that using a visual metaphor in the design of a napkin dispenser would encourage mindful consumption of napkins, presumably through a central processing route (assuming that the message is congruent with users' attitude). We used the proposed persuasive heuristics to design a napkin dispenser to encourage users to use fewer napkins. In a local coffee shop, we measured napkin consumption using three different napkin dispensers: the original dispenser with no metaphor, one dispenser that shows metaphorical connotations of sustainable consumption (conservation metaphor), and a dispenser with a non-conservation metaphor (non-relevant metaphor). The results suggest effective behavior change in response to the consumption related metaphorical design.

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