DESIGN FOR BEHAVIOR CHANGE: AN ELABORATION-BASED APPROACH TO PERSUASION IN PRODUCT DESIGN

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Abstract

This paper investigates the premise that products can be designed in a principled persuasive way to induce behavior change; specifically it explores how designers can adopt behavior change theories from psychology to design products that make people behave more environmentally responsible. Studies were conducted in two parts; Part I entails a retrospective study of persuasive products with behavior change intent. Adopting the Elaboration Likelihood Model of persuasion from Psychology, these products were studied with respect to the elaboration of the persuasive message. Part II presents 2 empirical studies of behavior change based on the ELM to test the effectiveness of these strategies in product design. The studies showed that the aesthetics of a product can influence how it is used and can prompt users to change their behavior. This work shows that if designers identify the right information-processing route, the visual appearance of a product can cue desirable behavioral responses. This is an example of an evidence-based approach to understand the link between perceived formal and meaningful properties of design and how these properties influence behavioral responses.

Keywords: Human behaviour in design, Design cognition, Sustainability, Elaboration Likelihood Model, Persuasion

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1 INTRODUCTION

A recent trend in social sciences and human computer interaction is to develop persuasive strategies to help people change their undesirable everyday behaviors in support of the desirable lifestyle they aspire to. Behavior change is challenging even in simple situations. Behaviors are culturally ingrained and have personal and social desirability. People want to be socially acceptable, fit and healthy, and feel happy in their personal lives. Yet, in reality, many people struggle with addictions, suffer from obesity and health complications due to insufficient physical activity, poor eating habits, and lack of work-life balance. The discrepancy between desired and actual lifestyle can be in part attributed to simple everyday decisions. Sometimes these decisions support one's desired lifestyle; other times they do not (Consolvo, McDonald, and Landay, 2009). Rachlin (2004) ascribes this discrepancy to a "pattern of poor decisions."

Some environmental psychologists argue that the human being is a reasonable pro-social organism and a possible explanation for unreasonable behavior is that behaviors (reasonable and unreasonable) are outcomes of interactions between people and their environments, with the environments often lacking the qualities that bring out the best in people (Kaplan and Kaplan, 2008). Consistency in the type of environmental cues that individuals are exposed to may lead to consistency in observed behavior. This creates an opportunity for designers to design environments that incentivize, demand or encouragement people to behave in a certain way. Design has been shown to be cause desirable behavioral change, for example, encourage physical activity through musical stairs (The Fun Theory, 2011) or interactive video games (Lin et al., 2006). Following a persuasive approach, this paper investigates the relationship between perceived formal and meaningful properties of design and their influence on an individual's behavioral responses. In particular, we discuss how people respond to a persuasive visual message in both high and low elaborate messages, in the context of sustainable behaviors.

2 LITERATURE REVIEW AND THEORETICAL BACKGROUND

Addressing behavior-related issues is a multi-dimensional challenge and calls for an interdisciplinary approach. Designers try to influence behavior drawing strategies from behavioral theories such as Goal-Setting Theory (Locke, 1968) and the Transtheoretical Model of Behavior Change, or using social norms to design products and services that support certain behaviors.

In product design, a strategy may be appropriate for specific behaviors, context of use, and intention of designers. Studies show that forced functionality (intelligent products) does not automatically lead to desirable behavior such as sustainable behavior (Derijcke and Uitzinger, 2006), partly because users are not aware of the intervention and its intention. Thus, people maintain their (undesirable) behavior once the intervention is removed. Sometimes, designers can motivate people to adopt a more desirable behavior by providing the users with constant and continuous feedback of their existing (less desirable) behavior. This strategy is grounded in the Feedback Intervention Theory (Kluger and DeNisi, 1996), and aims to provide consumers with information about their behavior to enable them to make more informed decisions (Lilley, Bhamra, and Lofthouse, 2006). The Fun Theory seems to be effective while the product is novel and intrigues the users' curiosity.

Figure 1. Energy Joule is an example of eco-feedback. The device shows real time energy consumption and the display turns red when the consumption increases (Anonymous, 2007)

Behavioral scripts can steer the behavior while not being too forceful, but could be annoying to the user when the product does not function well, and might make the user stop using the product.

In human computer interaction, Persuasive Technology or Captology (Fogg, 2002) strives to change people's attitudes and behaviors through interactive computing systems. This field investigates the extension of social principles to the human computer interaction domain. Applying this notion to human-product interaction implies that products might embody human qualities and exert persuasive influence. Persuasive Technology follows a quite forceful approach to elicit behavior and requires the users to have motivation and ability to change their behavior.

In order to use products as a medium for behavior change, we need to acquire a deeper understanding of the users, beyond the traditional human-centered design approaches. The traditional human-centered approaches assume that the primary role of the designer is to "choreograph experiences that support the existing needs and motivations of the user," regardless of whether they are congruent with the designer's values and intentions (Fabrican, 2009). With the growing awareness regarding the influence we can exert as "choice architects" through subtle design decisions (either intentionally or not), design has the power to step beyond mere user satisfaction and advance to support personal and social values. Therefore, a deeper study of behavior change theories and the psychological mechanisms underlying these models is required. The existing methods on "persuasive" design provide general, if limited, frameworks with respect to the relationship between context, design elements and properties, cognitive processing, and behavioral responses.

3 THEORETICAL BACKGROUND: ELABORATION LIKELIHOOD MODEL (ELM) OF PERSUASION

Persuasion is the influence of beliefs, attitudes, intentions, motivations, or behaviors (Seiter, 1987). According to Perloff (2003), persuasion can be defined as "a symbolic process in which communicators try to convince other people to change their attitudes or behaviors regarding an issue through the transmission of a message in an atmosphere of free choice." Persuasion is a powerful drive in daily life and has a major influence on society as a whole. "Politics, legal decisions, mass media, news and advertising are all influenced by the power of persuasion, and influence people in turn" (Cherry, nd). Persuasion is often viewed as a negative tool to deceive people when thinking of a political candidate trying to sway voters to choose his or her name on the ballot box, or a television commercial enticing people to buy the latest and greatest product; but persuasion can also be used as a positive force. Anti-smoking commercials, energy conservation campaigns, and AIDS prevention ads are examples. Persuasion can be subtle and its success in eliciting desirable responses depends on a variety of factors.

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 thoughtful evaluation of a persuasive communication in which a person considers the merits of the arguments (being reliable, well-constructed, and convincing) behind the message. If a message's position is congruent with one's attitude, after the elaboration process, the message will most likely be accepted and, if unfavorable thoughts are generated while evaluating the merits of the argument, the message is very likely to be rejected. Then if the opportunity exists, the behavior associated to the formed attitude is likely to occur. Although behaviors changed under low elaboration (the peripheral rout) are more likely to happen quickly, studies suggest that behaviors formed under high elaboration, the central route, are stronger, leading to behavior change that is more stable over time and less susceptible to decay (Petty, 1995).

The route a person takes in analyzing a persuasive message is determined by the motivation and ability to process the message presented to her. Since central processing requires active participation of the audience an individual needs to have both motivation and ability to evaluate the message. A person's motivation can be influenced by several variables, such as the perceived personal relevance of the issue, general enjoyment of thinking, and being personally responsible for processing the message. Ability refers to an individual needing the resources and skills to understand and attend to a message. Several factors impact ability, such as intelligence, time available to engage in the message, a person's level of actual or perceived knowledge, the amount of distraction in the communication environment

(e.g., a noisy environment might inhibit a person's ability to think), and the number of message repetitions (i.e., with increasing amounts of message repetition, people are better able to comprehend, scrutinize and recall the arguments conveyed in a message) (Rucker and Petty, 2006; Wagner and Petty, 2011). "Individuals can think a lot, a moderate amount, or indeed very little about a message, and the amount of thinking they engage in goes a long way in explaining how people will be persuaded (if at all)" [Ibid].
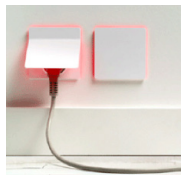
4 EVALUATION OF ELM IN PRODUCTS

Although the Elaboration Likelihood Model (ELM) of persuasion explains how a persuasive message is processed based on personal factors and the way the message is presented, the role of ELM in the design of consumer products has not been studied in-depth. The different strategies that designers use have not been investigated with respect to the cognitive processing, elaboration of the message, and the context of use. We expect that if designers were familiar with the cognitive processing, they would be able to adopt more appropriate strategies based on the context of behavior, product, and user. To have a better understanding of the existing strategies in terms of their elaboration, we conducted a retrospective study of persuasive products for behavior change.
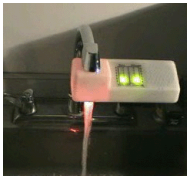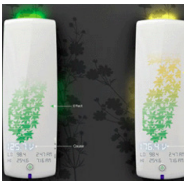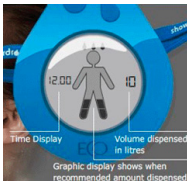
For the purpose of this research, we narrowed down the scope of behavior change to sustainable behavior. In this context, "Eco-friendly" or "environmentally friendly" are the most prevalent, yet broad and ambiguous terms used to label the products and services that claim to cause reduced, minimal, or no harm at all, upon ecosystems or the environment. This could be regarding the product itself (material, energy consumption, recyclability, waste and pollution) or the interaction that occurs between the product and the user during use. Since this research studies behavior change, we focus on how to persuade individuals to be more environmentally responsible during the use phase of products.

4.1 Method:

Over 80 product design concepts were collected from the Internet and analyzed based on the strategies they use to change behavior. The list was narrowed down to products that are persuasive and put the user in charge of whether or not they would like to change their behavior. We analyzed each product with respect to the type of behavior they aim to change, the strategy the designer has used, the context of product (personal use versus public) and the extent to which the persuasive message is elaborated. Since several products featured the same strategy, we summarized our list to 12 products that represented a variety of strategies (Table1).

Table 1. This tables shows examples of sustainable products with different strategies. The products are coded in terms on their focus on increasing motivation and ability, and trigger to the behavior

Elaboration	Product1	Product 2	Behavior	Strategy	Motivation	Ability	Trigger
1.Very low	This plug lights up when it is in use.	The cord glows when the device is charged.	Electricity Consumption	Prompt/ reminder			X
2.Low	The light blooms when the	A message appears on	Electricity consumption/ Water consumption	Visual message/ feedback			X

	consumption is efficient and withers when it's on for a long time.	the shower curtain as the temperature goes up.					
3.Medium	The device shows the electricity consumption in real time and changes color based on the consumption.	The device shows water consumption and the light's color changes accordingly.	Electricity consumption	Numerical Feedback+ Prompt	X		X
4.Medium-High	The product shows electricity consumption.	The amount of water consumption is shown real time.	Electricity/ Water consumption	Numerical Feedback		X	
5.High	The amount of consumption is displayed and an image of a plant changes color to yellow and disappears when the energy consumption goes up.	Time and the amount of dispensed water is displayed and the graphic shows when the suggested amount proportionate to an individual is dispensed.	Electricity /water Consumption	Visual metaphor +Numerical Feedback	X		
6.Very High	The image on the ice cream containers show sustainable packaging delays global warming referring to penguins.	The basins are made of soap and look like giant soaps and deteriorate as they are used, warning the users to be mindful about the negative impact of overusing detergents and water.	Unsustainable packaging/ water consumption	Visual Metaphor	X		

4.2 Results:

Table 1 shows 12 products in six categories in terms of the elaboration of the message (from low to high), type of behavior, focusing on ability, motivation or trigger, and the number/type of different strategies used in each product to facilitate behavior change. These categories are identified as bellow:

Very low: These products use a prompt to remind the users about the desirable behavior. Here, the product does not try to increase the motivation or ability of the user assuming that people forget to enact the behavior simply because they do not care enough to remember and be attentive about it. Thus, these prompts act as a trigger to the expected behavior and do not involve much thinking.

Low: These products respond to the unsustainable behavior through change in their appearance and indirectly remind people to change their behavior. The way that the message is represented is more elaborate than prompts, in a sense that it is more explicit and the change in the design motivate people to correct their behavior to return to the default setting (the closing petals of the light open up or the messages on the curtain diminish). Since the message is more explicit than a prompt, there might be more cognitive processing involved.

Medium: The products in this category use a combination of prompt (changing color) and numerical feedback on the amount of energy consumption to motivate people to use less energy. Although the prompt help people to know about the status of their consumption, analyzing the numerical information require cognitive processing.

Medium High: Using only numbers to show the amount of consumption, these products give real time feedback on the behavior. Response to the feedback requires thinking about the numbers and paying attention to the sustainable range, as there is no prompt that warns about excessive consumption.

High: In these products the designer uses a combination of numerical feedback and visual metaphor that shows the consequence of user's behavior.

Very High: These products show the long term consequence of the unsustainable behavior in terms of visual metaphors which is not very much related to the context of the product in use. Hence, it requires deliberate thinking and deciphering the meaning behind it.

4.3 Discussion:

The analysis of these products indicates that there is no relationship between the type of behavior and the strategy that designers use. In other words, these strategies have been used across the board and for different behaviors. The context of use is not very clear and there is no information regarding the ability or motivation of users. No empirical study was found to compare a high elaboration and low elaboration strategy and suggest where and when each of these is more pertinent. Thus, we investigated the application of low and high elaboration strategies in the paradigm of product design considering the context and type of desirable behavior. Since it is not economic to rationalize all the decisions we make, especially with the industrialized and "in rush" lifestyle we lead, it is more likely to use mental shortcuts for most of everyday decisions we make. For instance for mundane tasks (throwing out the trash, washing hands, etc.), people make decisions quickly based on instantly available cues and move on to more important tasks. For highly familiar situations that do not require high levels of cognitive processing (e.g. we install compact fluorescent lamps, but forget to turn them off or have recycling bins but discard the recyclables in standard trash cans), it may be more efficient to use a peripheral processing route to trigger behavior change.

5 CASE STUDIES

5.1 Low Elaboration (Recycling Bin):

As noted in Section 4.1, there are paradigms of salient situational cues that encourage sustainable actions, such as the glowing power cord or blooming/withering light. Sometimes these cues are underrepresented in the environment. One of the environmental properties that might influence the choice and decision making process is "Salience" of relevant cues. Salient cues associated to a certain behavior are examples of peripheral cues that grab attention and may implicitly encourage people to behave in a certain way. Products that are potentially related to a specific behavior can also act as a situational cue. For instance, a recycling bin is associated to recycling behavior or using a re-usable water bottle means less use of plastic bottles. We argue that in the context of recycling, if we assume

that our population is familiar with the concept and is not opposed to it, eliciting attention to the behavior could be achieved through a peripheral route of "visual salience" of recycling products or cues. We hypothesize that the visual salience of recycling bins encourages recycling behavior, presumably through a peripheral route of persuasion. In other words, if a recycling bin is highly visible, stands out relative to other neighboring objects, and elicits attention, it will be more likely to promote the associated behavior of recycling. We predict that salience will increase the probability that the recycling bin will be seen and used (assuming all other aspects are equal).

Through an online pre-test, green showed to be more memorable and salient among other colors (red, blue, and grey) for a recycling bin, and was selected to be used in the field test. In a lab setting, the invited subjects (n=48) were randomly assigned to either the low salience (grey recycling bin) or high salience (green recycling bin) conditions. Then, the subjects were engaged in a task that involved disposing some papers. We compared the amount of recycled papers across these two conditions. The results show that 88% of subjects in the high-salience condition (green) put at least one item (the instruction papers) in the recycling bin, whereas only 52% of subjects used the recycling bin in low-salience condition (grey). Statistical analysis shows a significant difference between the proportions in these two groups (Z= 2.73, P= 0.006). A follow-up study was conducted to confirm whether the salience of the green recycling bin was due to physiological aspects (contrast) or meaningful association of green with green behavior. We substituted the green bin with a red one and compared the recycling rate between red and grey recycling bins and found that people recycled more in red condition (88.4% versus 70.8%, Z= 1.62, P= 0.10). Although the result is not statistically significant, the small sample size and the different subject pool used for this study may have produced a confound. Overall, the results confirm the role played by design principles as peripheral cues in steering underlying mechanisms of behavior change. They also highlight the importance of low-cost implicit incentives in triggering the desired behavior compared to the traditional high-level, knowledge-based cognitive processing. There are different ways designers can make messages or cues more salient, say, through color, contrast, shape, light, and so forth.

5.2 High Elaboration (Napkin Dispenser)

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, 2003). Table 1 represents some examples of products that apply visual metaphors to inform users about the consequence of their behavior on the environment (rows 4 and 5), which we categorized them as examples of high and very high elaboration. Making the connection between the product being presented and the message being expressed is a complex cognitive process (Jeong, 2008). Also making sense of metaphors requires careful scrutiny of a persuasive communication. Therefore, it can be 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). This complexity might also make people more curious about understanding the potential mystery of the communication.
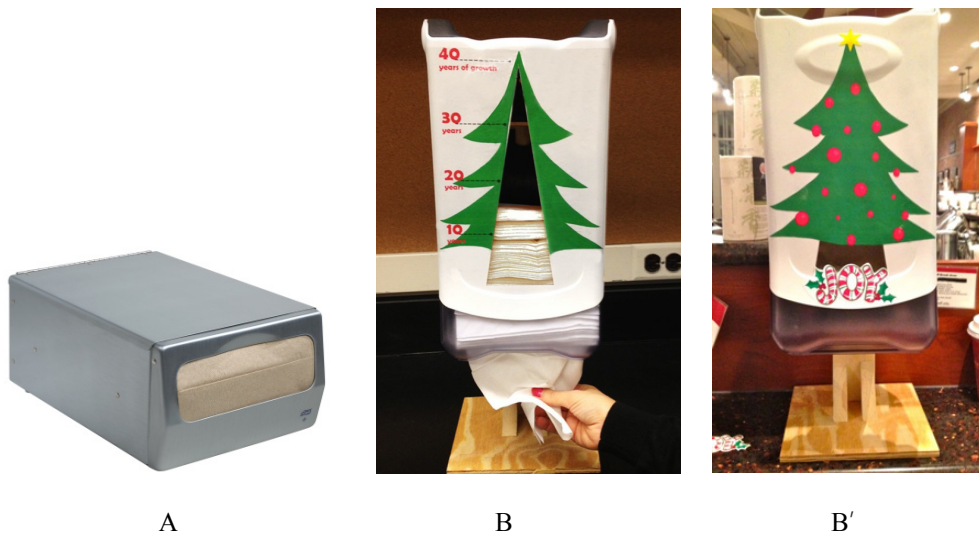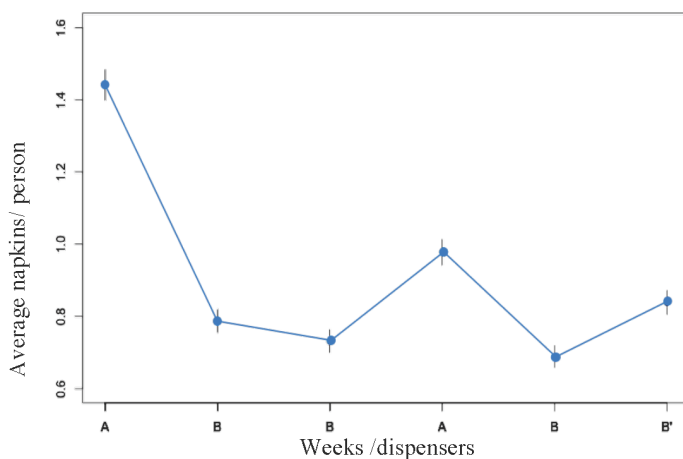
A   B   B′

Figure 4. Napkin dispensers A, B, B′

In this study, we used a consumption-related metaphor to design a napkin dispenser, to encourage mindful consumption of napkins and examine behavioral responses. 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 predicted that visual metaphors will elaborate the informative message in a more concrete, succinct, and effective way and would encourage people to practice more environmentally cautious behavior.

In a local coffee shop, we measured napkin consumption using three different napkin dispensers: the original dispenser with no metaphor (Figure 4-A), one dispenser that shows metaphorical connotations of sustainable consumption (conservation metaphor; Figure 4-B), and a dispenser with a non-conservation metaphor (non-relevant metaphor; Figure 4B'). During six weeks of experiment we used one of these dispensers at a time for one week (A, B, B, A, B, B) and measured the consumption. The results suggest 45% decrease in napkin use in response to the consumption related metaphorical design (Montazeri, 2013). The average of napkin consumption per week is demonstrated in figure 5. Each point in Figure 5 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 5 with non-overlapping confidence intervals are statistically significant at $p < 0.001$, even with a Bonferroni correction for multiple tests.

Week	Product	rate	Number of customers
1	A	1.4	3124
2	B	.78	3051
3	B	.73	2873
4	A	.98	3069
5	B	.68	3051
6	B'	.84	3044

Figure 5. Average napkin consumption per dispenser through six weeks of experiment

We also conducted 53 post-consumption interviews with the customers (n=39, female=17) and acquired a deeper understanding of how the design was perceived by the users. The interviews consisted of multiple choice, open-ended, Likert-scale questions about personal and demographic information, coffee shop habits, the napkin dispenser (memorability, description, understanding the message, overall impression, self assessment of napkin consumption, etc.), and some questions on sustainable attitude measures. The results of the interviews suggest that more than half of the participants understood the metaphor, remembered it and were completely able to describe the design and metaphor (64%). Correct description of design and understating the metaphor are highly correlated (Montazeri et al., 2013). These interviews highlighted some idiosyncratic differences in the interpretation of metaphors or napkin consumption patterns in general.

We conclude that to understand metaphors, the designer and the user should share specific common experiences and knowledge. To accept the persuasive message (and behave accordingly), the goal of the message should be congruent with users' attitudes. We also argue that since the process of understanding the metaphors requires more cognitive resources, it will not be as effective on people who are distracted, in rush, or not familiar with the topic.

6   DISCUSSION AND CONCLUSION

This paper investigated the effect of behavior change product strategies with respect to cognitive routes to persuasion per ELM. These two strategies (peripheral and central) are not mutually exclusive and are not really two choices but the end points of a continuum. Comparing the two case studies, we can see how people respond to both low and high elaborate messages in different contexts. The implication for design process is to identify the environmental and idiosyncratic factors that affect cognitive processing during the preliminary stages of user research. This helps designers to employ more effective strategies accordingly. Aside from individual factors (ability and motivation) that determine where people fall along the elaboration continuum, we assert that designers should decide about the elaboration of the message based on situational and contextual factors such as design goals (short term or long term effect), the type of behavior (familiarity, mundane versus interesting), and level of environmental distractions. For instance, if people do not have enough time, are distracted, have less personal interest in the topic, and do not have sufficient knowledge to understand and analyze the message, they are less likely to process the message centrally. We suggest using fewer elaborate messages (prompts, reminders, triggers, cues) in situations with low motivation or ability and making the message more attractive to users attention. For the situations that users have higher motivation and ability (e.g. knowledge, attention, interest) to reflect upon it, a more sophisticated, elaborate, and information-based design strategy can lead to more mindful behavior change. Although the case study of napkin dispenser involved higher cognitive processing and is more likely to fall into central processing category, its persuasiveness might partly be explained by the novel appearance and the way in which the message is presented (ironic, exaggerated, and indirect), as opposed to mere scientific facts and arguments. Another implication for designers is that combining visual attractiveness and subtle cues (low elaboration) with arguments or information (high elaboration) will maximize the persuasiveness of the design. Visual metaphors sound to be an appropriate tool that involves contemplation to understand, while being interesting and easy to relate to.

The limitations of this study include dependency of behavioral responses on idiosyncratic factors and contextual sensitivity. Since a diverse range of users with different levels of motivation and ability would interact with the same product, the applied strategy inevitably would not impact a sub-group of users. Additionally, ELM of persuasion is one way of framing how people process information, an example of dual process theory. The work presented investigated only physical design concepts in the context of sustainability. We hypothesize that the proposed approach can be extended to other design contexts and paradigms of behavior change such as public health and other pro-social behaviors. Future research can explore a wider range of users and desirable behaviors that offer benefits at both individual and societal levels.

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