

**DESIGN FOR BEHAVIOR CHANGE:
THE ROLE OF PRODUCT VISUAL AESTHETICS IN
PROMOTING SUSTAINABLE BEHAVIOR**

BY

SOODEH MONTAZERI

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Doctoral Committee:

**Professor Richard D. Gonzalez, Co-Chair
Professor Panos P. Papalambros, Co-Chair
Associate Professor Jan-Henrik Andersen
Emeritus Professor Robert W. Marans
Professor Carolyn Yoon**

@ Soodeh Montazeri 2013

*To my late **grandpa** for his insatiable thirst for learning, design, and creation,*

and,

*my **loving parents** for their unconditional love, endless support, and persistent inspirations.*

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ABSTRACT

This dissertation tested the hypothesis that products can be designed in a principled way to induce users to modify their behavior; in particular, it explored how products can make people be more environmentally responsible such as increasing energy conservation and recycling. Adopting an interdisciplinary approach, we reviewed literature from psychology, human computer interaction, social marketing, and product design to identify a gap in our knowledge, formulate research questions and select paradigms to use in behavioral testing.

Empirical studies were conducted in two parts. Part I consisted of one retrospective study and two case studies based on the Elaboration Likelihood Model of Persuasion. The studies showed that the visual properties of a product can influence how it is used and can prompt users to change their behavior to be more environmentally friendly and sustainable. In the recycling case study (Study 1), more people recycled in a visually salient recycling bin. In the napkin consumption case study (Study 3), patrons of a coffee shop consumed fewer napkins when the napkin dispenser was designed to elicit the metaphor that compared the use of napkins with consuming a tree (a 55% reduction in napkin consumption), versus using the original standard dispenser. A retrospective study (Study 2) was conducted and identified seven persuasive heuristics to help designers use metaphors that promote sustainable behavior. We called these Persuasive Metaphors Heuristics. Part II validated the Persuasive Metaphors Heuristics by studying how designers use them, and how they influence design outcomes in terms of persuasiveness, effectiveness, and uniqueness of the concepts. The results indicated that the heuristics increased the persuasiveness of the design concepts as measured by two independent judges who were blind to the hypothesis. Overall, the dissertation showed that if the designer can identify the right information-processing route (based on behavior, user, and context) and implement the Persuasive Metaphors Heuristics, then the visual appearance of a product can successfully cue desirable behavioral responses. Also, Part II suggested that the heuristics can be taught to novice designers as a tool to narrow down the solution space toward designs with persuasive intent.

This research pursued an evidence-based persuasive approach to understand the link between perceived *formal* and *meaningful* properties of design, how users process these properties, and how these product properties influence decision-making and consequent behavioral responses. The dissertation concluded with discussion of the limitations of the conducted research and next steps for furthering this line of research investigation.

CHAPTER 1

INTRODUCTION

1.1 ROLE OF DESIGN IN DAILY DECISION-MAKING

Human beings interact with the surrounding environment and, directly or indirectly, are influenced by the seemingly arbitrary elements of the environment. Even brief exposure to subtle cues such as certain colors or brands can increase creativity, task performance, or evaluation and choice decisions (Mehta & Zhu 2009; Fitzsimons, Chartrand, & Fitzsimons, 2008). The way people use, adapt to, or change their surroundings and how the physical environment often affects humans has been the focus of numerous studies across different disciplines such as psychology, sociology, anthropology, marketing, architecture, design, and engineering. Products, as part of the built environment, are increasingly intertwined with people's lives, and play an important role in human life (Tromp & Hekkert, 2012). Studies suggest that interaction with some objects can activate cognitive associations and consequently initiate emotional, behavioral, and perceptual

responses congruent with these associations and mental representations. For instance, briefly holding a warm cup increases feelings of interpersonal warmth (Williams & Bargh, 2008), mere exposure to a weapon can elicit strong, aggressive responses in male college students (Berkowitz & LePage 1967), and evaluating a job candidate's CV on heavy clipboard makes it appear more important to the interviewee (Ackerman, Nocera, & Bargh, 2010). Based on "The Theory of Affordances" (Gibson, 1977), products are capable of "affording" certain cognitive and behavioral responses, which explains the link between users' actions and the material features of products. This theory describes how perception can inform people about the meaning of their physical environment (Johns, 2003). A chair has the affordance of "sitting", because of its shape, height and carrying capacity, and humans have the ability to sit. However the chair also affords standing, blocking, and holding. Additionally, products could embody values and may act as vehicles for expressing and communicating certain beliefs or attitudes, over and above their initial and intrinsic functional affordance. Even a person's simple choice of a pen might indicate her taste, values, social and socio-economic status, and so forth.

1.2 DESIGN FOR BEHAVIOR CHANGE

A recent trend in social sciences and Human Computer Interaction is to develop persuasive strategies to help people change their everyday behaviors in support of the lifestyle they aspire to (Consolvo et al. 2006; Jafarainaimi et al. 2005; Lin et al. 2006; Maitland et al.2006; Prochaska, DiClemente, & Norcross, 1992). However, getting an individual to change her behavior is already challenging even in simple situations; it is complicated with behaviors that 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 and poor eating habits, and struggle to find a work-life balance. The discrepancy between desired and actual lifestyle can be in part attributed to simple everyday decisions. Sometimes those decisions support one's desired lifestyle; other times they do not (Consolvo et al. 2009). Rachlin (2004) ascribes this discrepancy to a "pattern of poor decisions."

In the field of environmental psychology, the Reasonable Person Model (RPM; Kaplan & Kaplan, 1982) suggests that the human being is a reasonable pro-social organism. However, one might wonder why one sees so much unreasonable behavior in so many places. A possible explanation is that both reasonable and unreasonable behaviors are outcomes of an interaction between people and their environments, and that the environments often lack the qualities that bring out the best in people (Kaplan & Kaplan, 2008). That is, environments (physical and non-physical) may create a press, an incentive, a demand, an encouragement, or a "nudge" (Thaler & Sunstein, 2008) for people to behave in a certain way. In a society, to the degree that there is consistency in the type of environmental cues that individuals are exposed to, there may be consistency in the observed behavior.

Designer and educator, Victor Papanek (1971), asserted "Designers shape the development of products and services, which directly impact upon society and the environment." He believed that designers are responsible for the choices they make in design processes and are able to cause real change in the world through good design.

Whether through something as simple as musical stairs (Volkswagen, 2011), or through a complicated, interactive video game (Lin et al. 2006) to encourage physical activities,

design have been shown to be effective in causing successful desirable behavioral changes.

1.3 DESIGN FOR SUSTAINABLE BEHAVIOR CHANGE

1.3.1 MOTIVATION

Sustainability is a familiar global concern and the focus of attention since the 1970s. In the past people were more used to being conservative in consumption because resources were more scarce and their costs were prohibitive. As economic fortunes flourished after World War II, the culture of indulgence and consumerism became ingrained in modern consumer behavior and established a lifestyle that cannot be easily changed now. If everyone realizes today's American lifestyle, it would take four extra planets to provide the necessary resources (Wackernagel & Rees, 1998). The challenge in developed countries today is how to motivate people to choose a more conservation-oriented lifestyle in the middle of accessible abundance. So the question is, are we able to create products and services that promote environmental awareness? Can we integrate the sustainability mindset with the new face of modern life, regardless of the abundance of resources?

There has been ample investment and attention to this topic in the past decades and a large body of research exists in different areas of engineering, manufacturing, and policy making to address this issue. 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). However, technological interventions impose extra costs, are not universally feasible, and are ineffective without

proper education. Studies (Derijcke, & Uitzinger, 2006) indicate that merely focusing on the design of technologically efficient products without recognizing the significant role of users' behavior is destined to fail and does not result in real change. We install compact florescent bulbs, but forget to turn them off when leaving the room. We drive fuel-efficient cars, but overuse them, assuming they have less environmental impact. It seems failure to recognize the role of behavior will not allow us to utilize the full potential of new sustainable technology.

Traditional User-Centered Design (UCD) and similar approaches of design inform the business community so that it considers “improving ease of use”—not aesthetics – as the primary value of design (Fabrican, accessed 2009). Thus, promoting a design approach that directs users' behavior requires stepping beyond the traditional boundaries of UCD.

A project carried out by Yale University, “Six Americas”, segments the American public into six audiences that range along a spectrum of concern and issue engagement from the Alarmed, who are confident about the danger of climate change and highly supportive of all possible actions to mitigate the threat, to the Dismissive, who are totally convinced that climate change is not occurring and that no response should be made (Leiserowitz, Maibach, Roser-Renouf, & Hmielowski, 2012). Although the Concerned and Cautious group believe that the problem exists, they are less personally involved and take fewer actions, and the Disengaged group is not well-informed about the issue and associated required actions to reduce the impact (Figure 1.1).

Concerned, Cautious, and Disengaged groups (61%) are more likely to be the target population of this research, where improvements in the surrounding environment might bring about behavioral changes.

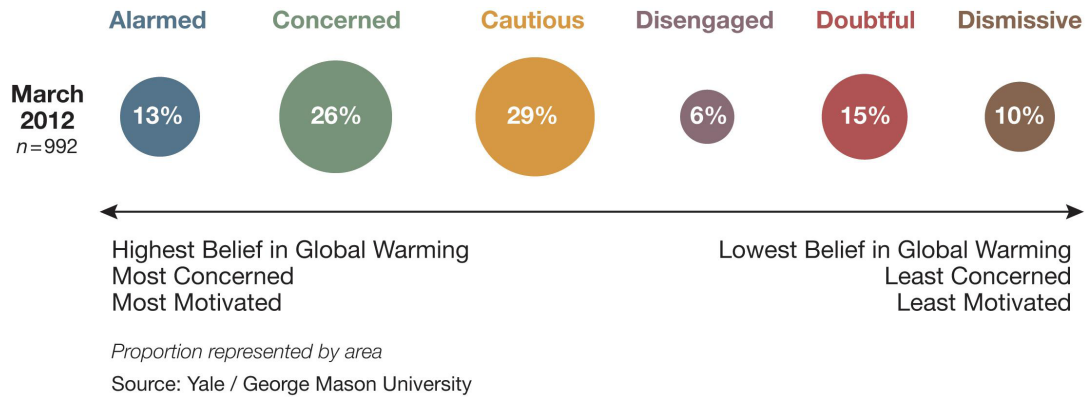


Figure 1.1. Distribution of American population by their environmental consciousness (Leiserowitz et al. 2012)

1.3.2 RESEARCH SCOPE

The way users interact with a product may strongly influence its environmental impact. For example, energy consumption is an activity that is behavior dependent and a positive change in consumption patterns will cause savings in resources (Harrigan, 1994). Designers are in a position to reduce use impact by purposefully shaping behavior towards more sustainable practices (Bhamra et al. 2008; Elias et al. 2008; Lockton et al. 2008; Wever et al. 2008).

Eco-design is mainly focused on the procurement, manufacturing, and disposal phase of a product’s life cycle. In this dissertation I intend to influence the “use phase” by changing unsustainable behaviors that occur. Instead of designing new supplementary artifacts to reduce energy consumption or motivate recycling behavior, this research focuses on redesigning use-phase of the existing products that people use on an everyday basis.

1.4 APPROACH: INTERDISCIPLINARY RESEARCH

Despite the dominant role psychologists attribute to internal factors for motivating Pro-Environmental Behavior, a handful of researchers identify the need to formulate an

interdisciplinary perspective (Van Liere & Dunlap, 1980; Messick & Brewer, 1983; Guagnano, Stern, & Dietz, 1995). In other words, we cannot assume that a human being can be isolated from his social bonds and affiliations. Additionally, cultures, policies, traditions, beliefs, values and norms vary from one society to another. These factors can influence people's wants, needs, and preference structure, making products as integral threads in the fabric of social life (Solomon, 1983).

Thus, addressing behavior related issues is a multi-dimensional challenge and calls for an interdisciplinary approach to the problem. In order to use products as a medium of behavior change, we need to acquire a more profound understanding of the users, beyond the traditional human-centered design approaches. Therefore, a deeper study of behavior change theories and the psychological mechanisms underlying these models is required.

More specifically, this research entails an understanding about the relationship between perceived *formal* and *meaningful* properties of design, how these properties are processed by the user and how they influence the decision-making, and the consequent behavioral responses. Hence, I will augment my knowledge of product design with literature from consumer behavior (marketing) and behavioral and social psychology to integrate technical support for behavior change into the individual's social world and everyday life.

1.5 HIGH-LEVEL RESEARCH QUESTIONS

This dissertation attempts to explore the following high-level research questions:

1. Can products, as part of the built environment, bring out the best in people?
2. Can we show that products make people change their existing behavior?

3. Can we decrease the environmental impacts that occur in the use phase of products, through product features?
4. Can products embody educational implications to make people more aware of their existing behavior?
5. Can we understand the link between perceived design elements and principles, and associated behavioral responses?
6. Can we propose a series of guidelines for designers that help them to design products and services that encourage behavior change?

1.6 PROPOSED CONTRIBUTIONS

Through framing an interdisciplinary approach and a set of rigorous empirical studies, this research examines the role of product design principles in triggering behavioral changes, with a focus on environmentally responsible behaviors.

I hope to make the following major contributions through exploring the defined research domain:

- Showing that low-cost subtle changes in the design of every-day products have the potential to elicit desirable behavioral responses in the context of environmentally responsible behaviors, affirming that products, as a part of the built environment, are capable of “bringing out the best in people.”
- Performing rigorous empirical studies to support the proposed assertions.
- Adopting a unique interdisciplinary approach in product design research, in terms of applying the existing literature from different disciplines,

consolidating the theories, and integrating them into the product design paradigms for behavior change.

- Proposing a set of design strategies for designers that helps them to design persuasive products (or services) that lead to intended behavioral changes.

1.7 DISSERTATION OUTLINE

In a quest to realize proposed contributions, this dissertation pursues both quantitative and qualitative methods. Through conducting three rigorous experiments, I will make product-based interventions, and observe and measure the potential behavioral responses. I will identify, propose and validate a set of strategies for designers to design more persuasive products in the context of product-driven behavior change.

The dissertation is presented in six chapters; Chapter 2 entails a multi-disciplinary review of literature in Psychology, Design, Marketing, and Human-Computer Interaction, a discussion of the areas that could be improved, specific research questions, and dissertation hypotheses. The studies are conducted in two parts: Part I features three studies in two chapters (3, 4), including two different empirical paradigms of behavior change, in which I evaluate behavioral responses through product-based interventions. In Part II, I present a set of persuasive design heuristics for designers who focus on persuasive product-driven behavior change. These proposed heuristics will be validated through a series of qualitative studies to understand how they influence the design process and the generated concepts. To conclude, I present the overarching and detailed contribution of this dissertation in Chapter 6.

This dissertation is organized as:

PREVIOUS SCHOLARSHIP AND THEORETICAL FOUNDATION

Chapter 2 provides a comprehensive review of existing literature on behavior change approaches, theories, and strategies across different disciplines such as design, industrial

design, human-computer interaction, social psychology, and behavioral psychology. The literature is followed by a summary and identification of the existing gap in the literature. We adopt the Elaboration Likelihood Model (ELM) of persuasion as the theoretical foundation for our future steps. This chapter concludes with specific research questions.

PART I

PARADIGMS OF PRODUCT-DRIVEN BEHAVIOR CHANGE

Chapter 3 presents an empirical study with a focus on behavior change through *peripheral* processing route of ELM. Using the salience principle in design of a recycling bin, I examine the behavioral responses of the users.

Chapter 4 features two studies based on the *central* route of processing. The first study is a retrospective analysis of existing persuasive designs that employ metaphors to encourage behavior change, to find the common heuristics designers have used in the context of persuasive design for behavior change. In the second study, the heuristics from the previous study are used to design a napkin dispenser that encourages conservation among the customers of a local coffee house. I apply metaphors as a means of persuasive communication to help users make more informed consumption decisions.

PART II

DESIGN HEURISTICS AND VALIDATION

Chapter 5 investigates how design students apply the proposed persuasive metaphor heuristics to generate design concepts for products that encourage energy conservation. Through comparing concepts generated using Brainstorming and Persuasive Heuristics, I

will evaluate the improvements designers made when they utilized the mentioned heuristics.

CONCLUSION

Chapter 6 summarizes the findings of this dissertation, identifies the major accomplished contributions, and discusses the potential future steps of this research as well as its application in other paradigms of behavior change.

CHAPTER 2

PREVIOUS SCHOLARSHIP AND THEORETICAL FOUNDATION

2.1 OVERVIEW

In this chapter I conduct an overview of the basic literature from different disciplines such as psychology, human computer interaction (HCI), social marketing, and product design. The literature in psychology and HCI follow a more general and comprehensive approach and the literature in social marketing and product design is geared towards “sustainable” behavior change. The review is followed by a summary and highlight of the areas of influence by designers. Then, I specify my research questions, select an approach to address these questions and establish the basic foundation to move towards dissertation hypotheses. Finally, I define the outline of my proposed studies.

2.2 DEFINITIONS: “SUSTAINABLE BEHAVIOR”

Sustainability: Sustainability has a broad meaning with different implications in economy, the environment, and society. According to the United Nations General Assembly’s (UNGA) definition in 1987, “Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UNGA, 1987).

Sustainable Design: As defined by McLennan (2004), sustainable design is “the philosophy of designing physical objects, the built environment and services to comply with the principles of economic, social, and ecological sustainability” (Wikipedia, accessed 2013). Subsequently, sustainable products are those providing environmental, social and economic benefits while protecting public health, welfare, and environment over their full life cycle, from the extraction of raw materials to final disposal. They can range from energy efficient products or the ones with longer life cycle, to those that are built specifically to motivate and promote sustainable behavior (for different approaches see McDonough & Braungart, 2002; Chapman, 2005).

Behavior: Behavior is defined as “anything that an organism does involving action and response to stimulation; the response of an individual, group, or species to its environment; the way in which something functions or operates” (Merriam-Webster, accessed 2013). In Wikipedia (accessed 2013) it is described as “the range of actions and mannerisms made by organisms, systems, or artificial entities in conjunction with their environment, which includes the other systems or organisms around as well as the physical environment.

Behavior Change: Behavior change “can refer to any transformation or modification of human behavior” (Wikipedia, accessed 2013; see Bergin & Garfield, 1994).

2.3 PSYCHOLOGY

Behavior change studies are heavily grounded in Psychology literature. For the purpose of this dissertation, I review the classic theories and models of behavior change, as well as the approaches emerged from social and ecological psychology that link the behavior to the environmental factors and cues.

2.3.1 HEALTH BELIEF MODEL (HBM)

Developed in 1950s by social psychologists Hochbaum, Rosenstock and Kegels, the Health Belief Model (HBM) is one of the best known and widely used to understand, explain and predict health behavior (Rosenstock, Strecher, & Becker, 1988). With a focus on the attitudes and beliefs of individuals, HBM suggests that an individual’s belief in a personal threat, together with her belief in the effectiveness of the proposed behavior, would predict the likelihood of that behavior (Ibid). The model was designed in response to the lack of public participation in a free tuberculosis (TB) screening program. Since then, the HBM has been adapted to explore a variety of long- and short-term health behaviors, including sexual risk behaviors and the transmission of HIV/AIDS (AIDSCAP, 2002). HBM is a framework for motivating people to take positive health actions with the desire to avoid a negative health consequence being as the major motivation.

The model is based on four major constructs: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. Two more concepts were added later: cues to

action and self-efficacy (Bandura, 1977). Self-efficacy is defined as one's confidence in the ability to successfully perform an action. Table 2.1 summarizes these six key concepts.

Construct	Action as related to this project
Perceived susceptibility	People will take preventive actions against some conditions linked with potential ill health, if they feel they might be susceptible, such as developing diabetes.
Perceived severity	Based on the potential harm or health condition (diabetes) which could negatively impact the person or their family members, due to inadequate consumption of healthy, fresh foods.
Perceived benefits	The person has the ability through gardening to create a healthy, low-cost, and traditionally appropriate way to enhance their diet and obtain some exercise.
Perceived barriers	May include the potential challenges of learning or adapting gardening techniques to their area of the reservation.
Cues to action	The healthcare personnel at the hospital or clinic can work with the gardening personnel and reinforce the health, nutrition and physical activity message.
Self-efficacy	People are educated about their ability to take control over their diet and their diabetes, grow their own food, and obtain some exercise, in the name of diabetes prevention or intervention.

Table 2.1. Health Belief Model (Glanz and Rimer, 1997)

General limitations of the HBM are lack of studies to validate the usefulness of the model as a whole, ignoring other factors, such as environmental or economic factors, that may influence health behaviors, and not incorporating the influence of social norms and peer influences on people's decisions regarding their health behaviors (AIDSCAP, 2002).

2.3.2 STAGES OF CHANGE / TRANS-THEORETICAL MODEL

Stages of Change Model (SCM) (Prochaska & Carlo DiClemente, 1983) also known as the Transtheoretical Model, was originally developed during a study about smoking habit cessation. Since then a broad range of behaviors such as weight loss, injury prevention, mammography screening, and overcoming alcohol and drug problems among others (Prochaska, 1994).

The idea behind the SCM is that, in order to change behavior successfully, people tend to progress through five different stages. Also, each person progresses through the stages at his/her own rate.

The five stages (Figure 2.1), between which individuals may move back and forth before achieving complete change, are pre-contemplation, contemplation, preparation, action, and maintenance (U.S. Dept. of Health and Human Services, 1996). At the pre-contemplation stage, an individual has the problem (whether he/she recognizes it or not) and has no intention of changing. From pre-contemplation to contemplation, the individual recognizes the problem and develops a desire to change a behavior. During preparation, the individual intends to change the behavior within the next month, and during the action stage, the individual begins to show new behavior consistently. An individual finally enters the maintenance stage once s/he exhibits the new behavior consistently for over six months (Ibid).

With respect to the limitation of this model, SCM focuses primarily on the individual without taking into account the role of structural and environmental issues that might impact a person's ability to enact behavior change. Moreover, the relationship between stages is not always clear because SCM presents a descriptive rather than a causal explanation of behavior. Finally, each of the stages might not exemplify every population very well (AIDSCAP, 2002). For instance, a study of sex workers in Bolivia discovered that few study participants were in the pre-contemplative/contemplative stages regarding lack of use of condoms with their clients (Posner, 1995).

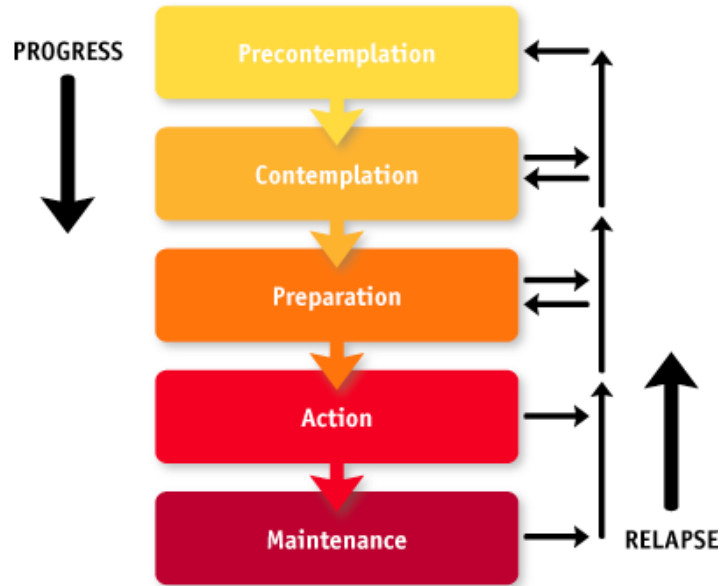


Figure 2.1. Five stages of change (<http://batonrougescounseling.net/stages-change>, accessed 2012)

2.3.3 THEORY OF REASONED ACTION (TRA) AND PLANNED BEHAVIOR

The Theory of Reasoned Action assumes that individuals consider a behavior's consequences before performing the particular behavior. As a result, intention is an important factor in determining behavior and behavioral change. TRA is based on the premise that humans are rational and that the behaviors being explored are under volitional control. The theory provides a construct that links individual beliefs, attitudes, intentions, and behavior (Fishbein, Middlestadt & Hitchcock, 1994). TRA model supports a linear process in which changes in an individual's behavioral and normative beliefs will ultimately affect the individual's actual behavior. Ajzen (1985) expanded upon this theory by adding the Theory of Planned Behavior, which covers cases in which a person is not in control of all factors that affect the actual performance of a behavior. As a result, the new theory states that the incidence of actual behavior performance is

proportional to the amount of control an individual possesses over the behavior and the strength of the individual's intention in performing the behavior (see Figure 2.2).

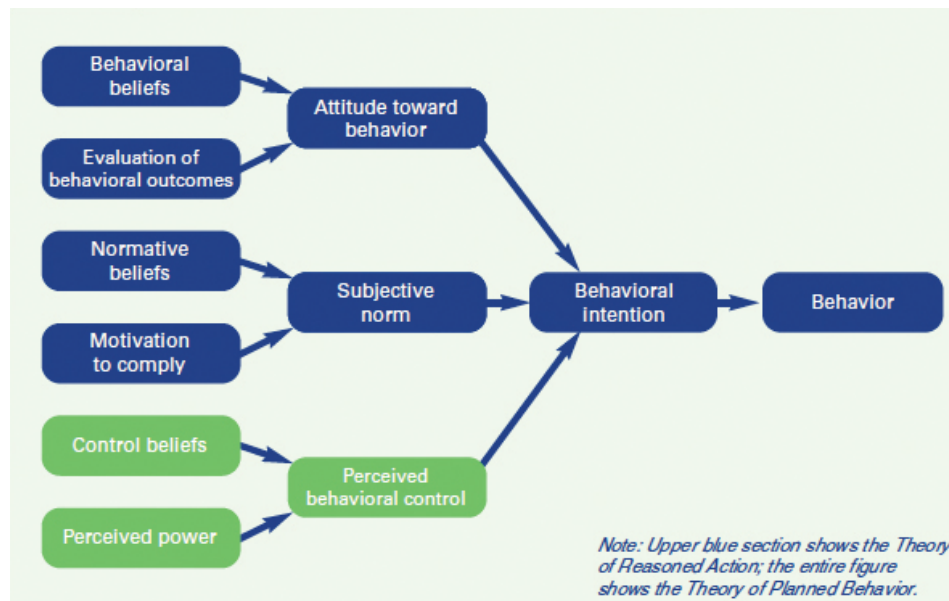


Figure 2.2. Theory of Reasoned Action and Planned Behavior (<http://www.pharmacist.com>, accessed 2012)

Behaviors explored using the TRA include smoking, drinking, using contraceptives, dieting, wearing seatbelts or safety helmets, exercising regularly, voting, and breast-feeding (Fishbein et al., 1994). In Zimbabwe, TRA was applied to research on condom usage by females and males (Montano, Kasprzyk & Wilson, 1990; Wilson, Zenda & Lavelle, 1993).

As summarized in the AIDS Control and Prevention project report (2002), some limitations of the TRA are the inability of the theory to consider the role of environmental and structural issues and the linearity of the theory components (Kippax & Crawford, 1993). Individuals may first change their behavior and then their attitudes to fit their behavior. For example, studies revealed that people often changed their negative attitudes about the use of seatbelts as they habituated to the new behavior.

2.3.4 SOCIAL COGNITIVE THEORY

Bandura's (1986) Social Cognitive/Learning theory proposes that people are driven not only by inner forces, but behavioral change is also determined by environmental and behavioral elements, and each factor affects each of the others. This is often known as reciprocal determinism. For example, one's thoughts affect behavior and the social environment responds to one's characteristics. Similarly, an individual's environment affects the development of personal characteristics and the person's behavior. Environmental factors represent situational influences and environment in which behavior is performed while personal factors include instincts, drives, traits, and other individual motivational forces (see Figure 2.3).

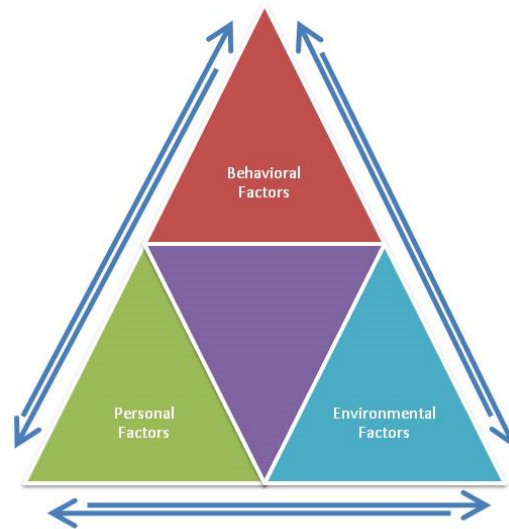


Figure 2.3. Theory of Cognitive Learning: triadic interaction of behavior, person and environment

(<http://wikispaces.psu.edu>, accessed 2012)

This theory has been primarily used for health promotion (Bandura, 1998) and organizational functioning (Bandura, 1988). Most of applications are focused on the concept of *self-efficacy* as one of the construct of this theory. Several limitations to this

theory prevent its effective application in terms of behavior change. The theory is very broadly defined and has been criticized for lacking any unified principle or structure. It is unclear to what extent each of the components of this model contributes to the formation of behavior. The model focuses primarily on the learning process and neglects the idiosyncratic, hormonal dispositions, and biological differences. For instance, it does not explain why different individuals respond differently to similar conditions and stimuli. The theory also ignores the role of emotion and motivation in predicting behavioral responses.

2.3.5 ECOLOGICAL PSYCHOLOGY: AFFORDANCE

The Theory of Affordances was originally coined by perception psychologist Gibson (1977; 1979), and explains how perception can inform people about the physical environment (Johns, 2003). According to this concept, people first perceive what the object affords or offers them, rather than the object's properties such as color, form, or texture. Tromp and Hekkert (2012) suggest that applying the notion of affordance to product design might help designers to clarify the way product can influence behavior. Behavior can result from an unconscious process in which perceived product properties (and features) are linked to an individual's abilities. Thus products can influence behavior either by changing (adding or removing) some design properties or the salience of these properties congruent with users' capabilities.

For example, architects sometimes use inclined planes to prevent people from leaving their belongings, such as coffee cups, on flat spaces. Some desks in the US Library of Congress in Washington, DC, are angled down toward the user, so that nothing harmful (like coffee cups, food and ink pens) can be put on top of the desks and spill over the

documents. “This makes them less usable (from a user-centric point of view) but much more appropriate for their overall purpose” (Beale, 2007). By doing so, these “Slanty” surfaces do not afford “lost items” or damaged documents. Similarly, pyramid shaped cigarette bin (Figure 2.4a) keeps waste from being placed on the top, and paper cone cups (Figure 2.4b) do not allow the attendees of a party to leave them on the tables or windowsill.



Figure 2.4. a: pyramid top cigarette receptacle (left), b: conical paper cups

<http://architectures.danlockton.co.uk>

This indicates the role that shape (in this case angled surfaces) plays in intuitively affording certain behaviors.

2.3.6 BEHAVIORAL ECONOMICS: NUDGES AND SOCIAL NORMS

Behavioral Economics (Kahneman, Slovic, & Tversky, 1982) evolved in response to the emerging distance between economists and psychologists during the development of neo-classical economics. Psychologists in this field such as Ward Edwards, Amos Tversky, and Daniel Kahneman began to benchmark their cognitive models of decision-making under risk and uncertainty against economic models of rational behavior. Their

research studies the effects of social, cognitive, and emotional factors on the economic decisions of individuals and institutions. Following this notion, Thaler and Sunstein (2008) assert that choices can be influenced by “nudges”, or in other words, subtle environmental pushes. They argue that individuals do not always make choices that are rationally considered as the “best.” Rather, they often make choices by using their “intuitive system” (Kahneman, 2003). This suggests that “designers – choice architects – exert considerable influence over those choices through product representation, or by extension through design of the choice environment” (Tromp & Hekkert, 2012). Several studies in social psychology have established the power of social and contextual cues in steering an individual’s behavior (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). One of the best-studied nudges is the concept of *social norms* that can activate particular human tendencies and trigger automatic behavioral responses (Cialdini, 2001). The fact that people are more likely to (automatically) accept and follow rules that are desirable and approved by their group (or society) makes the “choice architects” empowered to draw on social norms as a persuasive “weapon of influence.”

2.3.7 PERSUASION: ELABORATION LIKELIHOOD MODEL

Persuasion is the influence of beliefs, attitudes, intentions, motivations, or behaviors (Seiter & Gass, 2010, p.33). 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 and a whole. “Politics, legal decisions, mass media, news and advertising are all influenced by the power of persuasion, and influence people in turn”

(Cherry, 2013). 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 of this kind. 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 & Cacioppo, 1986a; 1986b), 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. So 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 route, 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; see Petty et al. 1983; Verplanken, 1991).

I will elucidate upon ELM and its implications from design for behavior change standpoint later in sections 2.7 and 2.8.

2.4 MARKETING

Social Marketing is the systematic application of marketing to achieve specific behavioral goals for a social good (McKenzie-Mohr, 1999). Examples of social marketing include the use of campaigns to encourage people to stop smoking in public areas, use seat belts, or donate to charities. While the primary aim of commercial marketing's is financial, social marketing is focusing on social benefits. A variation of social marketing has emerged as a systematic way to foster more sustainable behavior, referred to as Community-Based Social Marketing (CBSM) by environmental psychologist Doug McKenzie-Mohr (1999). He points to several studies indicating that neither mere environmental awareness (Geller, 1981; Tedeschi, Cann and Siegfried, 1982; Bickman, 1972), nor financial incentives (Hirst, 1984; Hirst, Berry, & Soderstrom, 1981) can lead to "actual" behavior alterations. CBSM suggests to change the behavior of communities to reduce their impact on the environment through a pragmatic and sequential process that involves the following steps: carefully selecting an activity to promote; identifying the barriers to the behavior; designing a strategy to overcome these barriers; piloting the strategy with a small segment of the community; and, finally, evaluating the impact of the program.

2.5 HUMAN COMPUTER INTERACTION (HCI)

In HCI, “Persuasive Technology” or “Captology” is a discipline that has been developed by Fogg and his team (2003), primarily in the context of website and software design. Persuasive Technology suggests that computer products can leverage the principles of social influence (peer pressure, social comparison, group polarization, and social facilitation) to motivate and persuade people to change their behavior (Fogg, 2002). Studies verify that when using principles of motivation and influence in computer products, people respond as though the computers were social entities (Fogg, 1997a; 1997b). Products such as Kinect or Nintendo Wii (Figure 2.5) employ technology to make physical activity more engaging. These motion-controlled video game consoles detect movement in three dimensions and project user’s actions onto the TV screen.



Figure 2.5. Wii provides a control to detect motion (left) and Kinect uses has a camera sensor (right;

<http://www.themarriedgamers.net/>, accessed 2013)

Fog’s Behavior Model (FBM) suggests that three elements must converge at the same moment for a behavior to occur: Motivation, Ability, and Trigger (Figure 2.6). When a behavior does not occur, at least one of those three elements is missing. The three core motivators are Sensation (pleasure/pain), Anticipation (fear/hope), and Social Cohesion

(acceptance/ rejection). Behavioral triggers are essential for behavior change and can be in many forms “ an alarm that sounds, a text message, an announcement that a sale is ending, a growling stomach, and so on” (Fogg, 2009, p. 40). Successful triggers have three characteristics: they are noticeable, the user is able to associate the trigger with a target behavior, and the trigger happens when the user is both motivated and able to perform the behavior (Ibid).

Consolvo McDonald, and Landay (2009) suggest a set of strategies for technologies that support behavior change as: 1) Abstract & Reflective, 2) Unobtrusive, 3) Public, 4) Aesthetic, 5) Positive, 6) Controllable, 7) Trending / Historical, and 8) Comprehensive.

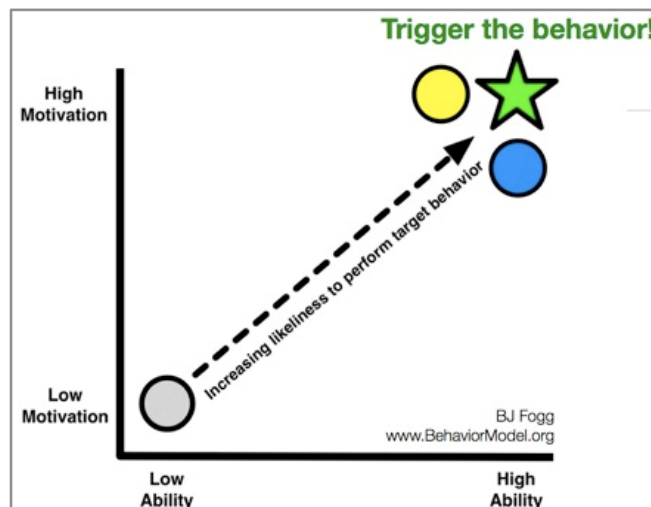


Figure 2.6. Fog Behavior Model (Fogg, 2009)

2.6 DESIGN

Designers try to influence behavior through the products they design. They often draw strategies from behavioral theories such as the Goal-Setting Theory (Locke, 1968; 2006) or the Transtheoretical Model of Behavior Change, or use social norms to design products and services that support certain behaviors. In the context of sustainable

behaviors, “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 with respect to the product itself (material, energy consumption, recyclability, waste and pollution) or the interaction that occurs between the product and the user during use. Since the focus of this research is on the use phase, I narrow down the scope of this review to the design paradigms that target behavioral changes with a higher emphasis on eco-friendly products. Over 80 product design concepts were collected from the Internet and organized in a table (See Appendix I). For each, I provided a description, the type of behavior they aim to change, and the strategy the designer has used to influence the behavior. Table 2.2 is an excerpt of the table.

2.6.1 STRATEGIES

In this section, I draw the most frequently used strategies by designers to influence behavior from the literature and product examples.

2.6.1.1 TECHNOLOGICAL INTERVENTIONS

“Intelligent” products and services use technological interventions to either prevent the user from performing certain behaviors or coerce sustainable behaviors. Through this strategy, designers use technology as a substitute for human behavior or to forcefully correct it. Two familiar examples are motion activated light sensors (that automatically turn the light on/off) and automatic sensing faucets. Although intelligent products can decrease energy consumption in many instances, they have not shown to be effective in terms of behavior change.


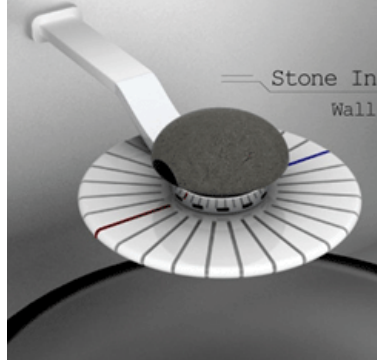

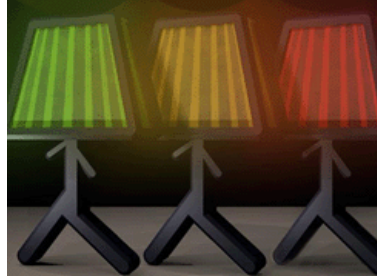
Name	Product image	Behavior/strategy	Description
Green Goose	 <p>Be a good egg. Learn more</p> <p>MOM Approved</p> <p>Basic Station</p> <p>Basic Sensor</p> <p>Sticker</p> <p>many more...</p>	<p>Behavior: Different desirable behaviors</p> <p>Strategy: Feedback Making the behavior fun</p>	<p>This product is a technological platform, which uses sensors and accelerometers on stickers or credit cards to track everyday behavior and record it online.</p>
Stone in the creek	 <p>Stone In</p> <p>Wall</p>	<p>Behavior: Water conservation</p> <p>Strategy: Technological intervention</p>	<p>It is a sink mixer that makes use of natural stone in order to control water flow and limit consumption.</p>
Waterpebble	 <p>waterpebble</p>	<p>Behavior: Water Conservation</p> <p>Strategy: Eco-feedback</p>	<p>It is an electronic pebble that monitors water usage during showering by showing a green, amber, or red light depending on showering time.</p>
Spark Lamp		<p>Behavior: Electricity Conservation</p>	<p>A lamp that charges with sunlight and when turned on in the evening, flickers green, yellow or red depending on the energy use during the month compared to the goal energy use of the month.</p>

Table 2.2. A collection of product examples to change behavior

2.6.1.2 ECO-FEEDBACK

While intelligent products assume responsibility for making the “right” sustainable decision, eco-feedback products, as introduced by McCalley and Midden (2006), let the users decide if they want to behave in a “recommended” way. Eco-feedback is grounded in the “Feedback Intervention Theory” (Kluger & DeNisi, 1996), and aims to provide consumers with information about their behavior to enable them to make more informed decisions (Lilley, Bhamra, & Lofthouse, 2006). Several studies have discussed the ways product design might influence users. There are examples of eco-feedback devices and strategies (see Appendix I for some examples). Through this strategy users are informed about their consumption behavior through devices that are installed in the environment. Some of these products have shown to change behavior through empirical studies, while most are limited to concepts or designed products with hopes to elicit sustainable behavior. Kappel and Grechenig (2009) used this approach to conserve water during a shower by indicating the amount of water consumption with a number of LEDs assembled on a stick (Figure 2.7a). The subjects who considered themselves as ecologically conscious, changed their behavior and turned the water down or off while soaping. Other subjects who did not have the goal to act more sustainably, were surprised about their water consumption and tried to reduce it. However, after the removal of these displays, users did not maintain their behavior and fell back into their previous habit. Eco-feedback may also inform users about their behavior in a more subtle way. The "Efficiency Leaves" (Figure 2.7b) in Ford Fusion Hybrid's fuel gauge “tell you if you are being a green driver. Keep the leaves on the trees and all is well, try your best to not

make them fall” (Loveday, accessed 2009). Here, leaves connote a metaphor for “green” behavior.



Figure 2.7. a: Show-me shower head (Kappel and Grechenig, 2009) and (left), b: Ford Fusion fuel gauge (<http://static.ed.edmunds-media.com/>, accessed 2013)

Another example for implicit eco-feedback, is a group of products called “erratic appliances” (Ernevi, Palm, & Redström, 2007), a series of objects behaving erratically when an individual is using too much electricity. These objects cease working efficiently when the energy consumption increases dramatically. For example, the Erratic Radio may “untune” when there are too many objects in the room consuming energy. The negative side of these products is that they might seem annoying to the point that the user stops using them. The feedback devices can demonstrate the financial costs of the behavior as well. Ambient Devices’ wirelessly networked “Energy Joule” (Ambient Devices, n.d.) aims to persuade users to alter their discretionary electricity use in response to signals about the current electricity cost per unit in order to save money. Energy Joule communicates changes in energy prices by glowing in a variety of different colors. Red indicates high prices, yellow shows above average pricing, and green indicates average or low energy prices (see Figure 2.8).



Figure 2.8. Energy Joule turns red when the consumption increases (*millennialliving.com*, accessed 2013)

2.6.1.3 SCRIPTING: REMOVING OR INCORPORATING BARRIERS

Scripting is a strategy that neither coerces a behavior nor gives the full responsibility to the user in terms of decision-making. Developed by Jelsma and Knot (2002), scripting is defined as the design of a “product-layout guiding the behavior of the user, in a more or less forceful way, to comply with values and intentions of the designer” (Wever, Van Kuijk, & Boks, 2008). This means designing products in such a way that unsustainable behavior is made difficult or impossible, while sustainable behavior is made relatively easy or even automatic (example in Appendix 1). Product scripts can be related to the affordance theory, where the product presents potential actions and functions through its perceived features. A good example of using behavior scripts is Eco-kettle (Figure 2.9a). This electric kettle has a special feature that allows user to fill the kettle to its maximum, but then allows them to boil one to eight cups according to their requirements.

Sometimes these scripts fail to be effective if they are not thoroughly understood by the user. For instance, dual-function toilet flush offers two flush modes: a low water flush for disposing of liquid waste only, and a higher volume flush for dealing with solid waste. In one particular version of this product (Figure 2.9b) the user should push the flush up for using less water. However, habitually, people are accustomed to push the handle down, using the regular flushing with standard toilet designs. Thus, the flushers have to pay

extra attention, pause, and behave in an unintuitive way. In fact, they are very likely to miss the fine print or sign above the toilet and use the maximum amount of water by default, even though there is an option to use less water. This is an example where the product does not afford the best option, because the design is perceived as counter intuitive.

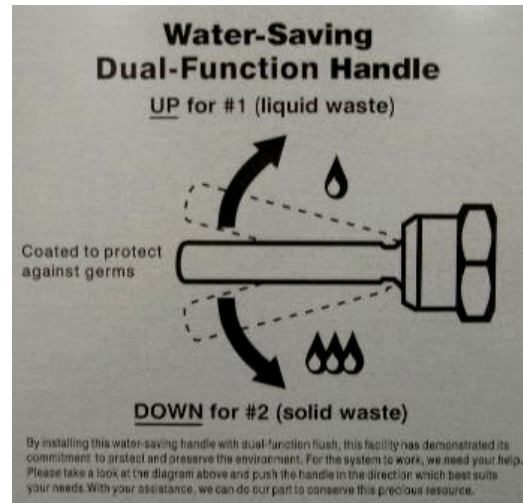


Figure 2.9. a: eco-kettle (left) from (<http://www.ecokettle.com>), b: dual-function flush handle (right)

2.6.1.4 MAKING THE BEHAVIOR FUN TO DO: THE FUN THEORY

"The Fun Theory" (Volkswagen, 2011) campaign is an initiative encourages behavior change by allowing people to see the fun side of mundane, everyday activities. The campaign has started up with a number of experiments in which the theory -that fun can change people's behavior- is tested in various situations. The World's Deepest Bin (Figure 2.10a) that produces a sound resembling an object falling down a very deep pit when a piece of trash is put into the bin, or the Piano Staircase (figure 2.10b) are successful examples of making mundane, everyday behaviors (throwing out trash) or lazy behaviors (going up the stairs) fun.



Figure 2.10 (a, b) Making a behavior fun to do (Volkswagen, 2011)

2.6.2 HEURISTICS AND FRAMEWORKS

In this section I introduce a design toolkit that incorporates several design patterns, and two frameworks for user-centered design to influence behavior.

2.6.2.1 DESIGN WITH INTENT TOOLKIT

Design with Intent Toolkit includes 101 strategies derived from different types of existing systems (products, services, interfaces, environments) that have been strategically designed with the intent to influence how people use them. These strategies are structured into eight categories and each strategy is illustrated on a card with an example (Figure 2.11). Developed by Lockton (2010), this toolkit features eight “lenses” for design with intent as Architectural, Errorproofing, Interaction, Ludic, Perceptual, Cognitive, Machiavellian, and Security. The Architectural Lens draws on techniques used to influence user behavior in architecture, urban planning and related disciplines such as traffic management and crime prevention through environmental design. The Errorproofing Lens treats deviations from the target behavior as ‘errors’, and similar to scripting, guides the users to avoid them by making errors impossible in the first place. The Interaction Lens draws on some of the most common design elements of interfaces

where users' interactions with the system affect how their behavior is influenced. This lens also includes some patterns from the field of Persuasive Technology, where computers, mobile phones and other systems with interfaces are used to persuade users. The Ludic Lens brings together a number of techniques that can be derived from games and other “playful” interactions.



Figure 2.11. Design with Intent Toolkit (<http://danlockton.com>, accessed 2013)

The Perceptual Lens combines ideas from product semantics, semiotics, ecological psychology and Gestalt psychology about how users perceive patterns and meanings as they interact with the systems around them. Most of these patterns are visual, but also include sounds, smells, textures and so forth. The Cognitive Lens is grounded in behavioral economics and cognitive psychology and looks into how people make decisions, and how this is affected by “heuristics” and “biases”. Many cognitive biases and heuristics have been identified by psychologists and behavioral economists, a lot of which could potentially be applied to the design of products and services. These patterns

draw heavily on the work of social psychologists, namely, Robert Cialdini (2006), Richard Thaler and Cass Sunstein (2008) among others. The Machiavellian Lens consists of design patterns, which embody an “end justifies the means” approach associated with Niccolò Machiavelli. The Security Lens represents a security worldview, i.e. that undesired user behavior is something to deter and/or prevent through “countermeasures” imbedded into products, systems and environments, both physically and online, with examples such as digital rights management.

2.6.2.2 USER-CENTERED DESIGN FRAMEWORKS FOR BEHAVIOR CHANGE

Traditional User-Centered Design (UCD) focuses on “improving ease of use”—not necessarily aesthetics – and satisfying the “needs” and “wants” of the user as the primary value of design, and facilitates what users “want” to do rather than what they “should” do. More recently, some efforts have been made to enrich this approach with design with the intent of behavior change. Lilley, Lofthouse, and Bhamra (2005) and Wever (et al. 2008) have proposed frameworks for user-centered design for behavior change, based on a comprehensive review of distinct methods. Lilley (et al. 2005) define three types of product-led interventions: eco-feedback, scripts and steering, and intelligent products. They later modify this framework and replace persuasive technology with intelligent products (Lilley, 2009). The recent proposed framework (Figure 2.12) looks into different levels of influence in terms of decision-making, ranging from the lowest product coercion (eco-feedback) to the most forceful strategy (persuasive technology).

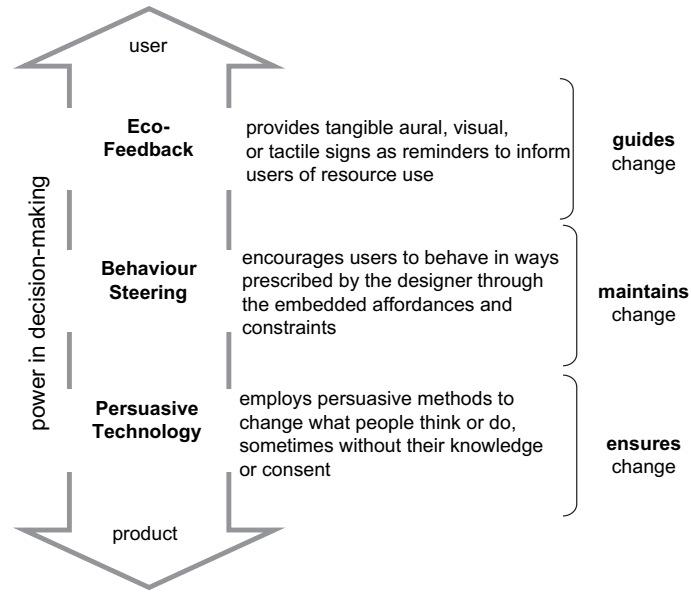


Figure 2.12. Strategies for designing sustainable behavior (Lilley, 2009)

Wever (et al. 2008) expanded the first categorization of Lilly et al. (2005) and suggested a new framework that entails two different approaches: functionality matching and behavior adaption. In functionality matching, as described by Rodríguez and Boks (2005), they suggest eliminating mismatches between delivered functionalities and desired functionalities. Sometimes unnecessary functions have an impact, while missing functionalities can trigger unwanted behaviors that cause unsustainable effects. By behavior adaption, they suggest influencing behavior through product design (as described by Jelsma & Knot, 2002, and Lilley et al. 2005). Behavior adaption is divided into three sub-categories: Eco-feedback, Scripting, and Forced-functionality. Forced functionality refers to either intelligent products (as defined by Lilley, 2005) that adapt automatically to changing circumstances, or to designing-in strong obstacles to prevent unsustainable behavior (see figure 2.13).

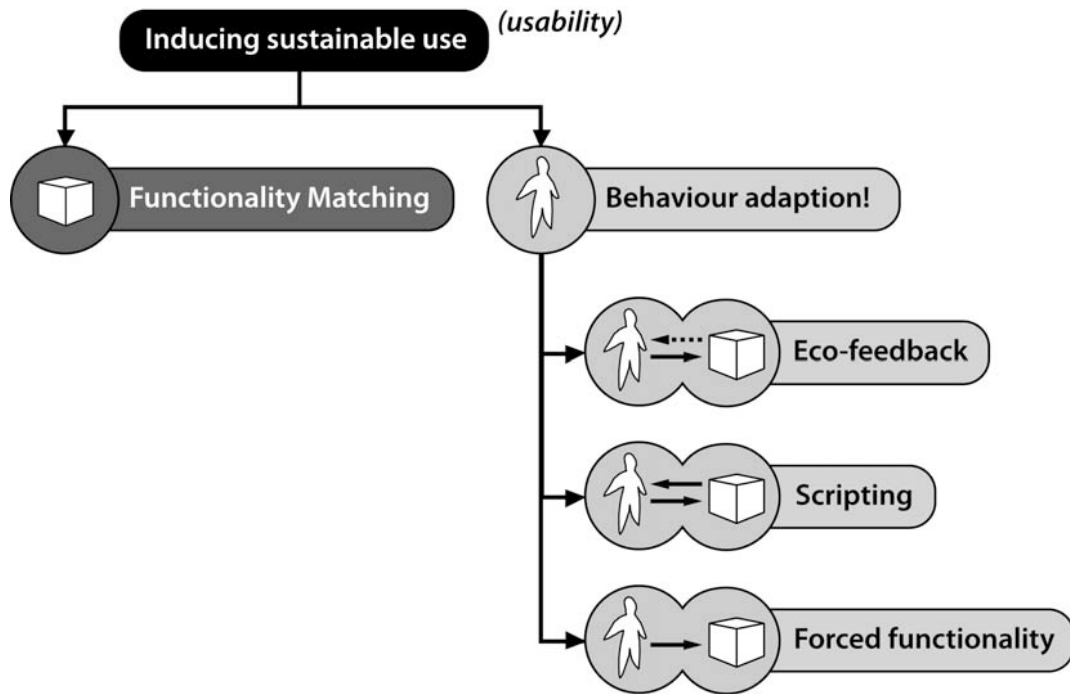


Figure 2.13. typology of sustainable behavior-inducing design strategies (Wever et al. 2008)

2.7 SUMMARY OF LITERATURE

In **psychology**, the existing theories and models of behavior change provide us with a deeper insight of underlying mechanisms of behavior change and their essential components. While most of the major theories (HBM, SCM, and TRA) consider behavior change as a rational and sequential process and consider an individual's "intention" as the best indicator that the desired behavior will occur, the Social Cognitive Theory frames it as a result of interaction between personal, behavioral, and environmental factors. Moreover, the different approaches of context-based behavior (ecological psychology and behavioral economics) suggest that the environments (products, spaces, etc.) may (differently) influence behavior; Products may "afford" certain cognitive and physical behavioral responses based on the perception they create in people. They can also influence choices through "nudges" and steer one's behavior "in a way that will make

choosers better off, as judged by themselves” (Thaler & Sunstein, 2008, p. 5). The fundamental difference between these approaches and the classic theories (HBM, SCM, and TRA) is grounded in different decision making models: intuitive versus rational. The classic literature draws upon the fact that behavior change is a rational, sequential process in which individuals will achieve their goal (of change) if they have the intention and follow all the steps as advised. In contrast, and as mentioned before, the behavioral economists and social psychologists claim that contextual and other emotional factors play a primary role in the decision-making process and that we are easily and predictably influenced by environmental cues and nudges.

Persuasion design embeds various forms of influence and “choice architectures” in products and services to maximize the likelihood of positive behavior change. Behavioral economists provide countless examples of subtle cues that lead to major shifts in behavior.

In **marketing**, community based social marketing suggests that contrary to the traditional educational approaches and media advertising, we should follow a more pragmatic and step-by-step approach in which a behavior is carefully selected to promote, the barriers to the behavior are identified, a strategy to overcome these barriers is designed, a pilot test of the strategy with a small segment of the community is conducted, and, finally, the impact of the program is evaluated.

In **human computer interaction**, Persuasive Technology (Captology) strives to change people’s attitudes and behaviors through interactive computing systems. This field investigates the extension of social principles to 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 the behavior and requires the users to have motivation and ability to change their behavior.

In **product design**, each of the introduced strategies could be appropriate for specific behaviors, context of use, and the intention of designers. Studies show that forced functionality (intelligent products) does not automatically lead to sustainable behavior (Derijcke & 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. However, technology may help designers to reduce the environmental impact during use phase by providing the users with constant and continuous (eco) feedback of their behavior. Eco- feedback has been used and some studies show that providing users with information about real-time consumption rate encourages them to use less energy (Darby, 2000; Völlink & Meertens, 2006; Kappel & Grechenig, 2009). The Fun Theory seems to be effective while the product is novel and intrigues the users' curiosity. 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. Lockton (2009) proposes behavior change heuristics to facilitate brainstorming process of design for behavior change, and draws upon different strategies from various fields (architecture, HCI, industrial design, social psychology, etc.) with the intent of behavioral changes. Wever (et al. 2008) and Lilley (2009) summarize the existing strategies into frameworks for sustainable behavior change.

2.8 RESEARCH POTENTIAL (KNOWLEDGE GAP)

With respect to the existing user-centered design approaches, there are factors that are often unaccounted for in a more deliberate UCD model, and there is a need for designers to act as choice architects and step beyond the notion of what is “desired” and advance towards what is “desirable” for people and the society as a whole.

Overall assessment from reading the literature suggests that except for eco-feedback, relatively little empirical research has been done to assess the effectiveness of each of these strategies through measuring the actual “behavioral” responses and with a rigorous method. Most of the work relies on predicting behavior based on attitude, and through surveys, which reflect self-reports. Self-reports are not reliable because people might misunderstand the question, they might not completely remember the accurate answer, or intentionally give the wrong answer (see Dillman 1978; Kalton & Schuman 1982; Sudman & Bradburn 1982; Belson 1986; Converse & Presser 1986) partly because they want to appear more socially acceptable (social desirability bias; Gendall, Hoek, & Blakeley, 1992). The mentioned design strategies are mostly focused on the functionality rather than the aesthetics of a product. Even in those instances that the appearance of the product communicates a persuasive message (eco-feedback, erratic appliances) the designers demonstrate the general mechanisms (top-down) rather than the design elements and principles (bottom-up). Thereby, the role of design elements and principles has not been studied and acknowledged with respect to behavior change.

The existing literature on “persuasion” and “motivation” provide general, yet limited, frameworks for designers interested in sustainable, low-cost, product-driven behavior change. While persuasive technology emphasizes the power of social and contextual cues

in steering one's behavior, this concept is often used for situations in which people have enough motivation to change their behavior and the "technology" leverages the change through prompts and triggers. Moreover, it remains unclear how these strategies can be transferred from HCI and computing systems to the physical domain of products.

Although the Elaboration Likelihood Model 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.

It is concluded that there is a need for an investigation upon the specific design elements and principles to understand how to use design language to persuade individuals to change their behavior through the aesthetics of the products. This need is being addressed in this dissertation. I have not been able to find research that compares the relative effectiveness across the different methods and different conditions (e.g., under what conditions will Fun Theory lead to more effective behavior change than, say, scripting or eco-feedback) and what are the important factors that designers should consider when choosing a strategy. Such study will be important but is not addressed in the dissertation.

2.9 DISSERTATION RESEARCH QUESTIONS

Recognizing that the topic of design for sustainable behavior is fairly broad, a specific focus on persuasive approach with an inclination towards the literature from ecological psychology and behavioral economic has been selected for further investigation. The particular research questions that we are seeking to answer are:

Q1. Which design properties can afford product-driven sustainable behaviors through a persuasive intuitive system?

Q2. Which design properties can afford product-driven sustainable behaviors through a rational persuasive pathway?

Q3. Can we identify a series of heuristics that can be used by designers to design products (and services) to persuade effective behavioral changes?

2.10 DISSERTATION APPROACH

As stated previously, this dissertation pursues a persuasive approach with regard to behavior change. Towards that end, I use the Elaboration Likelihood Model of persuasion to establish the theoretical background that supports my research hypotheses. I am also interested to understand the role of products visual aesthetics in eliciting behavioral changes, through exploring the above-mentioned research question. In doing so, knowledge of design elements and principles as well as aesthetics properties is required.

2.10.1 DESIGN ELEMENTS

Design elements are the basic units of a visual schema such as painting, drawing, and design. These elements are universally accepted as line, color, texture, form, shape, and space. A design is primarily represented by one or a combination of mentioned elements (Wikipedia, accessed 2013; Lovett, accessed 2013).

2.10.2 DESIGN PRINCIPLES

Principles of design are applied to the elements of design to bring them together into one unified being defined as design. How a person (designer) applies these principles determines how successful a design may be (Lidwell, Holden, & Butler, 2010). Unity, balance, harmony, dominance, similarity, contrast, and scale are some of the basic design principles, among the others (Ibid).

2.10.3 AESTHETICS AND AESTHETICS PROPERTIES

Aesthetics is a branch of philosophy dealing with the nature of beauty, art, and taste, and with the creation and appreciation of beauty (Merriam-Webster, n.d).

Aesthetics is a very old concept, rooted in the Greek word 'aesthesis' that can be translated as understanding through sensory perception (Hendrik, Schifferstein, & Hekkert, 2008). In the eighteenth century the concept started to be used as referring to sensory pleasure and delight (Goldman, 2001). Hekkert (2006) believes that this definition is most appropriate because it clearly distinguishes aesthetic phenomena from other types of experience, such as the construction of meaning and emotional responses. He believes that "People may and do differ extensively in their aesthetic reactions to objects; these reactions as well as the differences are not arbitrary, but lawful" (Hekkert & Leder, 2008). Years of theorizing and experimentation in this field has provided quite a bit of information about the drivers of people's aesthetic responses to the things around us in general, and designed artifacts in particular.

The aesthetic properties are generally classified into three categories: psychological, organizational, and meaningful properties (Hekkert & Leder, 2007; see Hekkert, 1995 for an overview).

Psychological Properties: According to Hendrik, Schifferstein, & Hekkert (2008), psychological properties are the formal qualities of objects, such as their intensity, size and color (in terms of hue, saturation, and brightness), or properties that can be quantified. Aesthetic effects of these properties are highly relational and contextual. More specifically, the most interesting findings come from color studies. It has often been demonstrated that, for humans from different cultures and even for animals, the hues are preferred in the order of blue, green or red, and yellow (McManus, Jones, & Cottrell, 1981). Furthermore, the three dimensions of color (hue, saturation, and brightness) differ in terms of their impact on aesthetic preference.

Organizational Properties: Psychology of perception has achieved a good understanding of how our perceptual system makes sense of our environment by analyzing edges, contours, blobs, and basic geometrical shapes (e.g. Marr, 1982; Biederman, 1987). However we need to perceive which elements belong to the same object in order to make sense of our surroundings. The organizational properties both explain what we see and also why we prefer to see certain patterns over others (Ramachandran & Hirstein, 1999). In other words, we like to look at patterns that allow us to see relationships or create order. There are three organizational properties that have been central in aesthetic research as unifying properties, complexity and variety, and unity in variety. Unifying properties can be order, balance or harmony, symmetry or 'good' proportion. Although unifying properties are believed to be pleasant, if humans would just look for orderly and balanced patterns, our world and our designs would be rather simple, and presumably be experienced as boring. According to Berlyne's collative-motivation model, complexity and variety of patterns are proffered for their ability to generate arousal (Berlyne, 1971). Visual patterns with low arousal potential are not stimulating and leave the observer indifferent; patterns with very high arousal potential are too difficult to grasp and are considered unpleasant. Preferred are patterns with an arousal potential at a medium (or optimum) level. If people are attracted to order and unity, they also (occasionally) seek complexity and variety. It is easy to predict that a balance between these opposing forces would lead to maximum pleasure (unity in variety).

Meaningful Properties: Unlike the organizational properties that an observer can perceive in the design and can be measurable and formalized, meaningful properties are by definition subjective and are not thus properties of things, but rather properties as we perceive them. Based on our knowledge and previous experiences, we, for example, qualify something as familiar or novel, typical or strange, original or outdated. Familiarity and prototypicality, originality and novelty, Most Advanced Yet Acceptable

(MAYA), and product expression and association are meaningful properties, among others (Hekkert & Leder, 2007).

2.11 REFINED DISSERTATION RESEARCH QUESTIONS:

Based on the theoretical foundation and specific concentration on persuading behavior change through visual and aesthetic properties of design, the refined research questions are as follows:

Q1. How an aesthetic property, specifically color, can afford product-driven sustainable behaviors through a peripheral persuasive route?

Q2. How meaningful properties of designs, specifically metaphors, can afford product-driven sustainable behaviors through a central persuasive route?

Q3. Can we identify a series of heuristics that can be used by designers to design products (and services) that persuade effective behavioral changes through the appearance?

In the next following chapters I will investigate these questions through systematic empirical studies.

PART I

CHAPTER 3

VISUAL SALIENCE: A PERIPHERAL ROUTE TO PERSUASION

3.1 OVERVIEW

In this chapter I examine the first research question, “How an aesthetic property, specifically color, can afford product-driven sustainable behaviors through a persuasive intuitive system?” Pursuing a top-down approach to explore behavior change phenomena and define hypothesis, I study how implicit environmental cues (processed through a peripheral route) to a behavior can be incorporated to a product, and which design principles or elements might be used as peripheral cues to trigger the desired behavior. In order to prove hypothesis, I follow a bottom-up approach by identifying a design element and a desired behavior, conducting a series of systematic experiments to test the proposed hypothesis, and analyze the results to see whether or not the behavioral responses are observed as predicted.

3.2 PERIPHERAL ROUTE TO PERSUASION

As explained in 2.10.1, a persuasive message is processed through a central (high elaboration) route when people have enough motivation and ability to analyze the argument rationally. However, people are not capable of analyzing the numerous choices they make every day. The industrialized and “in rush” lifestyle we lead (Lewis & Cooper, 1999) likely increases our propensity to use mental shortcuts rather than pay more attention to the merits of the arguments (Gigerenzer, 2007). Moreover, from an evolutionary point of view, it is not economic to rationalize all the decisions we make. Specifically, with respect to the 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. Hence, the stimuli (persuasive messages/cues) are more likely to be processed through a peripheral route for the situations when motivation, ability, or both are insufficient. As discussed earlier, the peripheral route is a mental shortcut that accepts or rejects a message based on cues (attractiveness, credibility, etc.) as opposed to actively thinking about the issue (Petty & Cacioppo, 1986a; 1986b). For instance, research has shown that physically attractive sources are persuasive (Berscheid & Walster, 1974; Eagly & Chaiken, 1975; Shavitt, Swan, Lowrey, & Wanke, 1994). So a person considers the way the message is presented rather than the content. Also, environmental characteristics of a message can be processed through the peripheral route. For example, implicit situational cues associated with a certain behavior can trigger the behavior change through this processing route.

In product design, there are paradigms of salient situational cues that encourage sustainable actions, such as the piano stairs (Fun Theory), dual-function flushes

(scripting), and Erratic Appliances (eco-feedback) among others. Erratic Appliances, for example, react to the behavior by changing appearance and/or function without explicitly pointing to the behavior (Figure 3.1). A recent study suggests that being in a sustainable building (and exposure to sustainability cues) can elicit environmentally sustainable behavior if all of the other factors (disposal facilities) are equal (Wu, DiGiacomo, & Kingstone, 2013). 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 peripheral cues that grab attention, may implicitly encourage people to behave in a certain way.



Figure 3.1. Erratic Appliances, power aware cord gets brighter when more electricity flows through it

(<https://www.tii.se/>, accessed 2012)

3.3 VISUAL SALIENCE

Visual salience is “the distinct subjective perceptual quality which makes some items in the world stand out from their neighbors and immediately grab our attention.” (Itti, 2007) “Salience is the result of interaction of one element with another, as well as with a visual system (biological or artificial)” (Ibid). That is primarily a “bottom-up, stimulus-driven”

signal but it can be overridden by “top- down, user-driven” factors (see Desimone & Duncan, 1995; Itti & Koch, 2001). Saliency of an object and eliciting attention through product’s appearance can be achieved through design elements and principles; it could occur through increased felt arousal (arousing colors, patterns), or the contrast between a number of simple visual elements or properties such as color, edge orientation, luminance, and motion direction (see Itti & Koch, 2001). Figure 3.2 shows the different ways that certain elements or visual features make objects salient and easy to notice compared to similar objects that are non-salient and difficult to notice.

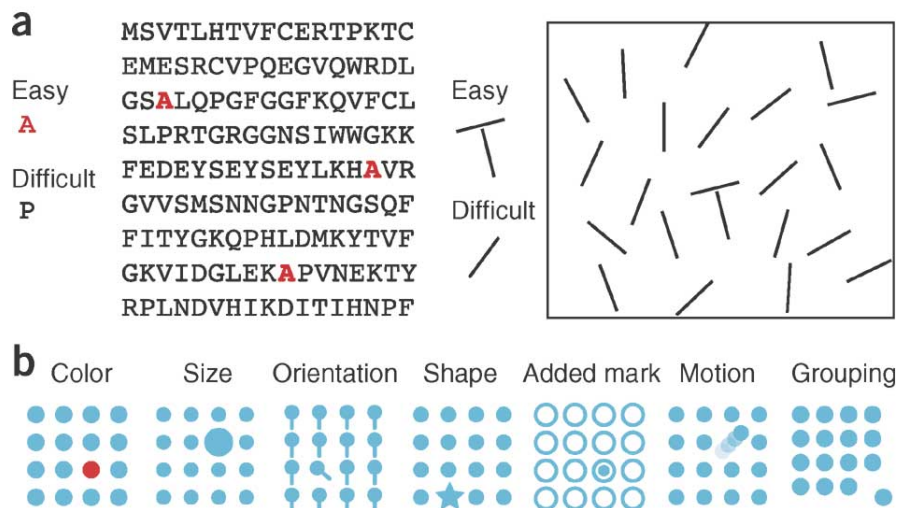


Figure 3.2. a: Certain elements can be seen in a single glance, whereas others are difficult to find, b:

Examples of visual features that make objects distinct (Wong, 2010)

3.4 COLOR AND VISUAL SALIENCE

Color is one of the visual properties perceived by human being, and derives from the spectrum of light interacting with light receptors in the eyes. Color has been studied as the topic of a great deal of literature from different aspects. Various biological, cultural, and environmental factors account for the perception of color. Color is a very salient

environmental cue and allows us to recognize, classify, categorize, and remember objects in a very efficient way (Hurvich, 1982).

Human's response to color is both physiological and learned (Aslam, 2006); it could be innate or of instinctive origin (see Humphrey, 1976) or of a learned/associative origin (see Adams, 1973). A number of studies suggest that demographic factors such as age, sex and even ethnicity also should be considered in explaining the communication values of various colors (see Boyatzis & Varghese, 1994; Choungourian, 1968; Yang, 2001).

Difference in color perception could also be due the physiological accounts that root in the geographical location. It has been shown that in areas where sunlight is very bright and direct, color intensity declines (see Birren, 1956; Pettersson, 1982). Thus, people living closer to the equator have a more highly developed vision and possess greater amounts of yellow intraocular pigmentation in the eye that causes a depression in color discrimination. People from northern latitudes, where light is reflected less directly, have developed a more refined color vision (Clarke & Honeycutt, 2000).

The meaning of colors could be learned. For instance, in human factors there are some universally accepted standards; red is a sign of danger (stop), yellow means caution, and green prompts 'go'. These standards can extend beyond the human factor context and activate cognitive associations in response to certain colors, as blue or green (versus red) can activate an approach (versus avoidance) motivation (Mehta & Zhu, 2009).

Cross-cultural and ideological differences influence the meaning attached to different combinations of colors (Madden, Hewett, & Roth, 2000). For example, black on red represents happiness to Chinese people, and therefore is commonly used for wedding invitations. A combination of red over white indicates celebration and signifies the life

force to the Japanese. Red and white is a combination used for ritual decorations in Melanesia and for representing the Sacred Heart of the Catholic Church in Mexico (see Geboy, 1996).

Studies show that color influences arousal. Some colors cause individuals to feel more aroused, and some cause to feel more relaxed (Walters, Apter, & Svebak, 1982). Walters (et al.) suggest that long-wave colors, like red and yellow, are more arousing.

In art and design, color is considered one of the basic design elements, a powerful tool to express feelings, emotions, messages, meanings, and so forth. In this dissertation, we use color as a tool to make an environmental cue to the behavior (recycling bin) more salient.

3.5 HYPOTHESIS

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. 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. 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). Formally, our hypothesis can be stated as:

Salient Colors increase the use of recycling bins, assuming all other aspects being equal.

3.6 EXPERIMENTS

In order to test the proposed hypothesis, it is necessary to conduct systematic empirical studies and examine behavioral responses to the intervention. The study involves testing a recycling bin with a relatively more salient color, comparing the rate of recycling to a recycling bin that has a relatively less salient color and find if people use the more salient recycling bin more frequently.

3.6.1 PRE-TEST: COLOR SALIENCE

In order to find the right stimuli (salient color for recycle bin) for Study 1, we conducted a pilot study. In this pilot study we tested how different colors on a recycling bin exhibit salience. The dependent variable was “recall” of a recycling bin in both cued and no-cued conditions (in this pilot study we did not measure recycling bin use). In the memory task, we were interested to see if people remember the recycle bin in the presented image, while they are not actively looking for a recycling bin (non-cued). In the second stage of this task, we provided a cue to facilitate recall (did you see any recycling bin?) to examine whether they remember the recycling bin after being prompted.

For the recycling bins and trashcans, we used three different color hues (red, green, blue) and a medium grey with the same level of brightness and saturation.

3.6.1.1 METHOD

We took a photo in the same experimental lab that will be used in Study 1. We then created four images and in each a recycling bin was imbedded in one of the four colors of interest, in the same location in the room, creating four experimental design conditions (Figure 3.3). We designed an online survey in which subjects used their own computers, were randomly assigned to one of the four conditions, and exposed to the photo for three seconds. They were then asked to list eight objects they remembered from the photo. In the next question, we asked them whether they saw a recycling bin or not and if their answer was “yes”, asked them to mark the location of the recycling bin. We also asked about the monitor size and colorblindness of participants. Data for colorblind subjects were excluded. The subjects were not able to take the survey if the monitor size was smaller than 21 inches. All subjects were required to run the survey in a full screen mode.



Figure 3.3. Each subject was randomly exposed to one of these images for three seconds

3.6.1.2 RESULT

Ninety-nine subjects (50 female) from the Amazon Mechanical Turk (Mturk) subject pool participated in the pilot study; 52.5% listed the Recycling bin/trashcan as an object they remembered from the photo and 58% of subjects remembered the right location in the cued condition. The general pattern of results showed that green was the most memorable color, while red and grey were the least memorable colors (Figure 3.4, left). An omnibus logistic regression analysis showed a significant effect of color ($Z=2.84$, $p = .043$). A planned contrast test revealed that in the no-cue condition green is significantly more memorable than grey ($Z=2.37$, $p = .018$) and red ($Z=2.23$, $p = .025$). We observed the same pattern for the second question using cued recall (Figure 3.4, right). In the cued condition, in addition to green being more memorable than red and grey, blue was also significantly more visible than grey ($Z=2.22$, $p = .028$).

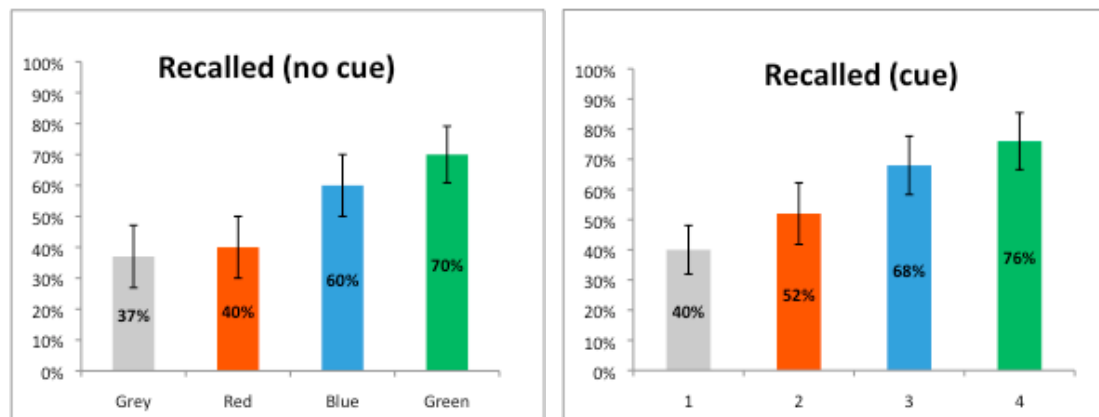


Figure 3.4. Recalling the recycling bin without cue (left) and after cue presented (right), $SE=\pm 1$

3.6.1.3 DISCUSSION

This pretest indicated that different colors affect the memory for a recycling bin in both cued and non-cued settings. The results are surprising as we expected red to be more noticeable than the other colors because of the higher arousal it tends to induce, followed

by blue which is a more familiar color for recycling bins. The pre-test suggests that the high arousal does not necessarily increase the memorability and salience of a recycling bin. This result helped us decide which colors to use in Study 1-A, which was intended to examine actual recycling behavior. In the next study, we tested the hypothesis that visual salience of a recycling bin affects the probability of its use.

3.6.2 STUDY 1-A: COLOR AND RECYCLING

The major goal of this study was to examine whether the salience of a recycling bin leads to a greater likelihood of recycling behavior. The experiment had two conditions: high-salience and low-salience. The high-salience condition was represented by a green recycling bin next to a grey trashcan in which the color contrast of two bins adds to the salience of the bin, whereas in the low-salience condition two grey bins were differentiated either as a recycling bin or trashcan only by a black and white label. Therefore, we compared a green and a grey recycling bin (all other aspects such as size and shape being equal) by placing it beside a grey trashcan, and measured the proportion of participants who recycle (Figure 3.5 represents two experimental conditions). All bins were labeled as either “TRASH” or “RECYCLE” in black on a white background with the same font style, font size, and color. Since subjects might behave differently if they notice that they are being watched, especially in the context of pro-social behavior, observations were discreet so participants were not aware of the purpose of the study or that their recycling behavior is being observed.



Figure 3.5. Two experimental conditions (Green versus Grey)

3.6.2.1 METHOD

Forty-eight undergraduate students participated in the study and were randomly assigned to either the high-salience (Green, $n=25$) or low-salience (Grey, $n=23$) conditions. Depending on the experimental condition, a recycling bin (grey or green) was positioned in an experimental lab located at the University of Michigan. A grey trashcan with the same shape and size was also located 35cm away from the recycling bin (Figure 3.6 shows the green condition). Subjects signed up to take a set of surveys for course credit. For their final task, they were asked to engage in a task that involved tearing some papers. They were asked to go to a table at the corner of the room (Figure 3.7, left) containing the materials for the experiment (instruction paper, a letter size label, and an empty bottle), and return to their seats to do the task. For the task, they were asked to choose one label for an orange juice container (among the four printed designs on a paper) that best fits the form of the bottle, cut it out, role it onto the bottle, return the bottle to the lab assistant, and clean up the unused materials.



Figure 3.6. Layout of the recycling bin and trashcan in the experimental lab

The lab assistant (blind to the hypothesis, purpose of the study, and manipulations) refused to take anything except the bottles from participants and asked them to “throw it out” while pointing to the area where the trashcan and recycling bin were located. However, since the bins were behind the lab assistant, he could not directly observe the behavior. The participants were arranged to start and finish the task at scattered time intervals so that no two participants could use the bin at the same time. Additionally, subjects were separated by cubicles and could not see each other as can be seen in Figure 3.7 (right). Therefore, we guarded against the potential effect of social conformity on subjects’ behavior. The location of the recycling bin and trashcan was counterbalanced to control for order effects and proximity/distance effects.



Figure 3.7. The table with experiment’s material (left) and subjects’ work stations (right)

3.6.2.2 RESULTS

We found that 88% of subjects in the high-salience condition (green R-bin) 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) (Figure 3.8). Statistical analysis shows a significant difference between the proportions in these two groups ($Z= 2.73$, $P= 0.006$).

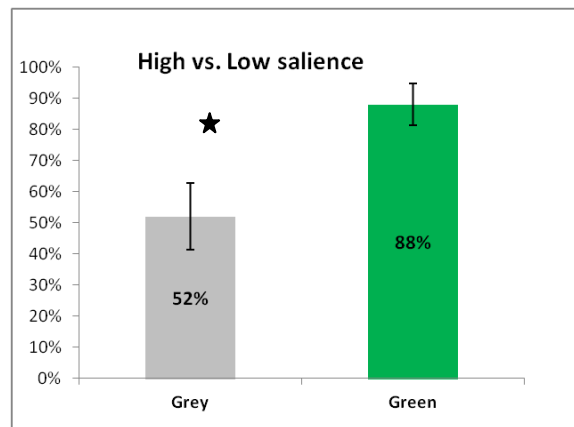


Figure 3.8. The ratio of recycled to total in High vs. Low salience condition

3.6.2.3 DISCUSSION

The result shows that color can affect the salience of an object and consequently trigger the associated desired behavior. However, it remains unclear why the green recycling bin has a higher salience compared to the grey recycling bin and the underlying psychological mechanism that implicitly triggers the associated behavior. The salience of the green recycling bin could be due to the higher arousal level of green compared to grey or induced arousal by the color contrast (vs. no contrast in grey trashcan-grey recycling bin condition). Further, the salience of the green recycling bin might be explained by something beyond the mere physiological accounts: the meaning of color. Although an online search shows that most of recycling bins in the U.S. are blue, the color green is typically attributed to sustainability and eco-friendliness. Thus, people might recognize a

green recycling bin faster than a red one because of the consistency of color meaning with the context of application. There is also other literature (Mehta & Zhu, 2009) affirming that blue or green (versus red) can activate an approach (versus avoidance) motivation. Therefore, additional studies are needed to tease out whether salience of green is due to arousal, symbolic meaning or motivational implications and to elucidate the underlying mechanism.

3.6.3 STUDY 1-B: SALIENCE THROUGH AROUSAL

The goal of this study is to shed light on the results of Study 1 and figure out whether the salience of the recycling bin (and subsequent behavior of more recycling) was due to the higher arousal of the recycling bin or the meaningful properties of color green and its association with “green” behavior. In this study, we add a high arousing condition (red) to the previous setting. In other words, a red recycling bin is compared to a grey recycling bin. We hypothesize that the arousal of recycling bin’s color makes it more salient, therefore people recycle more in the red recycling bin.

3.6.3.1 METHOD

The method, material, and all other features remained the same as Study 1. Fifty-one subjects (from a paid pool) participated in the study and were randomly assigned to either the high-arousal (Red, n=27; Figure 3.9, left), or low-arousal (Grey, n=24; Figure 3.9, right) conditions.



Figure 3.9. High arousal versus low arousal (Red versus Grey)

3.6.3.2 RESULTS

We found that 88.4% of subjects in the high-arousal condition (red R-bin) recycled, whereas only 70.8% of subjects used the recycling bin in low-salience condition (grey) (Figure 3.10). Statistical analysis shows that there is not a statistically significant difference (at $p < 0.05$) between the recycling rate in these two groups ($Z = 1.62$, $P = 0.10$, $SE_{red} = \pm 0.061$, $SE_{grey} = \pm 0.094$).

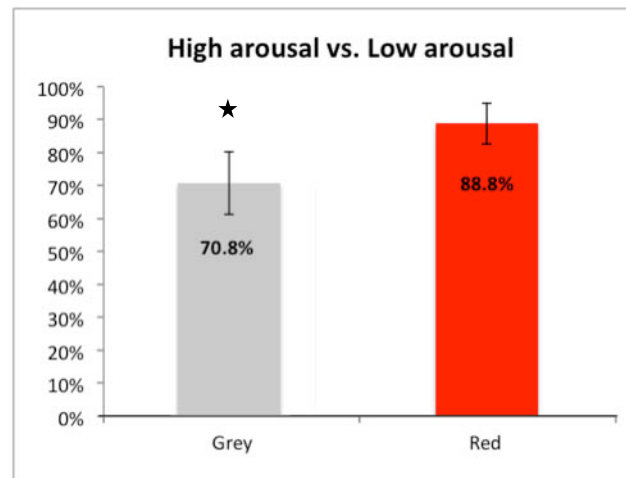


Figure 3.10. The ratio of recycled to total in High ($n=27$) vs. Low ($n=24$) arousal condition

3.6.3.3 DISCUSSION

The high rate of recycling in the red recycling bin was unexpected since in the pre-test, there was a healthy high difference between memorability of green and red recycling bin (green was recalled more than red), and not a significant difference between grey and red

R-bins. Although the analysis of results show that the difference between two groups in terms of recycling rate is not significant and is marginal, it is not surprising considering the small sample size. As it can be seen, there is a small shift in proportion of use in the grey condition (70.8% in Study 1-B vs. 52% in Study 1-A), but that small shift given the small sample size is most likely due to sampling fluctuation. It is expected that with an increase in the number of subjects, the difference between the means of low and high arousal conditions would turn significant. The insignificant results (comparing to Study 1) might also be explained by the different subject pool we used (paid) for this follow-up study. The study should be repeated with a larger sample size and with random assignment into all three conditions (grey, red, green).

3.7 SUMMARY AND CONCLUSION

In this chapter, I used ELM and visual salience and applied them to the context of design for behavior change. I selected color as an implicit but powerful design element, to make the recycling cue (in this case recycling bin) more salient. Through a pre-test, green showed to be more memorable and salient among other colors (red, blue, and grey), and was selected to be used for a recycling bin. The study of recycling bins revealed that people recycle more in a green recycling bin versus a grey one, if all of the other aspects (ease of use, availability/access, size, function, shape, and material) are equivalent. The next step involved a follow-up study (1-B) to shed light on these results and the mechanism that resulted in the salience of the green recycling bin. We hypothesized that in the case of recycling bins the salience is due to the physiological grounds (arousal), so that the same results are replicable using another arousing color or pattern. In doing so, we compared the recycling behavior between a red and a grey recycling bin. 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. The comparison between the pre-test and the studies suggested that memorability does not affect actual use so designers should be careful if they want to extrapolate memory measures into behavioral measures.

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 products or cues more salient, say, through color, contrast, shape, texture, and so forth.

Cultural and situational factors might influence the perceived salience of objects. For example a green recycling bin is less visible in outdoor spaces, especially with abundant green background, and would not stand out against its surrounding environment. In some cultures use of high arousal colors is more prevalent (some countries in Africa, central America, or India), people might not be as sensitive to colors like red or orange, or the objects with these colors might diminish among the other neighboring objects. By and large, it is designers' responsibility to choose an appropriate way to make these cues salient, based on idiosyncratic and contextual characteristics.

To conclude, the results of this study do not suggest using a specific color (red or green) for recycling bins or sustainability relevant cues. Rather, the studies show that salience of these cues can trigger behavioral responses, when the associated behaviors do not occur due to insufficient attention. Still, we suggest that green is more relevant to recycling bins

metaphorically, so it might remind people of recycling faster. Future studies can uncover whether or not people associate color green to “green behavior” more than other colors and if it is more pertinent to standardize such cues to specific behaviors. I will elaborate more on this point in Chapter 6.

CHAPTER 4

VISUAL METAPHORS: A CENTRAL ROUTE TO PERSUASION

4.1 OVERVIEW

This chapter explores the second research question, “How meaningful properties of designs, specifically metaphors, can afford product-driven sustainable behaviors through a rational persuasive route?” In doing so, I study how a product can persuade people with visual messages through a central processing route, whether or not metaphors are appropriate vehicles to communicate persuasive messages, how other designers have used metaphors to influence behavior, and finally, whether or not using metaphors in the context of products can effectively persuade people to change their behavior. I conduct a retrospective study to extract strategies (heuristics) designers have employed to use metaphors in the context of persuasive design, and perform an empirical study to use these strategies in the design of a persuasive product, in order to examine the actual behavioral responses.

4.2 CENTRAL ROUTE TO PERSUASION

As discussed earlier in Chapters 2 and 3, a persuasive message could be processed through different routes depending on the ability and motivation of the audience. Peripheral route investigated in the previous chapter, is used when an individual considers outside factors such as the situational characteristics of the message as opposed to actively thinking about the issue. The central route (high elaboration) process, however, 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. Central processing requires active participation of the audience and has two pre-requisite: motivation and ability to evaluate the message. So, if an individual does not “care” about the topic or is distracted, s/he lacks the motivation or ability to process the argument, respectively. Petty and Cacioppo explain that “Attitude changes that result mostly from processing issue-relevant arguments (central route) will show greater temporal persistence, greater prediction of behavior, and greater resistance to counter persuasion than attitude changes that result mostly from peripheral cues” (Petty & Cacioppo, 1986a, p. 21).

Motivation often results from personal relevance and importance of the issue. In addition to motivation, individuals should both be able to focus on the argument and understand it. If they are distracted or the message is difficult to understand (unfamiliar, complex, or confusing), central processing deems unlikely.

With respect to product design strategies for behavior change, Eco-feedback products are processed through central route because they require logical evaluation of the argument. In other words, the products provide users with information about their behavior and its

impact and the users are expected to think about their behavior and decide if they want to change their behavior or not. Since the users' decisions will be based on the facts presented through the feedback, it is processed centrally. Behavioral scripts (as explained in 2.6.1.3) are usually processed through peripheral route because the behavioral steers are built-in the product and the desired behavior is easier, more straightforward, or more appealing to conduct. Thus, such products and the related behavioral responses do not involve an active decision-making and thoughtful evaluation of the behavior and the users will follow the first thing offered by the product, without thinking carefully about the behavior. However, in some cases like the Eco Kettle (the user fills the kettle completely, but then can boil a fraction of the water in a separate container according to their requirements; see Figure 2.9.a), the decision of how much water to boil is more likely to be processed through the central route because they prompt the user to actively think about behavior and make a decision.

Central processing has two prerequisites: it can only occur when the receiver has both the motivation and the ability to think about the message and its topic. Hence, *attention* and the ability to focus on the argument is one of the major determinants of choice between these two routes.

4.3 ADAPTIVE INFORMATION PROCESSING, ATTENTION, AND MINDFULNESS

From an evolutionary standpoint, the human being is an information-seeking organism (Kaplan & Kaplan, 1978) and needs information to comprehend the surrounding environment, predict the consequences of the actions, and to move on. An individual makes numerous decisions in day-to-day life. However, due to the limited capacity of

cognitive processes, many of our daily decisions are a function of automatic processing (Bargh & Chartrand, 1999) and we rely on strategies and shortcuts to maintain efficiency. However, an individual is constantly bombarded with one persuasive communication after another (Pratkanis & Anderson, 2001). This turns living spaces into “environments of overwhelming stimulation that results in people growing more insensitive to these inputs” (Milgram, 1970). Therefore, attention becomes a scarce resource we need to process behavioral cues in the environment and maintain our mindfulness.

As mentioned in the previous section, attention and mindfulness of the audience is core to central processing. “Mindfulness” has been described as “bringing one’s complete attention to the present experience on a moment-to-moment basis” (Marlatt & Kristeller, 1999) and as “paying attention in a particular way: on purpose, in the present moment, and non-judgmentally” (Kabat-Zinn, 1994).

As cited and discussed by Kaplan and Kaplan (1978), there are two different kinds of attention (James, 1890): *voluntary* versus *involuntary*. Voluntary attention requires effort as we try to attend to a subject regardless of all distractions. By contrast, the involuntary attention, not only does not need effort to occur, it would take an effort not to attend. Something beautiful or interesting might capture attention of this kind, as well as something strikingly ugly or dangerous. Most of our daily lives and tasks fall back on voluntary attention. However, this type of attention requires high cognitive resources to inhibit the distractions and help individuals to stay focused on the task. The involuntary attention, though, does not use up much cognitive resources (for inhibiting distracting stimuli), and ultimately hinges on the availability of ‘things’ that are involuntarily interesting.

As discussed earlier (4.2), in order to engage people's thought process, a persuasive message requires capturing one's attention in the first place. James (1980) believes that involuntary attention involves the property of "fascination." Hence, we focus on "fascination" as a strategy to stimulate attention.

4.4 FASCINATION

"Fascination" means "the quality or power of fascinating" (Merriam-Webster Dictionary, nd). The word "Fascinate" springs from the Latin word "Fascinare", meaning "to enchant; bewitch; captivate, attract," etc. The definition of the English word, "Fascinate", is as follows: "to transfix and hold spellbound by an irresistible power; to hold an intense interest or attraction for; to arouse the interest or curiosity of," etc. According to Kaplan and Kaplan (1978), fascination can occur both in terms of content and process. A beautiful scene is fascinating content-wise while solving a puzzle is a fascinating process. There are two critical aspects to the process, both necessary for fascination to occur: making sense and involvement. Making sense involves two basic constructs as recognition (comprehension) and prediction. Curiosity and exploration are good examples of Involvement. Therefore, the process of coping with uncertainty is fascinating, since it requires exploration, prediction, and achieving clarity.

One design strategy that involves uncertainty and makes the interaction experience more fascinating is the application of metaphors, to make meaningful associations between different concepts.

4.5 METAPHORS

Metaphors are a powerful tool for understanding our world. They provide shortcuts to concepts and provide ways to elaborate meanings for less-understood concepts. Metaphor is defined as “understanding and experiencing one kind of thing in terms of another” (Lakoff & Johnson, 1980). Metaphors can explain an abstract concept in a concrete way that the audience could relate to more quickly and can frame a unique perspective to the experience of meaning. Understanding metaphors involves uncertainty, thus it might seem fascinating. However, the extent to which the concept is understood depends on a person's unique cognitive responses to the metaphor. Turbayne (1962), a philosopher, identifies three functions of metaphors: “Metaphors (1) provide perspective on an event by making it possible to see one thing in terms of something else; (2) integrate diverse ideas; and (3) induce attitude shift by functioning as a set that emphasizes some facts and suppresses others” (as cited in Lenrow, 1966, p.146). So metaphors can simplify events in terms of a schema (or concept) that highlights some aspects more than others (Ibid). As Turbayne (1962) suggests, metaphors can present concepts in novel patterns that break old-established habits of thinking.

As described by Richards (1965), a metaphor consists of two parts: the tenor (also known as target) and the vehicle (source). The tenor is the subject to which attributes are ascribed. The vehicle is the object whose attributes are borrowed. In other words, tenor refers to the concept, object, or person, and the vehicle is the image that carries the weight of the comparison (Thornborrow, 1998). In semiotics, metaphor is treated as a “sign”, consisting of a form of the sign (the signifier) and its meaning (the signified).

The application of metaphors is not merely limited to language, but is rather recognized as a thinking style. The association between metaphor's components the process of metaphor creation and interpretation have been the subject of a great deal of studies across different disciplines such as philosophy, psychology, and visual arts (Cila, Hekkert, and Visch, 2012; also see Katz, 1989; Clevenger Jr. & Edwards, 1988).

4.6 VISUAL METAPHORS AND DESIGN

Most human communication is nonverbal (Burgoon, Buller, & Woodall, 1989; Knapp, 1980; Seiter, 1988; Weiser, 1993; Mehrabian, 1971; Birdwhistell, 1970) and most mental images people use in daily life are visual (Kosslyn et al., 1990). Zaltman & Coulter (1995) argue that even though there is no formal documented evidence, the rule of thumb among communications specialists implies that about 80 percent of all human communication is nonverbal. Also, nonverbal cues account for much of the meaning of verbal language (Poyatos, 1993). Knapp (1980) suggests that when there is an apparent contradiction, nonverbal cues tend to be believed over verbal ones. The implicit, while effective influence of visual cues drives the focus of this study towards the application of visual metaphors to products.

Visual metaphors are often used by product designers to generate creative concepts and as a problem-solving tool in the early stages of design process (Hey & Agogino, 2007). Oftentimes designers use metaphors as a way of communicating meaning to the user; to personify (Figure 4.1a,b), or to make them react (Figure 4.1c).



Figure 4.1. a: Bathtub clog, left (<http://lh4.ggpht.com/>), b: Senseo Coffeemaker, center (<http://www.designdirectory.com/>), c: napkin dispenser, right (<http://inhabitat.com>)

Designers have begun to 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 or an electronic Withering Flower that signals you are consuming too much energy by “dying” and changing color (Figure 4.2).



Figure 4.2. Little Poor Fish basin, left (<http://www.inewidea.com>, accessed 2012) and Withering flower, right (<http://www.goodcleantech.com>, accessed 2012)

Making sense of metaphors also requires careful scrutiny of a persuasive communication and higher cognitive processing, so it would be an example of central route processing. Studies also show that using metaphors in an argument can be beneficial and more

persuasive when compared to just using a literal argument (Sopory & Dillard, 2002). It is a complex cognitive process to make the connection between what is being presented and the product it is referring to, and then understand the message that is being expressed (Jeong, 2008). This complexity might make the audience 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, Huhmann, & Franke 2002; Toncar & Munch, 2001). As cited by Sopory & Dillard (2002), “The literal-primacy view (Beardsley, 1962, 1976; MacCormac, 1985) sees a metaphorical expression as a semantic anomaly, which its recognition leads to negative tension (Bowers & Osborn, 1966; Tudman, 1971). When the metaphorical meaning is finally understood the negative tension is relieved. Three stages are involved; perception of error (or novelty), conflict (or recoil), and resolution.”

Application of metaphors into product design is relatively new with many of the available scholarship being theoretical. Only a few works have been completed on understanding the process of metaphor creation in product design (Cila, Hekkert and Visch, 2010). Comprehensive review of the relevant literature in the role of metaphors in behavior and habits change does not identify an empirical study that shows whether or not metaphorical design result in behavioral changes. Thus, our evidence-based approach suggests that there is a need for empirical evaluation of this phenomenon. In the context

of sustainability, we can apply a consumption related metaphor to the design of a product (napkin dispenser) to encourage mindful consumption of napkins and examine behavioral responses.

4.7 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 an 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, assuming that the message is congruent with users' attitude (beliefs).

4.8 STUDY 2: RETROSPECTIVE ANALYSIS

In order to create persuasive metaphorical design concepts, an extensive literature review is 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 conduct a retrospective study on products that use metaphors to convey a persuasive message (in order) to encourage a desired behavior.

4.8.1 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 (see Appendix II for a complete list). The 2D designs (posters) include advertisements in the field of social marketing that target socially desirable behaviors. All of these products or posters denote persuasive connotation for behaviors such as donation, energy conservation, mindful consumption, safe driving, smoking cessation, dieting, and anti-littering (Examples of donation, dieting, and safe driving can be seen in Figure 4.3). For each design, I identified the metaphor connotation, the source, and the target of the metaphor. Then, each design was analyzed to find the apparent strategies the designer has used to make the design more persuasive and effective. Several heuristics were identified in each design. I used the four semantic functions of the sign (Monö, Knight, & Monö, 1997) as a base to identify these heuristics. These functions (describe, express, signal, and identify) will be discussed further in the discussion section (4.9.3).



Figure 4.3. Examples of persuasive metaphors in donation, left (<http://fllxnn.blogspot.com/>, accessed 2012), healthy diet, center (<http://hongkiat.com>, accessed 2012), and alcohol

4.8.2 RESULTS

The seven design strategies most frequently used by designers (to make the metaphors more persuasive) 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 communicate the metaphor and help the users understand the meaning behind them, sometimes designers use a slogan to clarify the meaning and control for cultural variation (Figure 4.4).
3. **Evoke emotions in the user (reward/punishment):** Creating reward/satisfaction feelings if their behavior is congruent with design intention and/or guilt/punishment feeling if otherwise (Figure 4.4).
4. **Exaggerate the scale of impact:** Exaggeration or hyperbole is to create emphasis or effect and may be used to evoke strong feelings or to create a strong impression (Figure 4.4).
5. **Interactive design:** Making the design responsive to the behavior (Figure 4.4).
6. **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 4.5).

7. **Dynamic (evolving) design:** The behavior of the user complements the design, as if the design is incomplete and the metaphor is not clear without the behavior.

(Figure 4.5).

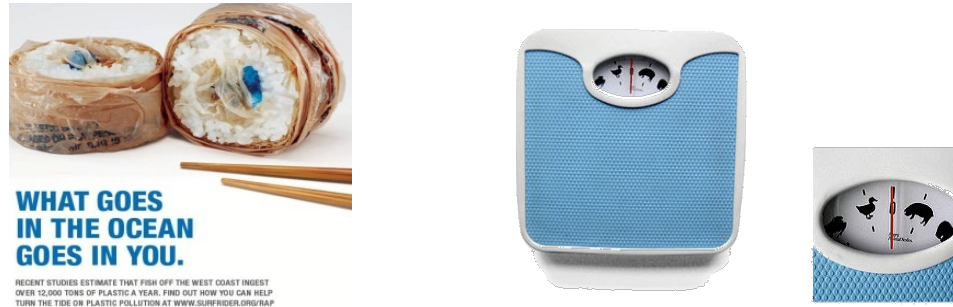


Figure 4.4. Slogan, left (<http://politicaladvertising.co.uk>, accessed 2012), Create feeling, Exaggeration, and Interactive, right (<http://core77.com>, accessed 2012)



Figure 4.5. Dynamic, left (<http://legalexaminer.com>, accessed 2012), Final impact, right (<http://blog.lib.umn.edu>, accessed 2012)

While some of these heuristics like “informative message” or “create feeling” are more prevalent, “interactive design” and “dynamic design” are less frequent as a big portion of these designs is two-dimensional and cannot be interactive or dynamic by nature. Figure 4.6 presents the frequency of these heuristics in the sample. Among these designs Informative message and Interactive Design are the most and the least popular heuristics respectively. Using these metaphors, we should be careful that they are not meant to help us create metaphors, but rather assist us to make the metaphors more persuasive.

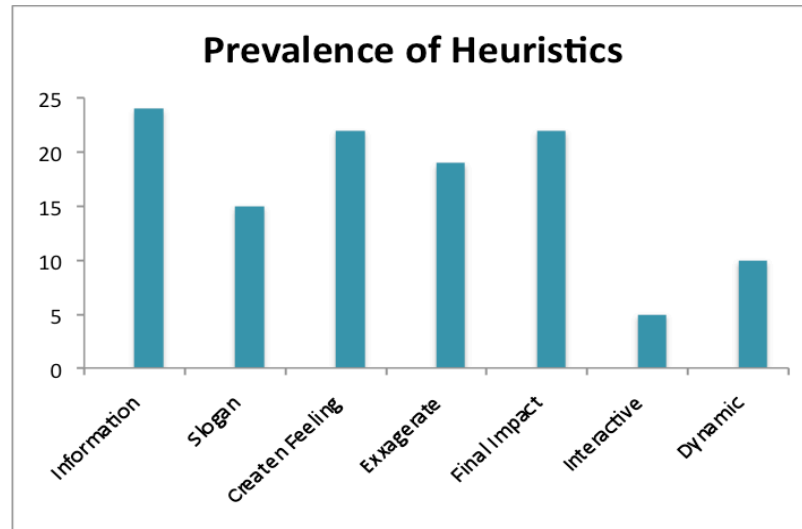


Figure 4.6. Frequency of persuasive heuristics

To examine the reliability of these heuristics, a second coder (graduate student in art and design) received training on these seven strategies and coded the twenty-four designs again based on them. The coder identified all the evident strategies in each design. The inter-coder reliability is relatively high for Slogan ($r=0.96$), Final Impact ($r=0.91$), Create Feeling ($r=0.87$), and Informative Message ($r=0.83$), and a little lower (but still high) for Responsive Design ($r=0.79$), Dynamic Design ($r=0.79$), and Exaggerate ($r=0.75$). A follow-up interview with the coder revealed that the fine line between Dynamic and Responsive strategies makes it difficult at times to differentiate them from each other. Additionally, the degree of exaggeration might be more subjective due to the perceived threat of the behavior and its consequences.

We labeled the seven previously described strategies as “persuasive metaphor heuristics”, where 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 & Seifert, 2009). Since the focus of these strategies is on using metaphors to encourage behavior change, we can label them persuasive metaphor

heuristics. These heuristics work on the premise that giving a designer a selection of focused prompts can lead to generating more persuasive metaphorical designs for behavior change.

4.8.3 DISCUSSION

In this study, we identified seven design heuristics that designers have used in their design process to create more persuasive metaphorical design concepts and named them as Persuasive Metaphors Heuristics.

Persuasive metaphorical designs can be characterized as “signs” to certain behaviors. In design, Monö, Knight, & Monö (1997) extend the notion of sign from semiotics into product design realm and define four semantic functions of the sign: to describe, to express, to signal, and to identify. The persuasive metaphor heuristics denote descriptive, expressive, and signaling (interactive) functions. Descriptive heuristics represent the definitional, “literal”, “obvious” or “commonsense” aspect of a metaphor and are the heuristics that the designer uses to present and convey the message and intention of design to the user. They facilitate the perception process; they help the user to understand the message and its rationale. Expressive heuristics are used to influence the user through empathy. Interactive heuristics make the design dynamic and create an opportunity for the user to respond to the design, add to her/his experience, and complement the design.

However, the individual effect of each heuristic on behavior change is still unknown.

We assert that these heuristics will make the metaphorical design seem more fascinating to the users because they signify the constructs of a fascinating process as defined by Kaplan and Kaplan (1978); An informative message and slogan will facilitate

recognizing the associations, and showing the final impact helps people to predict the outcomes of their behavior. These heuristics account for making sense of the metaphor. Exaggeration, interactivity, and dynamic design heuristics enable the involvement of the user in the process and help them relate more to the metaphor (and its inherent message).

As per ELM and different types of processing, although some of the heuristics such as giving and informative message, use of slogan, and showing the final impact, involve more thoughtful processing, while evoking emotions, exaggeration, interactivity, and being dynamic are more likely to be effective in terms of their presentation and as peripheral cues to the behavior. Although metaphors are presumed to be processed centrally in general, the combination of these heuristics can help a broader range of audience to get involved.

Thus, in the next study, we will investigate the effectiveness of metaphorical design concepts using these heuristics in triggering behavioral changes.

4.9 STUDY 3: METAPHORS AND CONSUMPTION

In Study 2, we identified some strategies that designers have used to persuade behavior change through metaphorical products and poster advertisements. Hence, there is no evidence-based study that demonstrates whether or not these metaphorical designs and identified heuristics will lead to “actual” behavioral changes. Study 3 was an empirical experiment that investigated the role of persuasive metaphorical concepts and persuasive heuristics on behavior change.

Focusing on napkin consumption behavior for this study, we used persuasive heuristics to design a napkin dispenser that encouraged napkin conservation. Through this study, we

compared the consumption rate across three experimental metaphor conditions: no-metaphor, conservation metaphor, and non-relevant metaphor. We studied how napkin consumption behavior changes in response to different napkin dispensing products. The comparison was between a regular box shape napkin dispenser (no metaphor, see Figure 4.7), one dispenser that showed metaphorical connotations of sustainable consumption (conservation metaphor, Figure 4.8, left), and a dispenser that showed a non-conservation metaphor (non-relevant metaphor, Figure 4.8, right). We anticipated that napkin consumption would decrease with the conservation metaphorical design relative to both the regular dispenser and the one with a non-conservation metaphor.

The method is presented in two parts; Part 1 consists of pre-experiment observation to help us understand napkin consumption behavior, find the variables that should be taken into account for Study 3, and finding a suitable location for this study. Part 2 involves Study 3.

4.9.1 PART 1: PRE-TEST

4.9.1.1 METHOD

We chose a local coffee house with three branches in different neighborhoods of a college town. The coffee house serves a diverse customer population (age, occupation, purpose for coffee shop visit, etc.) and reported obvious amounts of wasted unused napkins. Each coffee house has one or two condiment stations and on each there is a pair of regular box shape napkin dispensers (A) (Figure 4.7).



Figure 4.7. Regular napkin dispenser (A)

Before the onset of the observation, three trained coders performed observation for one week, once during month of August and again during month of September in order to monitor napkin consumption behavior and discover variables that might have an effect on consumption rate. The coders performed systematic observations both in weekdays and weekends and in different times of day (morning, noon, afternoon, evening), and each time for 60-120 minutes. They observed customers ($n=358$, female=168) that approached and used the condiment station and recorded their gender, number of napkins used, sitting in the coffee shop (or having a coffee to go), the number of companions, and any incident that made people use more napkins such as spilling coffee or cleaning the dirty tables. Due to logistics issues (confound in the measurement, abnormal distribution of customers between weekdays and weekends), we decided to discontinue observation in the farmers market location after a week and the rest of the observations were performed in two other stores (downtown and north). Finally, we chose one of three locations of the coffee shop to run the field study that satisfied data collection requirements.

4.9.1.2 RESULTS

During two weeks of observation ($n=358$, $f=168$) in three locations of a local coffee shop (Farmers Market, Downtown, and North), we observed an average consumption of 0.93

napkins per person among those customers who approached the condiment station. A three-way Analysis Of Variance (ANOVA) with location, month, and stay/go as factors reveals that there is a significant effect of location ($F_{2, 357} = 3.28$, $p = 0.039$) and stay/go ($F_{1, 357} = 24.87$, $p < 0.001$) on napkin consumption rate, whereas the consumption did not change from August to September ($F_{1, 357} = 0.55$, $p = 0.45$). Pair-wise comparison of three locations with Tukey correction at $\alpha = 0.05$ does not indicate any significant difference in the consumption rate across the three locations. The results also show that the customers who dine-in use more napkins ($m = 1.7$ per /person) than those who take out food/beverage ($m = 0.7$), ($p < 0.001$, $SE = \pm 0.218$). There is also a significant interaction effect of location and stay/to go ($F_{2, 357} = 4.97$, $p = 0.007$) suggesting that dine-in customers in farmers' market location significantly use more napkins (see Figure 4.8). The number of companions is highly correlated with napkin consumption (Pearsons' $r = 0.219$, $p < 0.001$) and a linear regression with the number of used napkins as the dependent variable and location, stay/to go, month, the interaction of location and stay/to go, and the number of companions as the predictors indicated a significant effect of companions ($B_1 = 0.54$, $SE = \pm 0.132$, $t(357) = 4.16$, $p < 0.001$), location ($B_2 = -0.90$, $SE = \pm 0.40$, $t(357) = 2.23$, $p = 0.026$), and the interaction of location with stay/to go ($B_3 = -0.65$, $SE = \pm 0.28$, $t(357) = 2.3$, $p = 0.022$). Visiting the coffee shop with (a) companion(s) and staying in farmers market coffee house are both positively associated with higher napkin consumption.

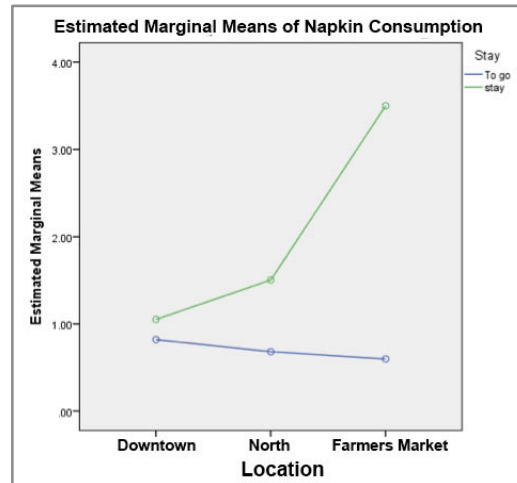


Figure 4.8. There is a significant interaction between location and stay/to go

Conclusion: Through the pre-experiment observations we found that location of the coffee shop affects the napkin consumption rate, and this may be due to the difference in the populations that visit certain locations. For example the farmers market store serves a large number of families (mostly with kids) during the weekends. The observation notes reveal that customers with kids use much more napkins particularly if they dine-in the store. We also found that dine-in customers use more napkins than those who take out food/beverage.

The results and observation helped us to choose the North location for Study 3, as the measurement, observation, and interview seems more feasible and the confounds are fewer.

4.9.2 PART 2: STUDY 3

As stated in 4.9, this study presents employing the persuasive heuristics from Study 2 (4.9) in designing a persuasive metaphorical product, examines how the product is used in the field, and measures the users behavioral responses. In doing so, we compare napkin consumption rate in respond to three different napkin dispensers: a regular box shape

napkin dispenser (Figure 4.7), one dispenser that connotes conservation metaphor (Figure 4.9, left), and a dispenser that shows a non-conservation metaphor (Figure 4.9, right).

4.9.2.1 METHOD

4.9.2.1.1 DESIGN

One graduate student with a background in product design and one undergraduate student in engineering designed and fabricated a napkin dispenser using persuasive metaphorical heuristics. The design of the napkin dispenser encouraged 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 metaphor compares the use of napkins with consuming a tree and shows how long it takes for a tree to grow in 10-year intervals (Figure 4.8, left). The transparent trunk exposes how much napkin is left as people take napkins. The heuristics that were used in the design are giving informative message, evoking feeling, exaggerating the scale of impact, responsive design, and dynamic (evolving) design. The new design followed the regular dispenser by dispensing one napkin at time. A second napkin dispenser was also designed to be used 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).



Figure 4.9. Persuasive conservation metaphor (B, left), and metaphorical design (B', right)

4.9.2.1.2 INTERVIEW AND OBSERVATION

Starting the first week of October, the regular napkin dispenser was replaced by the metaphorical one. Three undergraduate and graduate Research Assistants (RA) received training and instructions to perform unbiased observations and interviews during the course of the experiment. The RAs were blind to the purpose of the study, hypothesis, and the intervention (metaphorical napkin dispenser) in order to perform unbiased observation and interviews. The purpose of the interviews with the users who interacted with the napkin dispenser was to better 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.

The RAs were instructed to approach the customers who use the napkin dispenser and request a five-minute interview about their coffee shop experience. The volunteer customers were guided to a table reserved for the interview. The interviewers were

instructed to make sure that the interviewee sits in a way that would not see the napkin dispenser while answering the questions. In case the interviewees preferred to do the interview at their own table, the RA was to make sure that the participants cannot see the product. We encouraged the RAs to approach customers who are alone, not in a rush, not busy with a task (talking to someone or on the cellphone), and intend to stay in the coffee shop. The interviews consisted of multiple choice, open ended, and Likert scale questions and the interviewee read all the questions aloud and took note on the questionnaire sheets (see the questionnaire in Appendix III). The interviews were audio recorded with the consent of the interviewees. The questions consisted of personal and demographic information, coffee shop habits (the purpose, the frequency of visit, etc.), questions about the napkin dispenser (if they remembered it, could describe it, understood the message, how they felt about it, if they noticed any change in their consumption, etc.), and some questions on sustainable attitude measures (recycling habits, concern for environmental issues, energy conservation).

Thirty-nine customers (female=17) were interviewed after using the conservation metaphor napkin dispenser and seven customers (female=2) after using the holiday-themed product. The RAs also approached random people who were less likely to accept the interview (had companions, kids, had a coffee “to go”, etc.) and asked them a few questions about the napkin dispenser (informal interview). For example they were asked if they had noticed any change in the design of the napkin dispenser, if they remembered what the napkin dispenser looked like, if they realized the product was trying to convey a message, and if they liked the idea behind the product. The RAs conducted 15 (female=5)

informal, brief interviews for conservation metaphor condition and 14 (female=8) formal interviews with the customers who used the holiday-themed napkin dispenser.

4.9.2.1.3 NAPKIN CONSUMPTION

We measured napkin consumption for six consecutive weeks using three different dispensers, one at a time (A, B, B, A, B, B'), and tracked the number of customers (transactions) and counted the number of napkin bundles used (300 pieces per bundle) for each week. During the first week ($n_1=3124$), we used the coffee shop's regular dispenser (A, Figure 4.7). For the second ($n_2=3051$) and third ($n_3=2873$) week, we replaced it with the new dispenser with the conservation metaphor (B, Figure 4.8, left). For the fourth week ($n_4=3069$), we used the regular dispenser (A) and during the fifth week ($n_5=3051$) we used the persuasive design (B) again. Finally, we used the non-persuasive metaphorical design (B', Figure 4.8, right) during the sixth week ($n_6=3044$).

4.9.2.2 RESULTS

Napkin Consumption: 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 ($n_1=3124$), 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 ($n_2=3051$) and 0.73 napkins per person ($n_3=2873$), respectively. During the fourth week (regular dispenser, A), the consumption rate increased significantly to 0.97 napkins per person ($n_4=3069$). In the fifth week (metaphorical

design, B), the consumption dropped to 0.68 ($n_5=3051$). During the sixth, and final week, in which we used the non-persuasive metaphorical design (B'), the consumption rose to 0.84 ($n_6=3044$). Each point in Figure 4.10 is modeled as a rate parameter of a Poisson distribution and includes an exact 95% confidence interval rather than a normal approximation. Any two points in Figure 7 with non-overlapping confidence intervals are statistically significant at $p < .001$, even with a Bonferroni correction for multiple tests.

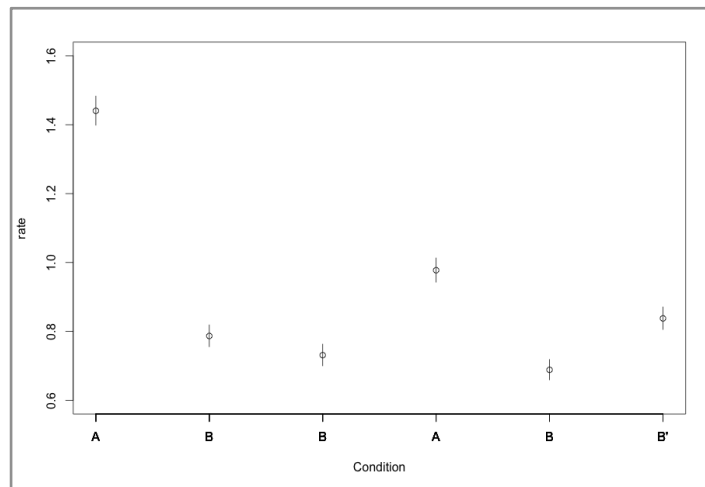


Figure 4.10. Average napkin consumption across six experimental conditions

Interviews: Analysis of interviews ($n=39$, female=17) indicates that 76% of the participants noticed that the napkin dispenser is different from the one previously used in that coffee shop. 64% of participants were able to describe the appearance and function of the product completely, while 28% of them were only able to describe the function of the napkin dispenser. 64% of the interviewees understood the metaphorical concept and the message that the product was supposed to convey. 46% of the participants liked the idea and were positive about the metaphor, whereas 18% were not positive about encouraging people to use fewer napkins. The rest of the interviewees did not express any feeling about the product.

A factorial analysis of variance (two-way ANOVA) with number of used napkins as the dependant variable and having food and gender as the independent variables denotes that having food does not have a significant effect on napkin consumption ($F_{(1,38)}=2.6$, $p = 0.11$), but gender has a marginal effect ($F_{(1,38)}=2.43$, $p = 0.067$) as women tend to use more napkins than men (Figure 4.11).

A paired-sample t-test comparing the actual napkin consumption ($m_1=1.55$, $SE=\pm 0.14$) and the self-report of regular consumption ($m_2= 2.75$, $SE=\pm 0.29$) indicates that people used significantly fewer napkins on the interview day ($t_{38}= 3.72$, $p = 0.001$). Figure 4.12 shows the difference between self-report and actual consumption. However, the participants did not believe that their behavior was influenced by the design of the napkin dispenser, as only 35% of them acknowledged the effect of the metaphor on their choice of using fewer napkins. On a scale of 1 to 5 (1= not successful, 5= very successful) the participants evaluated the design as being “to some extent successful” ($m=2.9$).

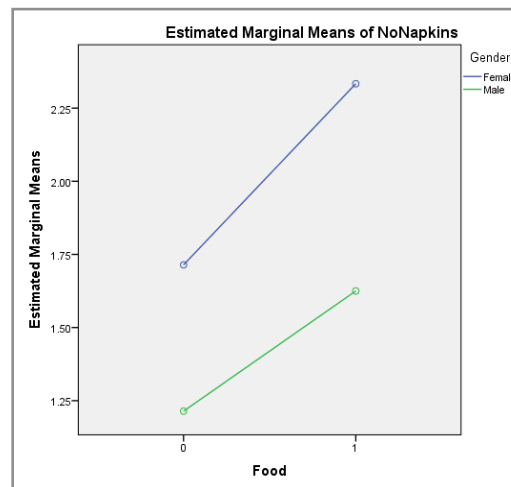


Figure 4.11. Women slightly use more napkins than men.

Analysis of sustainable attitude and habit measures (environmental concerns, recycling rate, energy conservation) indicates that energy conservation is highly correlated with

environmental concerns ($r=0.46$, $p =0.001$) and recycling ($r=0.47$, $p =0.001$). A linear regression with the number of used napkins as the dependent variable and environmental concerns and recycling as the predictors indicated that only environmental concerns is a significant predictor of napkin consumption ($B_1 = 0.34$, $SE = 0.163$, $t (38)=2.09$, $p = 0.044$).

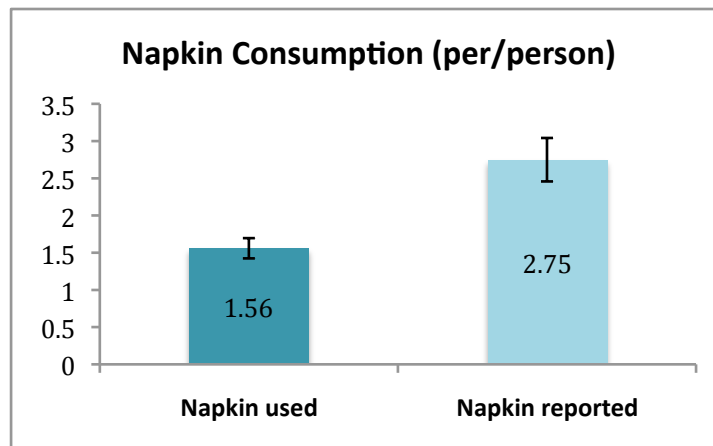


Figure 4.12. Participants used fewer napkins

From the interviews and through the feedback from the store’s staff, we found that some customers did not first notice the napkin dispenser because of its different appearance (unfamiliar form), and had to ask the staff where they can find napkins. On the other hand, some (two) other customers suggested that they used the napkin dispenser because it looked “cool” and “novel”, although they did not need any napkins. Two customers complained to the store’s manager and expressed their dissatisfaction with the intention of design. One customer mentioned that he used more napkins to show his objection to the environmental campaigns. The demographic information of the participants is shown in Figure 4.13.

Multinomial regression analysis with ability to describe the product appearance and function (remembering the tree, years, shape of the product) as the dependent variable

and level of education, gender, and understanding the metaphor (and its message) correctly as the predictors indicates a significant effect of understanding (Chi-square=40.44, $p < 0.001$), education (Chi-square=9.39, $p=0.052$), and gender (Chi-square=10.26, $p = 0.006$) in understanding the metaphor. We did not find any significant association between interaction time (with the product) and understanding the message.

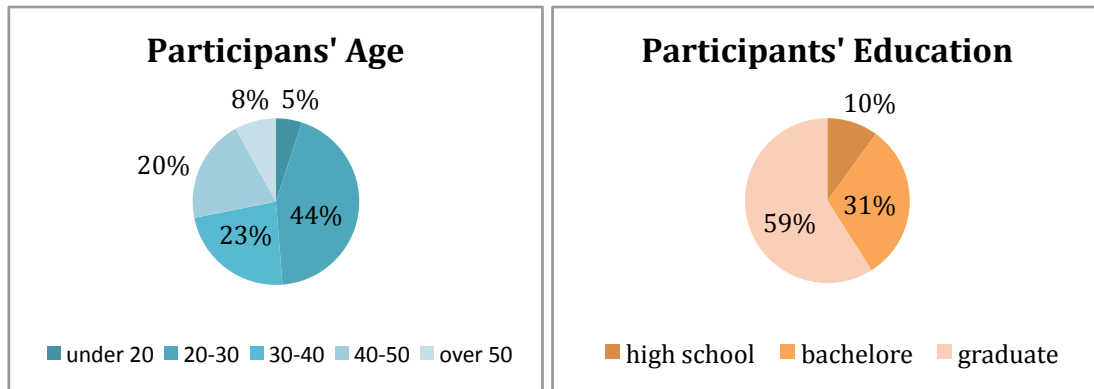


Figure 4.13. Participants' age (left), and level of education (right)

Analysis of the interviews about the holiday-themed napkin dispenser shows that 57% of the participants remembered the product and were able to describe it, 43% of them expressed positive feeling about the design, and only 29% of them believed that the napkin dispenser had a specific message. No participant noticed any change in her/his consumption because of the design of the napkin dispenser. The self-report data is also consistent with the actual use ($m_1=1.75$, $SE=\pm 0.25$, $m_2= 1.85$, $SE=\pm 0.27$, $t(13) < 1.00$, $p= 0.61$).

4.9.2.3 DISCUSSION

Through the case study of metaphorical napkin dispenser, 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, it did not reach the initial consumption rate and we can recognize a descending pattern in the consumption rate over the course of the six-week experiment. One potential explanation is the lasting effect of persuasive design on the regular customers' memory and their behavior (Childers & Houston, 1984; Reynolds & Schwarz, 1983). It would be interesting to measure the consumption again, three months and six months after the last experimental intervention.

The results of the interview 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. Factors such as education level, gender, understanding the metaphor's message can predict a right description of design (remembering the design). This suggests that when people pay attention to the design, they are more likely to understand the metaphor, particularly if they have a minimum knowledge and visual literacy (that might be achieved with education). Therefore, this design might not have the same effect in a context with less educated customers.

The participants who interacted with the non-conservation metaphorical design (Holiday season) used as many napkins as they regularly use (the self report is slightly lower but is not significant). The interviewees in the conservation-metaphor design condition claimed that their consumption was not influenced by the product, because they always use as many napkins as they need. Yet, their actual consumption compared to their self-report (of regular consumption) indicated that they used fewer napkins when using the

metaphorical napkin dispenser. This finding is in line with previous literature suggesting that people resist the fact that they can be easily manipulated.

As expected, the interviews endorse that the napkin dispenser with a Christmas tree image (non-relevant metaphor) does not have any effect on the napkin consumption and the design is not associated with napkin conservation.

The different and sometimes polarized reactions to the metaphor highlight the importance of individual differences, beliefs, and backgrounds on metaphors interpretation and understanding. Additionally, it affirms that the processing of metaphors occurs through a central route where the argument is accepted if favorable thoughts emerge, or else it is rejected.

We found that the metaphorical design persuaded the coffee shop's customers to use fewer napkins. Yet, we are limited in our 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. The interviews were informative and shed light on a part of the individual differences and the experience of users with the product. However, we were limited in terms of interviewing a broad and diverse range of customers. We only interviewed people who used the napkin dispenser, did not have companions, and dined in the store.

It is also unclear 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 of persuasion, a message's argument would most likely be

accepted through a central processing route when it is congruent with attitude of the receiver. The result of the interviews suggested that napkin consumption is influenced by environmental (concerns) attitudes and they moderate the effect of the metaphor-laden product. The findings of interviews and informal feedbacks affirm that metaphors are highly context sensitive and also subjectively interpreted. As Zaltman and Coulter (1995) suggest, metaphor's message must resonate not only with surface knowledge but also with deeper meanings associated with the topic of interest.

4.10 CONCLUSION AND SUMMARY

In this chapter the elaboration likelihood model, the picture superiority effect, and research on metaphors were applied to product design for behavior change. Visual metaphorical language was used as a tool to elaborate the persuasive message and to make the argument more fascinating to the user. 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 intentions, named as Persuasive Metaphor Heuristics. 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. We also conducted 53 post-consumption interviews with the customers and acquired a deeper understanding of how the design was perceived by the users. 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 won't be as effective on people who are distracted, in a rush, or not aware enough about the topic.

The next step involves transferring our findings in this study to design pedagogy, and study how designers use metaphors to produce persuasive designs for behavior change and how employing Persuasive Metaphors Heuristics might affect the design concepts.

PART II

CHAPTER 5

PERSUASIVE METAPHORS HEURISTICS: APPLICATION AND VALIDATION

5.1 OVERVIEW

In the previous chapter, I extracted seven persuasive heuristics through a retrospective analysis of persuasive metaphorical designs and used some of these heuristics to design a persuasive product to encourage people to change their behavior. As the next step, it would be informative to investigate the pedagogical aspect of design with heuristics and study how we can transfer these heuristics to design students, how these heuristics are being adopted by designers, and how effectively they can affect the design process and design outcomes. This chapter aims to investigate the third research question, “Can we identify a series of heuristics to help designers in designing aesthetically persuasive products (and services) to change people’s behaviors?” To answer this question, a set of systematic design activities are conducted to understand the application of the proposed

persuasive heuristics into the design process in the context of design for behavior change. In doing so, I compare the design concepts across different techniques of idea generation, and examine how these heuristics can guide the outcomes toward an intended “solution space.” A solution space is a conceptual space that accommodates all possible solutions to a particular design problem.

5.2 DESIGN HEURISTICS

As defined in chapter 4, “Heuristic” refers to an experience based (trial-and-error) method serving as an aid to speed up problem solving, learning, or discovery. The term was coined by French philosopher Rene Descartes (1596-1650), and is based on the Greek word “heurisko”, which means “discovery”. By and large, heuristics are short cut reasoning processes that are frequently used to ease the cognitive load of making a decision during a problem solving process. Heuristics are also known as rule of thumb, educated guesses, or common sense. Heuristics have been widely practiced in different disciplines from social sciences, philosophy, and law, to mathematics, engineering, and design.

In engineering, TRIZ is a heuristics-based problem solving analysis and forecasting tool designed to address specific mechanical trade-offs in engineering design (Altshuller, 1984), and applies to very specified features of mechanical designs. The TRIZ heuristics suggest a creative problem solving approach, and draws on extensive research among successful U.S. patent awards that identify common mechanical device improvements. TRIZ provides a systematic method for finding and using analogies to these past designs in a technical matrix consisting of 39 common engineering problems and 40 possible solution types. Although TRIZ has been frequently used by industry (Wallace, 2000;

Jana, 2006; Hamm, 2008; Lewis, 2005), the proposed heuristics are quite specific to engineering mechanisms, and the majority of them do not overlap with non-engineering design practices. There is also relatively little empirical research testing the effectiveness of TRIZ heuristics.

An alternative process to assist in exploring the design space is the application of “Design Heuristics” (Yilmaz, 2010). Design Heuristics is an idea generation technique working on the premise that giving a designer a selection of focused prompts can lead to novel solutions. Specific design heuristics help the designers to explore the problem space of potential designs, take them to a different part of this space, and lead to the generation of creative solutions. Design heuristics are not guaranteed to produce a high quality or innovative design, and contrary to TRIZ, they do not systematically take the designer through all possible designs. Instead, “heuristics serve as a way to ‘jump in’ to a new subspace of possible solutions” (Ibid, p.17).

The Design Heuristics are represented on a deck of cards (77 cards) and each card has a particular strategy on it. These heuristics draw on strategies used by award winning product designers, professional designers, and advanced design students. Recent empirical evidence shows the effectiveness of Design Heuristics (see Daly et al, 2012).

Both TRIZ and Design Heuristics pursue a general goal of generating novel designs, and do not follow a specific intention as this dissertation aims to achieve.

5.3 DESIGN WITH INTENT

As discussed in Chapter 1, the traditional User-Centered Design approach assumes 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, accessed 2009). With the growing awareness regarding the influence we can exert as “choice architects” through subtle design decisions (either intentionally or not), design is in power to step beyond the user satisfaction approach and proceed to the personal and social goods. Designers like Naoto Fukasawa have crossed over these boundaries and believe that the design should fit so well with user needs and expectations that it “dissolves into behavior” (Ibid).

Design with “intent” was first advocated by design thinkers such as Victor Papanek, and later was emphasized by some behavioral economists (Thaler & Sunstein, 2008) and social marketing scholars (McKenzie-Mohr). More recently, trends in design and HCI (Design with Intent toolkit, Captology) have emerged in an attempt to maximize the likelihood of positive behavior change through various forms of influence and “choice architectures” in products and services. The user might be unaware of the choices the designer has made, or is made aware intentionally, through design to adopt a more “desired” behavior.

Following this notion, Design with Intent toolkit (Lockton, 2010) offers several design heuristics focused on behavior change. These heuristics embrace a wide range of strategies but not necessarily persuasive ones. Moreover, these heuristics lack the focus on the specific design domain, as they do not distinguish between products, services, and spaces, in terms of limitations, context, and the type of desired behavior.

5.4 METAPHORS

In the previous chapter, I explained how metaphors are processed by the audience, and how they can communicate certain messages and influence people's behavior. In this chapter, metaphors are viewed from the designer's perspective and we study how designers use them as a design tool. In design, metaphors are viewed as heuristics that assist in the organization of design thinking and tackle ill-defined design problems (Antoniades, 1992; Rowe, 1987). Designers and artists can benefit from this feature and use visual metaphors to create a new experience with products, services, or works of art (Figure 5.1). Metaphorical reasoning is an iterative process through which designers gradually increase their knowledge of a design situation. The application of metaphors in design thinking is not limited to assisting in reflection upon the problem alone, but also helps to break away from the limitations imposed by initial problem constraints (Snodgrass & Coyne, 1992), explore unfamiliar design alternatives, and establish novel associations with the design problem (Casakin, 2006; see Coyne, 1995). These are important reasons for which metaphors are believed to stimulate design creativity. Casakin (2007) shows that the use of metaphors influences the "general creativity" and "innovation and constraints considerations" in design.



*Figure 5.1. Muji CD player and juice boxes by Naoto Fukasawa provide a new experience with everyday products
([http:// industrial.design.iastate.edu](http://industrial.design.iastate.edu), accessed 2013)*

5.5 PERSUASIVE METAPHOR HEURISTICS

Metaphors alone do not necessarily imply persuasive connotations or intent to influence. Rather, they are tools to elaborate abstract concepts, convey meaning, and create new experiences with products and services. As a result of Study 2 (Chapter 4) we proposed seven heuristics that can make metaphorical designs more persuasive to influence behavior. After using the Persuasive Metaphor Heuristics in a case study (Study 3) and examining how the users perceive and respond to them, at this point, we study the heuristics from the design pedagogy point of view. In other words, we are interested in finding if the heuristics can be taught to design student and whether or not they lead to better design outcomes (ideas) in comparison with traditional idea generation approaches. We believe that these heuristics can be used as design shortcuts to facilitate the use of metaphors in a persuasive context and direct their focus on the “intent to influence.” Therefore, they can be categorized as a subset of design with intent heuristics having a “persuasive” approach and within the context of using “metaphors”. These heuristics do not provide any guidance on how to use metaphors, but rather assist designers to frame the application of metaphors in the context of persuasion and influence.

5.6 DEFINITIONS AND A HYPOTHESIS

We presume that applying the Persuasive Metaphor Heuristics into the design concepts during the concept generation phase will help designers to generate more persuasive designs in terms of behavior change. As mentioned earlier, the traditional ideation techniques (Brainstorming, TRIZ, Morphological Analysis, Design Heuristics) assist the

designers in exploring the solution space more broadly and thoroughly, and potentially lead to a wider range of feasible solutions. For example, Brainstorming encourages “no judgment of ideas” and “wild” solutions, which are good techniques to think ‘out of the box.’ In contrast, the persuasive heuristics proposed in this dissertation are focused prompts (and shortcuts) aiming to narrow down the solution space into persuasive ideas that intend to change the behavior and make them more user-centric. Moreover, we expect these heuristics to boost the novelty and creativity of ideas, because the use of metaphor puts the solution space into a new perspective and is a non-conventional tool in the designs of everyday products. We also expect that while using metaphors (without heuristics) will increase the novelty and creativity of the ideas, it does not result in more persuasive design, because metaphors in general do not imply any specific persuasive direction and intent.

I hypothesize that if design students receive three individual training sessions on how to use brainstorming technique, the notion of using metaphors in product design, and using persuasive metaphors heuristics, their design outcomes would be more persuasive after using the persuasive heuristics. The hypothesis is formally defined as:

Employing the Persuasive Metaphors Heuristics during the concept generation results in more persuasive design concepts in the context of design for behavior change.

Since there is no universal consensus on the definition of some terms I use in this study, a general definition for each term is derived from dictionaries, and provided as follows:

Persuasive: “intended or having the power to induce an action or belief; convincing” (The free online dictionary, accessed 2012).

Creativity: “the ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc.; originality” (Dictionary.com, accessed 2012)

Novel: “strikingly new, unusual, or different” (Meriam-websters online, accessed 2012)

Unique: “existing as the only one or as the sole example; limited in occurrence to a given class, situation, or area” (Dictionary.com, accessed 2012).

Effective: “adequate to accomplish a purpose producing the intended or expected result” (Dictionary.com, accessed 2012).

5.7 STUDY 4

In the following study, I examined how the design outcomes could be more behavior centric, persuasive, and influential, when designers use the persuasive metaphors heuristics. In doing so, we set up several in-class design activities spread throughout a semester-long course in the School of Art and Design at the University of Michigan. The course provided sophomore and junior students with an introduction to concept visualization theories. As part of their educational curriculum, the students learned about metaphors, their application in design, and persuasive heuristics. Then they were engaged in multiple design activities that were used for the purpose of this study. Next, we evaluated the design concepts across different activities to see how these concepts change (or improve) through different methods and instructional strategies.

Although our primary goal of data analysis was to examine how the persuasiveness of the concepts was influenced with the application of persuasive metaphors heuristics, the literature (Coyne, 1995; Casakin, 2006; 2007) suggests that use of metaphors increase

design creativity and novelty. Hence, we were also interested to see how creativity, novelty and uniqueness of ideas were influenced by these heuristics. We also expected that using metaphors and persuasive heuristics would encourage the designers to think of more user-centered ideas and focus on changing or correcting the behavior rather than technological interventions and forced functionality.

5.7.1 METHOD

Between 12-18 students participated in each design task (male=5) with an average age of 21.4 (median= 20). The study consisted of two parts; in Part I, we conducted a longitudinal study in which participants worked on the same design topic (A) three times, each time after a different instructional method. The participants were introduced to (1) Brainstorming, (2) the application of metaphors in design (without any specific technique), and (3) the Persuasive Metaphors Heuristics, one at a time. After the participants were introduced to each of the methods, they worked on one design task with topic A, trying to generate concepts using the strategy they just learned about. Our goal was to compare the design concepts of these three design tasks and examine how the design outcomes varied across the three methods. Part II was designed as a control condition to shed light on the results of Part I. In other words, Part II informed us if working on the same design topic (B) twice and using the same ideation technique (brainstorming), would lead to any improvement in the outcomes. This part also helped us to understand if the participants apply their knowledge of a previously learned method (indirectly) when working on a design task, regardless of the instructions they received directly to apply a certain strategy. This part involved two design tasks, one of which occurred after the Brainstorming training session, and the second one was scheduled for

after the introduction to persuasive heuristics (see table 5.1). The students received formal training on Brainstorming right before both of these two tasks. The goal of Part II was to examine the difference between the outcomes of two design tasks (any potential improvement on the dependent variables) and see either it is due to the task repetition or the transferability of the educational methods from one condition to another.

5.7.1.1 MATERIAL

In the following sections, I provide the details of the experiment in terms of the instructional and physical material used for this experiment.

5.7.1.1.1 STRATEGIES AND INSTRUCTIONAL MATERIALS

Brainstorming: The first method that was introduced to the participants was Brainstorming (Osborn, 1963). Brainstorming emphasizes generating as many solutions as possible and by pushing the ideas as far as possible. We provided a brief (15-minute long) introduction to brainstorming technique and practiced briefly on how to use this technique. We explained the four basic rules attached to brainstorming (Ibid) as follows:

The first rule is to postpone and withhold the judgment of ideas and not to evaluate the ideas of self and the others. Criticism of ideas is withheld during the brainstorming session as the purpose is on generating varied and unusual ideals and extending or adding to these ideas. The second rule is to encourage wild, exaggerated, and unusual ideas. The third rule is that quantity counts at this stage – not quality. The greater the number of ideas generated, the greater the chance of producing a radical and effective solution. The fourth rule is to build consecutively on ideas. This means that people should let one idea flow into another, by changing a part of it in some way.

Metaphors: The second training involved introduction to metaphors, their application in linguistics, art, and design. We discussed the main components of a metaphor (signified and signifier) and then gave a 15-minute presentation on the application of metaphors by designers and showed the participants some examples of metaphorical designs. None of the presented examples implied the intent behavior change.

Persuasive Metaphors Heuristics: During a 20-minutes training, the participants were introduced to the Persuasive Metaphors Heuristics with some examples of product and two-dimensional designs (posters). Although all of the presented examples had behavior change implications, we did not bring any example from sustainable behavior change paradigms to prevent any induction toward the topic of the design task.

Each of these strategies was followed by a design task with a design topic.

5.7.1.1.2 DESIGN TOPICS

The participants completed five design tasks in total (topic A three times, topic B twice), each for 50 minutes. The activities were scheduled to occur in individual sessions of the course (Table 5.1 shows the order of the topics).

Both of the design topics involved designing products that encourage people to behave sustainably. Topic A was to “design a **light switch** for a household that encourages people to turn off the light when leaving the room.” Design topic B was to “Design a **napkin dispenser** for a coffee shop that encourages people to use fewer napkins (use as much as necessary).”

5.7.1.1.3 CONCEPT DOCUMENTATION

Each participant was provided with blank letter size papers for “warm-up” ideation and four concept sheets (three for top three concepts and one for the final design). The concept sheet (Appendix IV) had a box for drawing (sketch) at the top, a box in the middle for concept description (the function and other details), and a space to identify the strategies the participant used to generate that concept, at the bottom of the page.

5.7.1.2 PROCEDURE

The experiment occurred in five individual sessions, one design task at a time. At the beginning of each session, the instructor conducted training (presentation) on one of the strategies mentioned in 5.7.1.1.1. The participants were introduced to the brainstorming technique three times (a complete introduction for the first time and a brief review for the next two activities), once to the application of metaphors in design, and once to the persuasive metaphors heuristics. Each lecture was followed by a design task (either working on topic A or B). Table 5.1 demonstrates the order of the training sessions and design tasks.

	Sep → Dec				
Task	1	2	3	4	5
Method	Brainstorming	Brainstorming	Metaphors	Heuristics	Brainstorming
Part I	Topic A		Topic A	Topic A	
Part II		Topic B			Topic B

Table 5.1. The order of design tasks per topic, spread in 5 individual sessions from Sep-Dec 2012

Each design task was divided into three major steps, and the participants were allowed to spend a certain amount of time on each step. The number of steps and the time allocated to each step was the same across the five design tasks. These steps included (1) Ideation

(warm-up, generate as many ideas as possible), (2) Synthesis (come up with three main ideas), and (3) Development (finalize one of the ideas, merge two ideas, and improve).

After each design task, participants completed a questionnaire about their experience, challenges, strategies they used, and a self-evaluation of their creativity on the given design task (Appendix VI).

5.7.2 DATA ANALYSIS

Through this analysis we are interested in rating the concepts according to five primary measures: creativity, novelty, persuasiveness, effectiveness, and uniqueness.

5.7.2.1 CODING

A total number of 296 design concepts were generated by 12-18 participants across five different design activities. 186 concepts were generated for topic A (light switch) across three tasks and 110 concepts for topic B (napkin dispenser) from two different tasks. For each design task, each designer were supposed to generate three main concepts, and one final concept that was either a combination of two or all of the main concepts or an improvement of one of those three.

After the data collection, we reviewed the concepts and identified those that were repetitive. These were among the final concepts that could not be differentiated from the three main concepts (very similar to one of the three concepts). The repetitive concepts were removed and 256 concepts (A= 163) were prepared for further analysis. In the next step, we coded the concepts according to the experimental conditions and design topics, and eliminated any information for the anonymity of the concepts, so that the coders would not recognize the designer and the experimental condition. Then, we mixed all of

the three sets of concepts for design topic A(from brainstorming, metaphor, and persuasive heuristics sessions) and the two sets of concept for design topic B.

Two independent coders, blind to the goal of the study, hypothesis, different experimental conditions, and the details of the studies were recruited and trained about metaphors, metaphorical design concepts, and persuasive metaphorical heuristics. The coders attended three one-hour meetings during which they practiced on identifying metaphors, and any of the seven heuristics. Both coders were freshmen, one in the college of engineering and one in the School of Literature, Science and the Arts. They both used the same coding scheme provided by the researcher to rate the concepts and used it through coding and rating the concepts. The coders were trained to identify and report the seven heuristics and report if the participants mentioned using any of these heuristics explicitly.

The coding scheme (Appendix V) included definitions and clarifications that helped the coders to rate the concepts in terms of the dependent variable measures such as creativity, novelty, uniqueness, persuasiveness, and effectiveness, based on Likert-scale (7 points and 5 points). Additionally, the coders were asked to code each design based on other design features such as user involvement, use of metaphors, use of seven persuasive metaphors heuristics, use of text, and inspired by nature. Skimming through the concepts, we found some commonly used strategies that the participants used. These strategies included salience, use of humor/fun, use of technological intervention, financial incentives, physical enforcement, ease of use/difficulty of use, and eco-feedback. The coders were asked to code each concept based on these strategies, as well. The coding scheme can be found in Appendix V. With respect to “uniqueness”, we asked the coders

to first evaluate all of the concepts in terms of the other measures, then after having a glimpse of all of the concepts, go back and assess how unique each idea is comparing to the rest of the ideas.

After the coders finished the evaluation, we measured the inter-coder reliability, which was not high, with the gamma coefficient varying from 0.20 to 0.23. In order to resolve this problem, the researcher found all of the disagreements and judged the final rating scores under the constraint that the final rating had to be within the interval of the two raters (e.g., if one coder said 2, and the other 4, the researcher was constrained to choose a score of 2, 3 or 4). So, the final ratings consist of the coders' ratings (where they agreed) and the researcher's ratings in case of disagreement. Since the third coder was not blind to the hypothesis and details of the study, a fourth independent coder, blind to the conditions and interventions, randomly evaluated 35 concepts. The inter-coder reliability between third and fourth coder was relatively high as indicated in table 5.2. Appendix VII shows examples of concept evaluation on the five measures.

	Gamma	Pearson
Creativity	0.645	0.668
Novelty	0.761	0.816
Persuasiveness	0.795	0.745
Effectiveness	0.825	0.78

Table 5.2. The inter-coder reliability for the third and fourth coders

5.7.2.2 RESULTS

Designers' performance: For each participant, an average score of all the concepts generated for each design task was computed, in terms of five different measures

(creativity, novelty, persuasiveness, effectiveness, and uniqueness). The analysis was decomposed into two parts: in Part I, we analyzed the longitudinal study and compared each designer's performance across the three different educational methods (trainings) while working on task A. In Part II, we compared the performance between two design tasks (A vs. B). For part I (topic A), one way repeated measure analysis of variance (ANOVA) indicates statistically significant differences between methods used to generate concepts in terms of creativity ($F_{(1,13)}=8.94$, $P= 0.01$), novelty ($F_{(1,13)}=10.75$, $P= 0.006$), persuasiveness ($F_{(1,13)}=11.89$, $P= 0.004$), and uniqueness ($F_{(1,13)}=13.47$, $P= 0.003$). The Design variation graphs in Figure 5.2 demonstrate how the designers were influenced through the three methods in terms of the measures of interest. Additionally, a quadratic contrast reveals a statistically significant difference between the methods in terms of effectiveness of the concepts ($F_{(1,13)}=6.26$, $P= 0.021$) over and above the other measures.

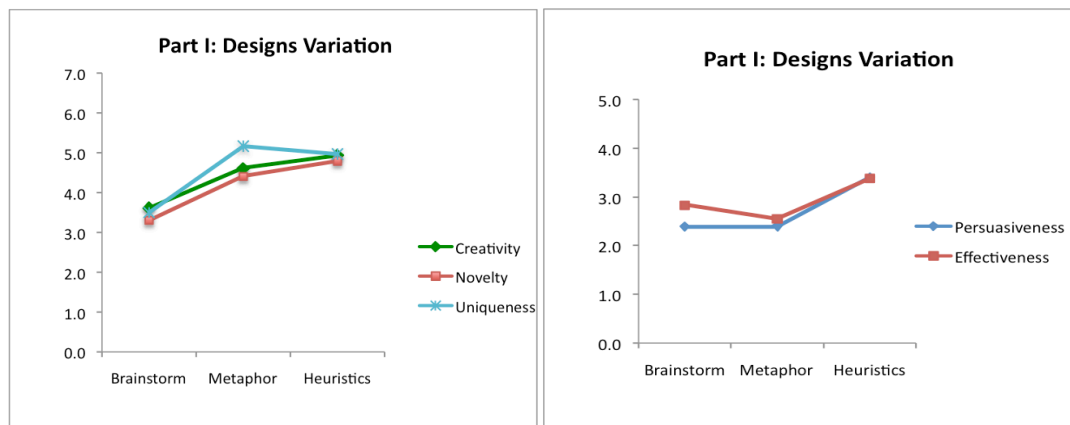


Figure 5.2. Within-subjects effects: Methods: 1= Brainstorming, 2=Metaphor 3=Persuasive heuristics

Post hoc tests using the Bonferroni correction (Table 5.3) revealed that the designers made improvements in their design concepts in terms of creativity ($P=0.031$), novelty ($P=0.018$), persuasiveness ($P=0.013$), and uniqueness ($P=0.008$) from brainstorming

method to persuasive heuristics, which was statistically significant for these four measures. However, use of persuasive heuristics did not lead to generating more effective concepts ($P= 0.34$). The analysis also suggests that the participants came up with more persuasive and more effective ideas from metaphor-only condition to persuasive heuristics condition ($P=0.041$ and $P=0.024$, respectively). Use of metaphors made the designs more unique from the brainstorming condition ($P= 0.008$).

Measure	(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig. ^b
Creativity	1	2	-.989	.459	.151
		3*	-1.321*	.442	.031
	2	1	.989	.459	.151
Novelty	1	2	-1.101	.643	.332
		3*	-1.491*	.455	.018
	2	1	1.101	.643	.332
Persuasiveness	1	2	-.011	.366	1.000
		3*	-1.016*	.295	.013
	2	1	.011	.366	1.000
Effectiveness	1	2	.280	.283	1.000
		3	-.546	.323	.345
	2	1	-.280	.283	1.000
Uniqueness	1	2*	-1.666*	.451	.008
		3*	-1.469*	.400	.008
	2	1*	1.666*	.451	.008
		3	.197	.255	1.000

Table 5.3. Pair-wise comparisons of methods: 1= Brainstorming, 2=Metaphor 3=Persuasive heuristics

For Part II (task B), we were interested to see whether or not the improvements observed in the designers' performance in Part I are due to the repetition of the task or because of the trainings they received. The participants applied brainstorming technique for the first time they worked on each topic (A or B). For the next time working on the same topic, they used brainstorming again for design topic B and persuasive heuristics for topic A. A

two-way repeated measure analysis of variance (ANOVA) with factors being time (2 levels: first time working on a task and last time working on it) and task (2 levels: A/B), determined that there is a statistically significant difference between time 1 and time 2 (of working on the same design topic) in terms of creativity ($F_{(1,17.24)} = 8.88$, $P = 0.015$), novelty ($F_{(1,23.87)} = 12.7$, $P = 0.006$), persuasiveness ($F_{(1,8.16)} = 10.7$, $P = 0.01$), effectiveness ($F_{(1,5.1)} = 8.88$, $P = 0.01$), and uniqueness ($F_{(1,17)} = 14.81$, $P = 0.004$). In other words, the results indicated that the participants improved in terms of the above-mentioned measures when they repeated working on the same topic (A or B) later in the semester. There was no difference in terms of the design topic the students worked on (Table 5.4).

Design Task				
Measure	Sum of Square	df	F	P
Creativity	1.25	1	0.78	0.40
Novelty	0.74	1	0.47	0.51
Persuasiveness	0.01	1	0.01	0.95
Effectiveness	0.58	1	0.28	0.61
Uniqueness	0.11	1	0.14	0.72
Task * Time				
Creativity	0.15	1	0.27	0.62
Novelty	0.48	1	0.90	0.37
Persuasiveness	0.69	1	1.26	0.29
Effectiveness	0.14	1	0.27	0.62
Uniqueness	0.12	1	0.17	0.69

Table 5.4. The effect of design task and the interaction are not significant.

Although the plots (Figure 5.3) show a potential interaction between time and topic for novelty, persuasiveness, effectiveness, and uniqueness, the results do not suggest a significant difference in these measures (Table 5.3) within different design topics (light switch and napkin dispenser).

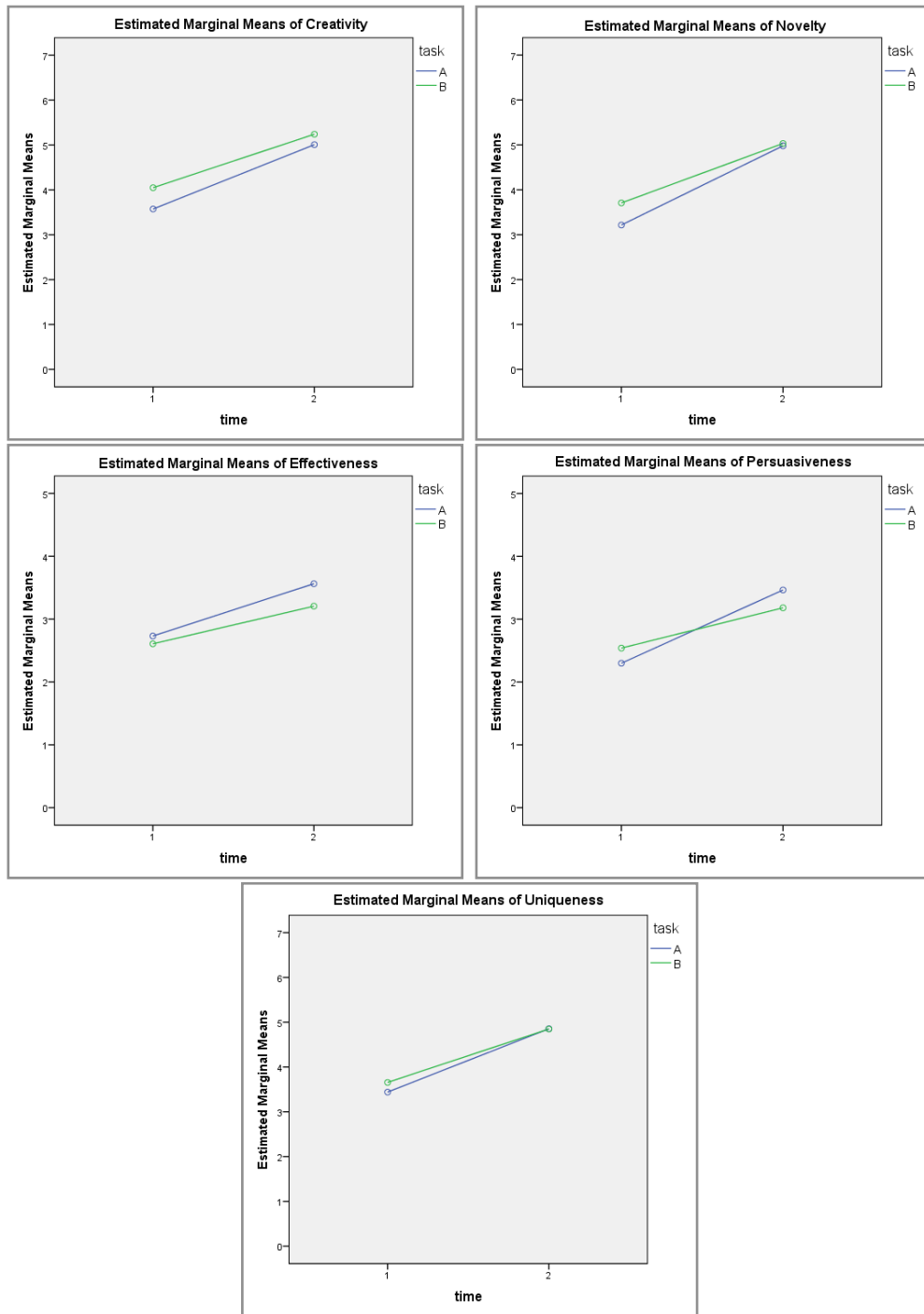


Figure 5.3. Potential interactions are not statistically significant

5.7.2.3 DISCUSSION OF RESULTS

The results of Part II analysis in the previous section did not suggest a significant interaction between time and task. In other words, the concepts a designer generated for the light switch in time 2 (using heuristics training) were not more (less) creative than the concepts s/he generated for the napkin dispenser design task in time 2 (using brainstorming method). It means that repetition of the task might have boosted the persuasiveness (and other measures), as well as the method they used. Since the interaction between time and task is not significant, we cannot provide a definite explanation for this improvement.

The analysis was based only on subjects who attended all three sessions (n=13) meaning that the data for some of the participants have been discarded by the statistical method. We also compared the tasks and the methods based on an average score for each participant. However, each designer generated more than one concept and these concepts were sometimes very different, say, in terms of persuasiveness or designers approach. For example, a participant who generated three concepts during a design task could have used metaphor (or heuristics) in two of his/her concepts but not in the third one. Since we lumped the scores of all three concepts together, say for persuasiveness, we are unsure whether the use of metaphor (or the heuristics) accounted for the persuasiveness or not. A review of the concepts from different design tasks revealed that the participants did not necessarily follow the instructions on using a certain method. For example, only half of the concepts generated during design task 4 (using persuasive metaphor heuristics to design a light switch) indicated using metaphors and the heuristics. On the other hand, 25% of the concepts for design task 2 and 29% of the concepts for design task 5 (where

the participants were instructed to use brainstorming to design a napkin dispenser) had metaphorical connotations with at least one heuristic identified. This led us to the next analysis, this time comparing the “concepts” between design methods to examine whether or not using metaphors (and at least one persuasive heuristic) leads to any improvement in the concepts regarding the measures of interest.

5.7.2.4 ANALYSIS OF CONCEPTS AND RESULTS

A two-way (2x3) factorial ANOVA (on 158 design concepts generated by 18 design students) with the use of metaphors (and at least one heuristic) as one factor with two levels (metaphor/ no metaphor), and method (training) with three levels (brainstorming, metaphor, heuristics) as the second factor, compared how the use of metaphors and heuristics influenced the five dependent variables (creativity, novelty, persuasiveness, etc.) for each concept, across three different methods.

Test of between-subjects effects indicated that there is a significant effect of metaphors in improving creativity ($F_{(1,157)} = 22.48$, $P < 0.001$), novelty ($F_{(1,157)} = 54.13$, $P < 0.001$), persuasiveness ($F_{(1,157)} = 7.23$, $P = 0.008$), and uniqueness ($F_{(1,157)} = 7.66$, $P < 0.006$). Also, the concepts significantly improved in terms of persuasiveness ($F_{(2,157)} = 22.48$, $P < 0.001$), effectiveness ($F_{(1,157)} = 4.39$, $P = 0.014$), and uniqueness ($F_{(1,157)} = 3.21$, $P = 0.043$), from the first time the participants worked on them (with brainstorming training) until the third time (with heuristics training) (see plots in Figure 5.4). Although the plots (Figure 5.5) suggest a potential interaction effect for effectiveness and uniqueness measures, they are not statistically significant.

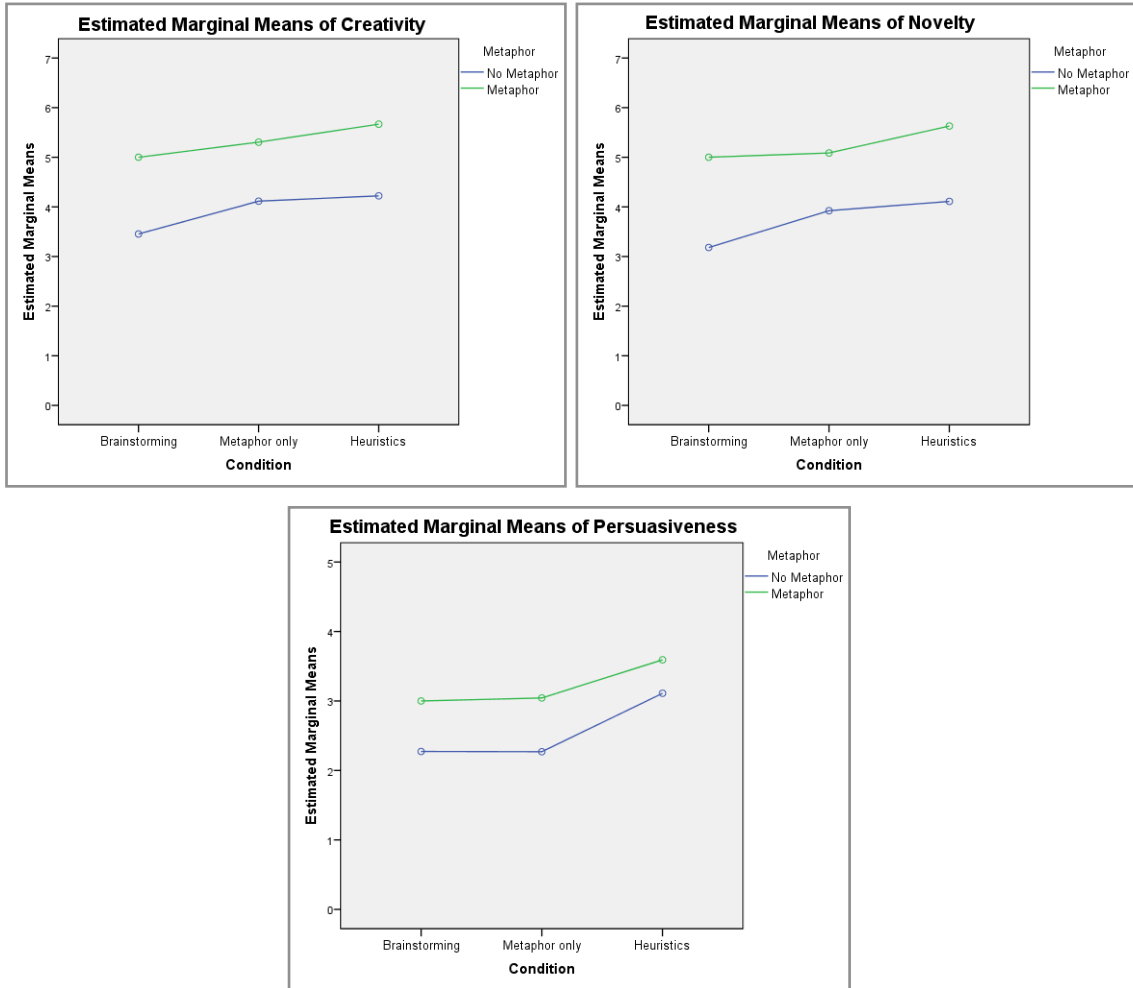


Figure 5.4. The plots illustrate the effect of using metaphors

Post hoc tests using the Bonferroni correction at $\alpha=0.05$ revealed that the concepts made improvements in terms of creativity ($P < 0.001$), novelty ($P < 0.001$), persuasiveness ($P < 0.001$), and uniqueness ($P < 0.001$) from brainstorming to persuasive heuristics. The analysis also suggested that the participants came up with more creative ($P < 0.001$), novel ($P < 0.001$), and unique ($P < 0.001$) on the metaphor related design task, than on the brainstorming task. There is also a significant improvement in terms of persuasiveness of concepts on the task fulfilled after heuristics training ($P = 0.009$).

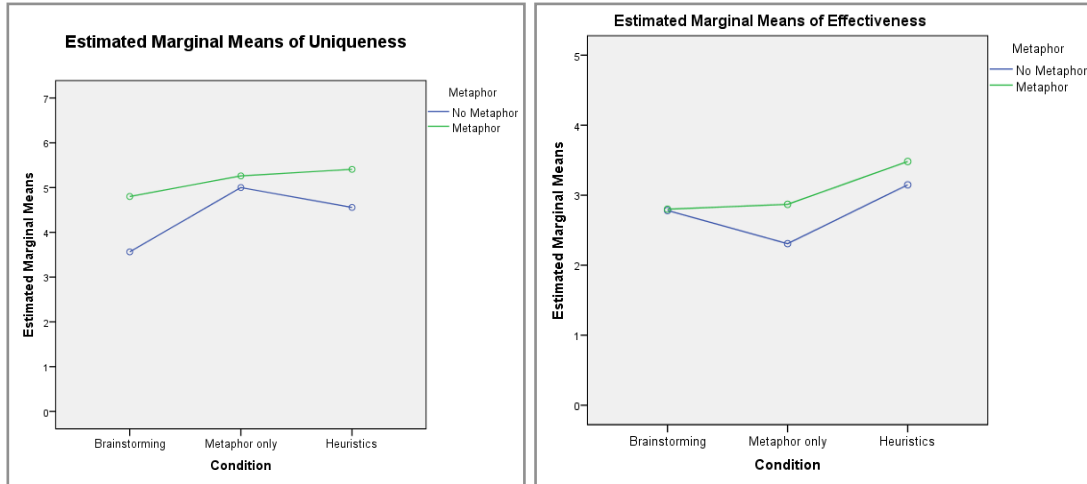


Figure 5.5. Potential interactions are not statistically significant

The individual analysis of concepts indicated that the concepts generated during the persuasive heuristics task were significantly more user-centric and behavior focused than the concepts generated during the first brainstorming task ($Z= 4.093$, $P <0.001$). The results from the brainstorming task show that only 73% ($SD=\pm 0.057$) of the ideas involved users and aimed at changing their behavior whereas all (100%) of the ideas generated during the persuasive heuristics task involves users' decision making and behavior change (Figure 5.6).

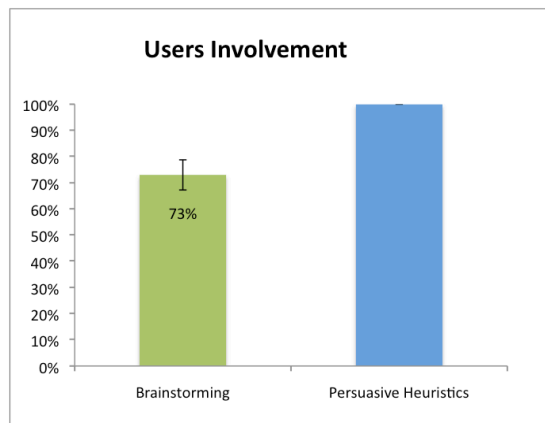


Figure 5.6. The focus shifted toward user involvement and behavior change (inter-coder $r=0.88$)

We next examined the frequency of the seven persuasive heuristics across the three design tasks for topic A (light switch). The results show that after the students received the training on heuristics, they have used them more frequently in the designs; having an informative message (24), create feeling (22), make the design responsive to the behavior (21), and dynamic design (18) were used more frequently than the others and use of slogan (7) was the least favorite heuristic. As demonstrated in Figure 5.7, the students sporadically used heuristics during the Brainstorming task, and then the frequency is boosted during designing with metaphors even before they receive the official training on heuristics. Finally, the students used the heuristics more often after they received the training. This comparison suggest that using metaphors might be inherently associated with some of these heuristics (e.g. informative message, evoke feelings, responsiveness, and dynamic design), as the students used them unintentionally during the metaphor task.

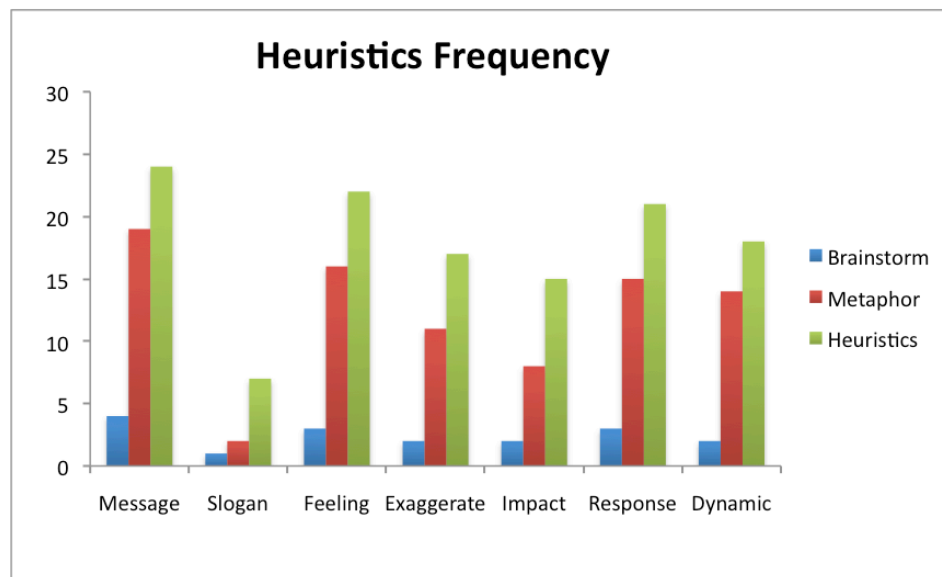


Figure 5.7. The frequency of heuristics increased with using metaphors and heuristics training

5.7.2.5 ANALYSIS OF QUESTIONNAIRES AND RESULTS

Analysis of the post-task questionnaires revealed what the participants (design students) think of the training they received and tools they applied, their challenges, how they assess their creativity during different design tasks, and how they compare different tools (methods) in terms of helping them to generate ideas. Overall, all of the participants (100%) found Brainstorming helpful, but only 58% and 82% of them believed that metaphor training and persuasive heuristics (respectively) helped them through idea generation. The self-assessment of creativity within subjects shows a significant difference across the three methods ($F_{(2,18)} = 9.80$, $P = 0.001$) and participants thought they were more creative when working with metaphors ($P=0.013$) and applying heuristics ($P= 0.045$) comparing to using brainstorming (Figure 5.8).

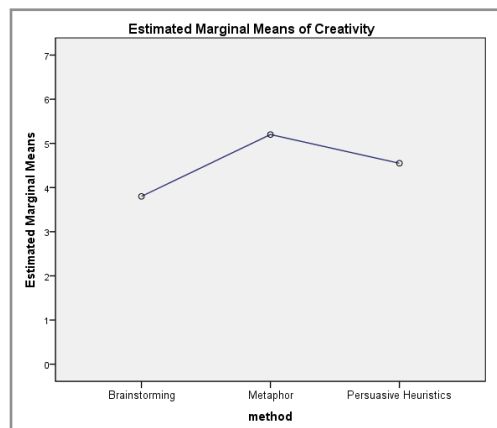


Figure 5.8. Use of metaphors and heuristics increased the perceived creativity among the participants

The participants, believed that the different methods do not make any difference in terms of the difficulty of the task and the challenges they faced to generate ideas ($F_{(2,18)} = 0.09$, $P = 0.91$). However, this is considered as a misperception since the students outperformed in different aspects when they used persuasive methods (heuristics and

metaphors) as evaluated by unbiased judges. Figure 5.9 shows how the students assessed the difficulty of the task.

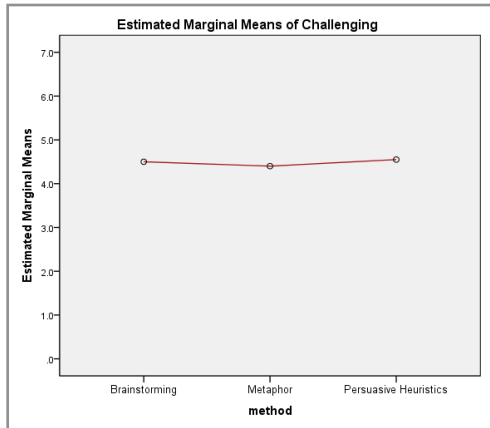


Figure 5.9. The perceived difficulty of the task is the same across the three methods

Among the challenges the participants mentioned we could point to time constraints, boredom due to task repetition, lack of interest in the design topic, no experience in product design, and running out of idea after the first brainstorming task. The participants’ feedback (pros and cons) on each of the methods is summarized in table 5.5.

Feedback on Methods			
	BRAINSTORMING	METAPHOR	HEURISTICS
Positive	Got more than one ideas	More emotional	Became interesting when started thinking
	Broadened my thoughts	More creative	Makes it much easier
	Lets me be creative	More relevant to personal life	It helped
	Gave me visual understanding of different directions	A good aid for brainstorming	Influenced me to think about response and emotion toward design
	Allowed sense of humor to pick up where creativity failed		Similar to the “hats” and gave direction which helped
	Sequential generation helps		I enjoyed
Negative		Less practical	Not much helpful
		Hard to work with	
		Boring	
		Less functional	

Table 5.5. Participant's evaluation of each method

The participants also compared the methods they used regarding their helpfulness in idea generation. Their evaluation is summarized into a table (5.6).

COMPARING METHODS		
Metaphor (vs. Brainstorming)	Heuristics (vs. Metaphors)	Brainstorming (vs. Heuristics)
Less about functionality or practicality	They are more off-topic ideas this time	Persuasive metaphors where better because I found a name to call my idea
Worse because I used up all my ideas last time	More complex and creative	Heuristics are more logically founded
Brainstorming -more logical, metaphors- more impulsive	They are more practically grounded	Very different
I think they are both valuable	Showed relationships which led to new ideas	Slightly different
Metaphors are more creative and abstract and less literal and practical	Slightly easier and more practical	The metaphor based ideas are a lot more interesting
More emotional, less about function	They are fairly similar	The guidelines help me focus
Worse	Much easier	More focus with heuristics
Metaphor allowed to draw inspiration from existing objects	Like much more	I had specific examples to consider, which did have an influence
Worse, more boring	Generated more ideas	I think it (brainstorm) is less visual
Using metaphor is more helpful	Not very different	They (brainstorm) came more naturally
Good tool for brainstorming		Very different- they touch on different aspects

Table 5.6. Participant's comparison between the different methods they used

5.7.3 DISCUSSION

As the results suggested for the first design topic, the participants made improvements in terms of generating more persuasive, creative, novel, and unique concepts when they used persuasive metaphors comparing to the first time they used brainstorming.

Additionally, mere use of metaphors not only did not lead to generating more persuasive concepts but also made them less practical and effective. However, when metaphors were used along with the persuasive heuristics, the design became more persuasive and effective.

Analysis of the second design topic with brainstorming method (Part II, control condition) showed that repeating the same topic with brainstorming method also improved the performance of the participants in terms of the mentioned measures. The insignificant interaction of topic and method could be ascribed to the small sample size ($n=10$). We speculated on two different explanations for these findings: 1) the improvements in the design concepts for topic (A) are due to the topic repetition, or 2) the students might have transferred their knowledge of heuristics and used them unintentionally or indirectly. Further analysis comparing the use of metaphors and heuristics in the “concepts” across the three methods revealed that not all of the students applied the method they learned before each task to generate all of their concepts. We found that when they used metaphors (and at least one heuristic) the design significantly improved in terms of persuasiveness, creativity, novelty, and uniqueness. This finding suggests that in addition to the role of persuasive heuristics and use of metaphors, task repetition helps the designers to explore the solution space better, and improves concepts’ practicality, persuasiveness, and diversity.

Use of persuasive metaphors heuristics also encouraged the designers to focus more on the behavior change purpose and shifted their concentration from technological interventions and forced functionality to user-centered, behavior oriented design concepts.

There were also some irrelevant concepts, which neither followed the instructions, nor focused on the design topic. The emergence of these irrelevant concepts could be partially attributed to the lack of motivation of some participants to fulfill the task, lack of background in product design and little interest in the topic, or boredom because of working on the same topic several times.

The feedback of the participants through post-task questionnaires indicates that all the three methods were evaluated positively, touching different aspects of idea generation. Brainstorming was evaluated very positive because it did not impose any constraint and let the think freely. While metaphors were assessed as being difficult to work with, complicated, and less practical, the students believed that metaphors assisted them to be more creative. The participants indicated that the persuasive metaphors heuristics helped them to be creative while directing their focus on persuasion and practicality of design. The participants' perceived creativity through the different tasks is similar to the coders' evaluations.

5.8 SUMMARY AND CONCLUSION

In this chapter we were interested to investigate how the persuasive metaphors heuristics would be effective, this time from the designers' perspective. Through Study 4 we examined how designers use these heuristics and how the application of these into design concepts influence the design outcomes.

Five design tasks were organized and spread throughout five sessions of a semester-long course in the School of Art and Design. The students received trainings on three problem solving methods/tools: brainstorming, use of metaphors, and persuasive metaphors

heuristics. After each training, the students were instructed to use the method to work on the design topic. The participants filled out a pos-task questionnaire after each design task about their experience with using that method and the challenges they faced.

Although we were primarily interested in comparing the persuasiveness of the concepts between the three methods, we were curious to examine how other measures such as creativity, novelty, uniqueness, and effectiveness of the concepts would be influenced.

The design concepts were coded (on 18 features) and rated on five major measures by two independent coders. Due to low reliability of the ratings a third coder went through all of the disagreements and judged the final score.

We found that the persuasive metaphors heuristics helped the participants to generate more persuasive, creative, novel, and unique concepts, comparing with brainstorming technique. The results indicated that merely using metaphors does not lead to generating more persuasive concepts and might result in less practical and effective ideas. However, integrating metaphors with the persuasive heuristics made the designs more persuasive and effective.

We learned that each of these methods has different merits and helps the students to further explore the solution in different ways. Brainstorming helps designers to go beyond the conventional “first ideas” that everyone might come up with, let their mind fly, and assists them to overcome fixation on a single idea. Using metaphors provides a new perspective to problem solving and leads to more creative and novel ideas, but using them without a guided method or focus would be confusing and might not support the intent and purposes of design. Persuasive heuristics incorporate persuasiveness and

intended values into the creative metaphorical design concepts, while making them more behavior oriented.

In fact, we are very limited in our generalization beyond our finding in this study. It can be partially explained by the small number of participants and removing the data for the participants who did not attend all the activities during the repeated measures analysis. Moreover, multiple confounds such as task repetition, lack of background and motivation of some students, and the effect of learning through time that we did not have control over, affected the analysis. In the next step, other analytic techniques will be used to consider the data from all of the participants.

Working with one group of students through multiple experimental conditions had both advantages and drawbacks. For example, we cannot tease out the influence of different methods the students learned through a semester-long course, and precisely define to what extent each method contributed to the improvement of designs and transformation of students' approaches. Nevertheless, it gave us this opportunity to understand how the students compare different methods while working on the same design task. The participants' feedback and evaluation enlightened us about the "appropriateness" of these methods based on design purposes and intentions rather than "preference" and "excellence" of one method over the other. Therefore, these methods and tools can be regarded as complementary to help the designer move through the different stages of concept generation.

Further limitations, explanations, and future steps will be discussed in Chapter 6.

CHAPTER 6

CONCLUSION

6.1 SUMMARY

This dissertation was an attempt to examine the role of product design principles in triggering behavioral changes, through framing an interdisciplinary persuasive approach. With a focus on environmentally responsible behaviors such as energy conservation and recycling, this work examined how the appearance of the product can influence the *use phase* of a product and persuade users to change their unsustainable behaviors. Instead of designing new supplementary artifacts to reduce energy consumption or motivate recycling behavior, this research focused on redesigning the use-phase of existing products that people use on an everyday basis. Based on the findings, a series of heuristics are proposed for persuasive design with the intent of behavior change. Finally, we studied how these heuristics can be used by designers and how they influence design outcomes.

This dissertation was presented in six chapters:

Chapter 1 provided an introduction to the research topic, its importance, and the motivation. The scope of research was narrowed to the use phase of products and a list of proposed contributions was presented.

Chapter 2 presented the state of the art, theoretical foundation, knowledge gap, and research questions. Providing a broad review of literature from behavioral and social psychology, social marketing, human-computer interaction, and design, an interdisciplinary perspective was framed to explore the research questions.

The studies were organized in two parts; Part I (Chapter 3 and 4) examined product-driven behavior change through two case studies that drew upon the elaboration likelihood model of persuasion and suggested a set of heuristics for designers of persuasive products with behavior change intent. Chapter 3 investigated how color –as a peripheral cue – triggers recycling behavior. Chapter 4 was built upon the effect of visual rhetoric as a fascinating tool to elaborate the persuasive message. This chapter demonstrated how metaphors –processed through a central route– persuade users to consume fewer napkins in a coffee house. Additionally, this chapter showed how designers have used metaphors to encourage behavior change, which led to seven persuasive design heuristics. Part II (Chapter 5) validated the application of the heuristics proposed in Chapter 4 in the design process, and studied how designers use these heuristics, and how they influence design concepts, through five systematic design activities with a class of 18 undergraduate students of Art & Design.

Chapter 6 summarized the findings of this dissertation and proposed future directions.

6.2 FINDINGS

In Chapter 2, I provided an interdisciplinary review of the state of the art in psychology, marketing, human computer interaction, and product design, and identified the existing gap, as there is a need for a more deliberate User Centered Design approach that incorporates “design intent” as well as an investigation upon the specific design elements and principles to understand how to use design language to persuade individuals to change their behavior through the aesthetics of the products.

In Chapter 3, I used the Elaboration Likelihood Model and the concept of visual salience from psychology in the context of recycling bins. We found that the salience of recycling cues (here color) increases the use of recycling bins through a peripheral processing route. More specifically, the case study of recycling bins revealed that people recycle more in a green recycling bin versus a grey one, if all of the other aspects (ease of use, availability/access, size, function, shape, and material) are equivalent. The pre-test study showed that a green recycling bin is more visible and memorable than other colors (blue, red, and grey). Overall, the results suggest 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.

In Chapter 4 the elaboration likelihood model, the picture superiority effect, and research on metaphors were applied to product design for behavior change. We compared the napkin consumption using three different napkin dispensers (a regular box shape non-metaphorical design, one with conservation metaphor, and a non-conservation metaphorical design) and found that using a visual metaphor in the design of a napkin

dispenser encourages mindful consumption of napkins, presumably through a central processing route. The results suggest effective behavior change in response to the consumption related metaphorical design. The results of 53 post-consumption interviews with the customers showed that 76% of the participants noticed the change in the napkin dispenser and more than half of the respondents (64%) understood the metaphor and its message. These interviews highlighted some idiosyncratic differences in the interpretation of metaphors or napkin consumption patterns in general. Comparing the observation and self-report showed that although the participants used fewer napkins (with the metaphorical design), they did not believe that their behavior was influenced by the design of the napkin dispenser. We also found that women use more napkins than men.

Chapter 4 also featured a retrospective study on persuasive metaphorical designs (2D and 3D) that target behavior change in both advertising and product design. The study led to seven persuasive heuristics for designing metaphorical products with behavior change intentions, named as Persuasive Metaphor Heuristics.

In Chapter 5 we found that each of the taught methods (brainstorming, use of metaphors, and persuasive metaphors heuristics) has different merits and help the students to further explore the solution in different ways. Brainstorming helps designers to go beyond the conventional “first ideas” that everyone might come up with; using metaphors provides a different and unconventional perspective to the problem and leads to more creative, novel, and diverse ideas; and persuasive heuristics guide the solution space towards more persuasiveness ideas and help the designers to incorporate the desired values into the creative metaphorical design concepts, and makes them more behavior oriented.

6.3 CONTRIBUTIONS

This dissertation's contributions to the knowledge and field can be summarized into five major points. This dissertation:

- Demonstrated that in the context of environmentally responsible behaviors, low-cost changes in the design of every-day products have the potential to elicit desirable behavioral responses when the appropriate design approach is chosen based on user information processing mode. The findings affirm that products, as a part of the built environment, are capable of “bringing out the best in people.”
- Performed rigorous empirical studies to support the proposed assertions; study 1 shows the effect of color in “sustainable” behavior change, and study 3 augments the literature with an evidence based approach, showing that product-laden metaphors can influence behavior.
- Adopted a unique interdisciplinary approach in product design research, in terms of applying the existing literature from different disciplines, consolidating the theories, and integrating them into the product design paradigms for behavior change.
- Proposed a set of design heuristics for designers that help them to design more persuasive products (or services) that lead to intended behavioral changes.
- Demonstrated that these heuristics can be taught to and will be used by design students.

6.3.1 IMPLICATIONS

The findings and contributions of this dissertation endorse the critical role of design and designers as choice architects in creating behavioral nudges that implicitly influence the everyday decisions of people. Although sustained behavior change is a complex and multi-dimensional process that does not occur overnight, every single behavioral decision can be a small step towards constructing habits. This lays emphasis on the responsibility that designers hold in the society to bring about positive changes through design with intent.

The findings of Part I, set the ground for a new perspective to design for behavior change, providing two different approaches to consider for persuasive design. The findings can guide the designers to consider different aesthetic properties based on the behavior, objectives, users, and all other contextual requirements.

For behaviors that the users do not have enough motivation for and are less personally relevant (such as recycling, using reusable shopping bags or non-disposable plates) or they lack enough ability (attention, knowledge) to think about the persuasive message (e.g. turning off the light when leaving the room), peripheral cues to the behavior might be more effective and result in faster changes. For example qualities such as pleasant texture or novel shape of a coffee mug, or an attractive form of a shopping bag, can motivate people to use them more often (instead of using the undesirable products) and a salient color or sound can prompt the users to turn off the light. On the other hand, for more personally relevant behaviors such as flossing or using sunscreen lotions, a persuasive packaging with a more direct argument and message (e.g. through using metaphors), might be more effective in terms of long-term changes.

However, these two strategies (peripheral and central) are not mutually exclusive and are not really two choices but the end points of a continuum. That is, it isn't an either/or choice, as the two "routes" suggests, and even peripheral processing requires some thoughts (CIOS, accessed 2012). So, it is the designers' responsibility to decide to what extent to incorporate peripheral and central cues into their design, based on various determinants such as the contextual characteristics, target behavior, and design intents and objectives. This approach can be used for other paradigms of behavior change such as public health and other pro-social behaviors.

Part II offers design heuristics that incorporate persuasiveness into design with metaphors. Design heuristics can be integrated with other idea generation techniques as a part of design curricula, as a tool to narrow down the solution space toward design with persuasive intent. These heuristics can be used for other paradigms of behavior change such as public health (disease prevention, health maintenance, diet, smoking cessation, safety, etc.) and pro-social behaviors (anti-littering, donation, etc.), either to design products or services.

6.4 LIMITATIONS

Study 1 (recycling bin) shows that people are more likely to use a green recycling bin, presumably due to its salience against the trashcan and surrounding environment. However, the current studies cannot distinguish whether the mechanism is due to only color salience or mediated by arousal and other psychological factors. In other words, we did not measure or manipulate constructs that would allow us to test the explanations.

Future work will have to nail down the explanation for the observed behavioral differences.

Moreover, we are limited in generalization of the findings because the cultural and environmental factors might influence the perceived salience of objects. For example a green recycling bin is less visible in outdoors with abundant trees or a light switch on patterned wallpaper. In terms of the subject pool, we were also constrained by using marketing students in a university, with a specific age range. Cultural and demographic differences might result in different behavioral outcomes.

With respect to the application of metaphors into persuasive product design, we should consider that in order to understand metaphors, the designer and the user should share specific common experiences and knowledge. Even if the message is understood, in order 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, under time pressure, or not sufficiently aware enough about the topic. For instance, the Christmas tree we used for Study 3 does not have the same implication in a Muslim country or where people are not familiar with the spruce tree and its connection with Christmas. The different and sometimes polarized reactions to the metaphor underline the influence of individual differences, beliefs, and backgrounds on metaphors interpretation and understanding. The interviews with customers, although helpful, were not normally and randomly distributed and were limited to a specific sample (with no kids, no companions, and dine-in customers), so we excluded a large portion of users due to logistics of the experiment. We only interviewed customers who

used napkins, while many people might have not used any because of the influence of the metaphor.

In Study 4, we were constrained to a class of 12-18 undergraduate students that learned three methods and worked on multiple design tasks. In spite of the informative results and feedback we received from the participants, several limitations prevent us from generalization and teasing out the unique contribution of persuasive heuristics such as the small number of participants, task repetition, lack of background and motivation of some students, and the effect of learning through time that we did not have control over. There were some issues due to the low reliability of the coders and we used some remedial methods (a third coder judged on the disagreements and a fourth blind coder was used to validate the ratings of the third coder) to address these concepts.

6.5 FUTURE STEPS

The immediate next steps of this research include:

- Repeating Study 1 (recycling bin and color) with a larger sample size and with random assignment into all three conditions (grey, red, green) to tease out the underlying mechanism of color salience in the context of recycling bins.
- Validation of Study 2 (persuasive heuristics) through individual interviews with design experts and educators with respect to sense making of the content and appropriateness of their names.
- Repeating Study 3 (metaphors) with different customer demographics in terms of education, age, and their geographical location, and see how the design is perceived and whether or not it becomes effective.

- Designing a new study for metaphorical design, and this time add a slogan (e.g. Save a napkin, Save a tree) and observe how it affects the behavioral responses.
- Repeating Study 4 with two separate groups of designers and larger sample size with one common design task and two different ideation methods (heuristics vs. brainstorming), to compare the effect of heuristics.


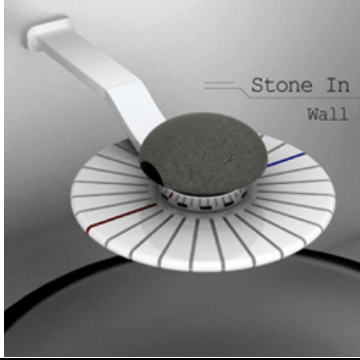


6.6 RESEARCH EXTENSION AND FUTURE DIRECTION





The implications of this research can be extended beyond the sustainable behavior domain and into other paradigms of behavior change in public health (e.g. disease prevention, health maintenance, diet, smoking cessation, safety) and social marketing. Although behavior change phenomena have some common characteristics that are shared among the mentioned behaviors, there might be some particular factors such as personal relevance and importance that distinguish them in terms of using of an appropriate design strategy. Future research can shed light on the transferability of our findings to the mentioned paradigms.





More in-depth research is suggested to explain the link between other visual elements and the desired behavior. Further investigation can address the existing gap between the object's language and the perception of the user.

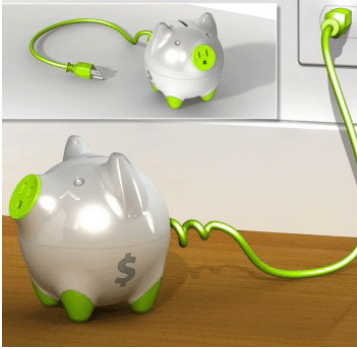

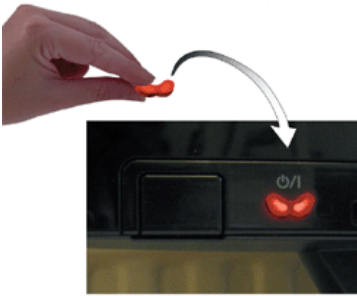

A broader extension of this research could be to explore the link between the design of environmental objects and associated behavior in support of some existing beneficial behaviors (not a change), for example, how we can maintain and support the existing workout and diet habits or enrich the workout experience through aesthetic features.






APPENDIX I: PRODUCT EXAMPLES TO CHANGE BEHAVIOR




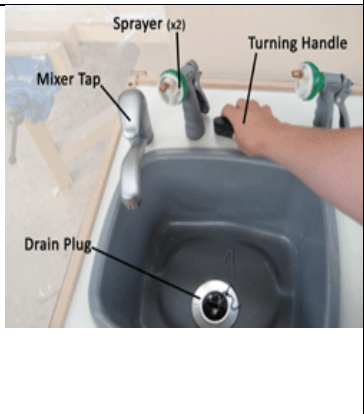
Name	Product image	Behavior/strategy	Description
Green Goose		Behavior: Different desirable behaviors	This product is a technological platform, which uses sensors and accelerometers on stickers or credit cards to track everyday behavior and record it online.
		Strategy: Feedback Making the behavior fun	
Stone in the creek		Behavior: Water conservation	It is a sink mixer that makes use of natural stone in order to control water flow and limit consumption.
		Strategy: Technological intervention	
Water pebble		Behavior: Water Conservation	It is an electronic pebble that monitors water usage during showering by showing a green, amber, or red light depending on showering time.
		Strategy: Eco-feedback	
Spark Lamp		Behavior: Electricity Conservation	A lamp that charges with sunlight and when turned on in the evening, flickers green, yellow or red depending on the energy use during the month compared to the goal energy use of the month.
		Strategy: Eco-feedback	




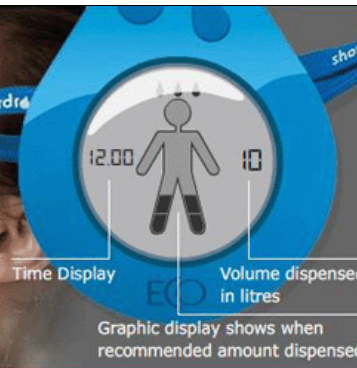
<p>Nokia Zero Waste Chargers</p>		<p>Behavior: Energy conservation</p>	<p>This product has three designs all aimed to reduce wasted energy while charging a phone: push a button to charge, have a hour limit charging time, or interact with the device being charged and only charge when needed.</p>
<p>Strategy: Scripting</p>			
<p>Our Energy Information (OEI)</p>		<p>Behavior: Observe energy consumption</p>	<p>This is an interactive touch screen light switch that rates you on your energy consumption using a low-energy colorful and animated display.</p>
<p>Strategy: Make energy consumption interesting, and understandable.</p>			
<p>Count on It</p>		<p>Behavior: reduce unnecessary food waste</p>	<p>Labels that have scratch of numbers that enable users to mark the date the product was first opened, stored or frozen and then judge whether the food is fresh, safe to eat, or should be thrown away.</p>
<p>Strategy: scripting</p>			
<p>Rocco: the Energy Pal</p>		<p>Behavior: Teach children about energy generation and conservation</p>	<p>This is a toy rocking horse which teaches children about energy generation and conservation by converting kinetic energy created through movement on the horse into energy.</p>
<p>Strategy: Uses visual eco-information</p>			





Pavegen		<p>Behavior:</p> <p>Strategy: Harvest energy from everyday pedestrian walking.</p>	Pavegen is a paving slab that lights up when kinetic energy in high footfall environments is converted to electricity.
Power Conscience		<p>Behavior: Electricity conservation</p>	An electricity monitoring device that shows the user real-time data about their energy usage and calculates their current electric bill.
		<p>Strategy: Eco-feedback, use of metaphors</p>	
Surestop		<p>Behavior: Water conservation</p>	This remote water switch connects to directly to the water supply alongside the existing stop cock, enabling consumers to turn on and off the water supply with ease.
		<p>Strategy: Scripting</p>	
Blink		<p>Behavior: Energy conservation</p>	A product with an infrared photocell which reacts with natural sunlight to turn the device off and on to stop energy consumption when unnecessary.
		<p>Strategy: Technological intervention</p>	





<p>Power-hog</p>		<p>Behavior: Teach children the value of energy.</p> <p>Strategy: Make energy usage a reward system, make the behavior fun</p>	<p>A power consumption metering piggy bank designed to sensitize kids to energy cost associated with running electronics devices.</p>
<p>Vampire Plug</p>		<p>Behavior: Electricity conservation</p> <p>Strategy: Scripting</p>	<p>This product is a mechanical timer power override switch designed to reduce unnecessary power consumption by reducing the time products are kept charging.</p>
<p>Standby Monsters</p>		<p>Behavior: Energy conservation</p> <p>Strategy: Evoke an emotional response</p>	<p>These are packs of small, sticky-backed lenses with a reflective internal surface that are designed to be stuck over the standby lights on gadgets at home - turning them into little pairs of glowing red eyes.</p>
<p>Flower pod</p>		<p>Behavior: Electricity conservation</p> <p>Strategy: Eco-feedback, use of metaphors</p>	<p>This product has a semi-transparent screen that displays a flower blooming, growing, or wilting depending on the household's energy usage.</p>





Wilting Flower		Behavior: Create more sustainable behaviors and energy conservation	A design that changes colors and shape according to the energy usage- blue and straight for low energy usage, red and closing petals for high energy usage, and purple and wilted for sustained energy usage.
		Strategy: Eco-feedback, use of metaphors	
Fiat Eco-drive		Behavior: Create eco-friendly driving habits	This is a computer application that helps the consumer improve the efficiency of driving by using less fuel, reducing CO2 emissions and saving money.
		Strategy: Financial incentives	
Bug plug		Behavior: Conserve electricity	This is an energy saving gadget with a built-in motion detector that turns off all connected devices when no motion is detected.
		Strategy: Technological Intervention	
Abisko Washbasin		Behavior: Natural resource conservation	This washbasin design resembles the waterfalls of Swedish National Park Abisko to remind consumers of the importance of natural resources and to limit their water usage.
		Strategy: Scripting	
'Greeny' Energy Meter		Behavior: Energy conservation	This meter displays the energy usage of a range of products through the screen also through LED lights that inform users of their energy usage.
		Strategy: Eco-feedback	





Every Drop Shower Saver		Behavior: Water conservation	This is a paddle-like device that fits onto the stem of the shower which allows the user to flip the paddle in one action to stop the water flow while keeping the same temperature and water pressure when turned back on.
Onzo's Smart Energy Kit		Behavior: Energy Conservation	This is a energy management tool that has a sensor, display and integrated website that give users real-time information about their energy usage.
Intergrated Toilet and Sink		Behavior: Water conservation	This two in one design uses clean water for the sink to wash hands and then, the dirty water from the sink fills in the toilet basin to be used during flushing.
Water Saving System		Behavior: Recycling water	This kitchen sink is suitable for small living environments uses water from the heavy mist sprayers used to pre-rinse dirty dishes, then filters and stores that water to be reused for the pre-rinse stage of the next wash.

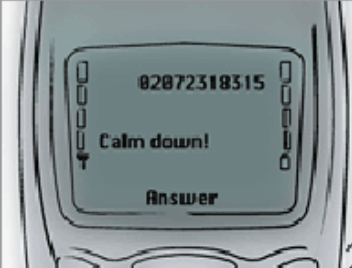


<p>Water and Energy Saving Tap</p>		<p>Behavior: Water and electricity conservation</p>	<p>This tap is designed to make users aware of their electricity usage due to hot water.</p>
		<p>Strategy: Eco-feedback</p>	
<p>Tap Meter</p>		<p>Behavior: Water conservation</p>	<p>This tap displays the amount of water used every time the tap is turned on</p>
		<p>Strategy: Eco-feedback</p>	
<p>Expandable Sink Concept</p>		<p>Behavior: Water conservation</p>	<p>This sink has a smart tap to regulate flow, an expandable basin, and a unique reverse osmosis filtering systems that helps recycle water.</p>
		<p>Strategy: Technological intervention</p>	
<p>Eco-showerd rop</p>		<p>Behavior: Water conservation</p>	<p>This device lets users know how much water they are using and notifies them when the recommended amount of water has been reached.</p>
		<p>Strategy: Eco-feedback</p>	


<p>Puzzle Match</p>		<p>Behavior: Electricity conservation</p>	<p>This light switch has a unique pattern that draws people to turn it off by playing with people's natural desire for order.</p>
		<p>Strategy: Fun theory</p>	
<p>Squirt</p>		<p>Behavior: Water conservation</p>	<p>This tap built with a water usage meter is a child-based interactive tap designed for kids between the age of 3-6 to teach them about water conservation.</p>
		<p>Strategy: Fun theory</p>	
<p>Eco Button</p>		<p>Behavior: Electricity conservation</p>	<p>This button attaches to a computer and can be pushed whenever the user leaves to put the computer into an "ecomode" that saves electricity and also records how many units of carbon, power and money the user has saved.</p>
		<p>Strategy: Technological intervention</p>	
<p>Domestic Water Meter</p>		<p>Behavior: Water conservation</p>	<p>This design attaches to a tap or shower head and displays water consumption using an internal turbine to make user aware of their water habits.</p>
		<p>Strategy: Eco-feedback</p>	





<p>Viridian Light Switch</p>		<p>Behavior: Educate user about energy conservation</p>	<p>This interactive switch stays lit when hit to turn on lights, and a glowing fingerprint slowly fades on the switch after energy usage.</p>
		<p>Strategy: Eco-feedback, scripting</p>	
<p>Inflatable Two-person Pillow</p>		<p>Behavior: Change selfish behavior</p>	<p>This pillow works to teach people values of sharing by needing two people to use the pillow for it to be comfortable, if one person uses it the air will be pushed to one side making for no support.</p>
		<p>Strategy: scripting</p>	
<p>Building Dashboard</p>		<p>Behavior: Water, electricity and natural gas conservation.</p>	<p>This interactive web based design provides water, electricity, natural gas, rainwater use, grey water and solar electricity consumption feedback to a building, informing the users of their resource use.</p>
		<p>Strategy: Eco-feedback</p>	
<p>Nissan's Eco Pedal</p>		<p>Behavior: Fuel-efficiency</p>	<p>This pedal is equipped with a counter push-control mechanism so that when the user applies to much pressure and uses more fuel, the counter push-control notifies them of the excess fuel use.</p>
		<p>Strategy: Eco-feedback</p>	




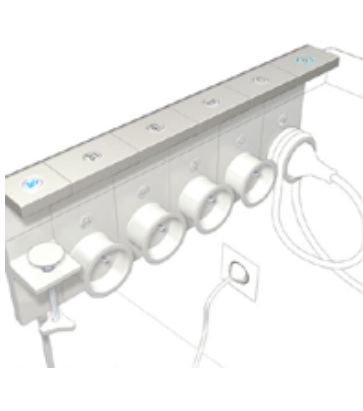
<p>Power Aware Cord</p>		<p>Behavior: Electricity conservation</p>	<p>This is an electrical power strip in which the cord lights up and shows a visual of the electricity being used.</p>
<p>Eyes off Road Time</p>		<p>Behavior: Talking on cell-phone in public</p>	<p>This phone provides visual feedback and is equipped with technologies to help the user avoid running to people while using their phones.</p>
<p>Kill a watt</p>		<p>Behavior: Electricity conservation</p>	<p>This device can be plugged into appliances to display the consumption measurement by Kilo watt-hour so that the user becomes aware of the consumption and also is able to calculate the cost by day, week, month and year.</p>
<p>Home Monitoring Display</p>		<p>Behavior: Energy conservation</p>	<p>This interactive design lets the user know how much an appliance or machine in the house is using up energy.</p>

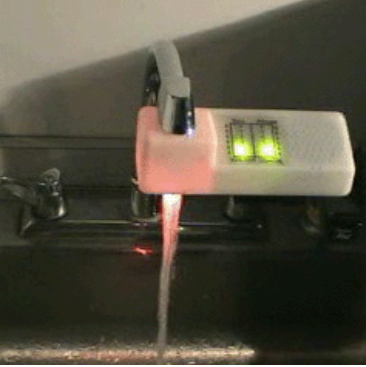



<p>Ambient persuasive Tea Cup</p>		<p>Behavior: Global warming awareness</p>	<p>This cup has a heat sensitive second layer so that when cup is formed with warm liquids, the graphics on the mug change to a melted ice burg.</p>
<p>Electric Shock Mobile</p>		<p>Behavior: Make phone usage less disruptive</p>	<p>This mobile phone attempts to stop people who persistently talk loudly by administering a shock depending on the user's and the other person's voice loudness on the other end of the line.</p>
<p>Rush'ower</p>		<p>Behavior: Water conservation</p>	<p>The curtain has heat sensitive ink so that when warm water has been used over it for too long a message displays telling users to be aware of their water usage.</p>
<p>Musical Mobile</p>		<p>Behavior: Make phone usage less disruptive</p>	<p>To encourage people not to make unnecessary call in public, this design requires that the user plays the tune of the phone number s/he wished to call.</p>
<p></p>	<p></p>	<p>Strategy: Scripting</p>	<p></p>





<p>Intellegent Mobile phone</p>		<p>Behavior: Make phone usage less disruptive</p>	<p>This phone reprimands user behavior by ‘shouting back’ and scrambling messages and caller ID’s if the user is talking to loudly or using the phone unnecessarily in public places</p>
		<p>Strategy:</p>	
<p>Prototype Kettle</p>		<p>Behavior: Energy conservation and energy awareness</p>	<p>This kettle encourages users to make more informed decisions about energy usage by allowing the user to “book a time” for the appliance to run and informing the user of the short-term predicted power usage.</p>
		<p>Strategy: Use ambient pleasing displays rather than hard facts and complex graphs</p>	
<p>Disappearing Pattern-Tiles</p>		<p>Behavior: Water and energy conservation</p>	<p>These tiles contain heat-sensitive thermo-chromic ink that disappear when exposed to prolonged heat such as the heat from a hot shower.</p>
		<p>Strategy: Eco-feedback</p>	

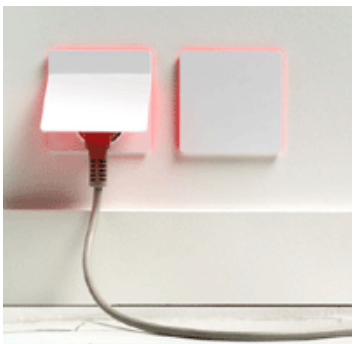



<p>Energy lock, and Power saver</p>		<p>Behavior: Electricity conservation and awareness</p>	<p>This electronic device gives the user feedback on their energy consumption, contains a switch that can be flipped by the user to deactivate all unnecessary devices while the house is vacant, and keeps track of all the electronic devices in the home wirelessly.</p>
		<p>Strategy: Eco-feedback</p>	





Four Point Squeeze		Behavior: Make phone usage less disruptive	This phone contains four pressure points that must all must be pressed to keep a connection on the phone, the pressure points are situated so that one hand has to cover the mouth which will aid in keeping the user voice volume down.
		Strategy: Scripting	
Jawbone		Behavior: Make phone usage less disruptive	This headset is equipped with technology that can gather information about the user's acoustic environment; it can detect user speech patterns, and can subtract excess noise making for clear communication which reduces the need to shout over the phone.
		Strategy: Technological Intervention	
Power Point		Behavior: Water conservation	This sink basin is made of soap, so that the more water is used during washes, the more the soap disintegrates resembling erosion of land.
		Strategy: Metaphors	
Power Point		Behavior: Electricity awareness and conservation	Each power socket displays the power usage at any given time through a clear, simple visible screen to show users their electricity consumption when using various products.
		Strategy: Eco-feedback	

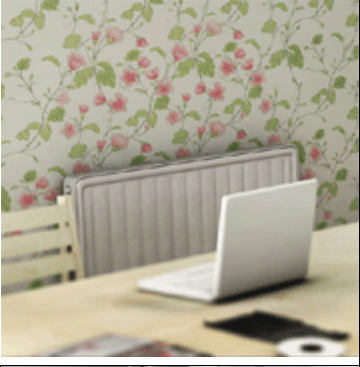



Thermo colour iron		<p>Behavior: Clothing waster reduction</p>	<p>This iron provides feedback by displaying a color through LED lights in the water tank, depending on the temperature of the iron to remind users which temperature level should go with which fabric.</p>
Catapult Mobile		<p>Behavior: Make phone usage less disruptive</p>	<p>This mobile design gives the user the ability to disrupt other peoples phone calls if they are being loud or annoying by firing sounds into the other person phone to interrupt and disturb their call.</p>
Flower Lamp		<p>Behavior: Electricity conservation</p>	<p>The shape of this lamp changes according to how much energy is being used; if too much energy is being used then the lamp closes and if it is at normal energy usage, the petals open up and form a flower.</p>
Energy Saving Adapter		<p>Behavior: Electricity conservation</p>	<p>This device contains a central that monitors the electricity consumption of each device plugged in, when the device goes into standby a light flashes giving the user 3 minutes to get the device or the central hub automatically shuts of the power supply.</p>
		<p>Strategy: Eco-feedback and automatic shut down</p>	

Water bot		<p>Behavior: Water conservation</p>	<p>This device hooks on to a tap and uses visual and auditory reminders to encourage the user to turn off the tap when water is not needed.</p>
		<p>Strategy: Eco-feedback</p>	
Paper Towel Dispenser		<p>Behavior: Paper conservation</p>	<p>This unique napkin dispenser has a cut out of South America with a green transparency paper covering the cut-out to make the paper towels appear green and resemble the diminishing “greenness” of South America.</p>
		<p>Strategy: Eco-feedback</p>	
Knocking Mobile		<p>Behavior: Make phone usage less disruptive</p>	<p>By the level of knocking on the phone, the user can tell if the call is urgent or normal and then decide to answer the call.</p>
		<p>Strategy: Scripting</p>	
Tyranny of the Plug		<p>Behavior: Electricity conservation</p>	<p>These appliances do not need to be inserted to electrical outlet to be used, but, instead need manpower to make the appliance work.</p>
		<p>Strategy: Forced functionality</p>	

Kambrook “axis” kettle		Behavior: Energy and water conservation	This design features a temperature gauge to indicate the suitability of water for making tea or coffee, a clearer volume indicator located at the top of the kettle, and an insulate double layer wall for heat loss protection.
Home Joule		Behavior: Electricity Conservation	The device provides real-time feedback on energy consumption and cost by displaying the price per kilowatt in numbers, graphs, and color information to the user.
Speaking Mobile		Behavior: Make phone usage less disruptive	A mobile device that allows you to communicate without speaking by pushing buttons with pre-assigned sounds.
Energy Tree		Behavior: Recycling and electricity conservation	This interactive device allows users to see their household energy and recycling practices by collecting information from electrical sockets and devices plugged in and displayed on the monitor screen, the more energy contentious the user is, the better the tree’s health.

Nootan		Behavior: Electricity conservation	This design consists of electrical sockets, switches and plinths that display a color depending on the amount of energy use.
		Strategy: Eco-Feedback	
Electrical Semaphore		Behavior: Electricity conservation	This design lights in color depending on the energy consumption, in off-peak times it is green, during energy use it is blue, and in peak times it is orange.
		Strategy: Eco-Feedback	
Sahara Eco Shower		Behavior: throwing the garbage out	Making the sound of an object falling on a deep well.
		Strategy: Making the behavior Fun	
Work You Phone		Behavior: Decrease dependency on electronic devices	This mobile device requires the user to be active and make hand gestures, quick movements or breathing to use the phone.
		Strategy: Technological intervention, scripting	

Wattson		Behavior: Electricity conservation	Using visual information in the form of numbers and colors, the device notifies the user of their energy consumption.
		Strategy: Eco-Feedback	
Piano Stairs		Behavior: Using stairs	Using visual information in the form of numbers and colors, the device notifies the user of their energy consumption.
		Strategy: Making the behavior Fun	
Power Peg		Behavior: Electricity conservation	This device automatically turns off and cuts off power supply to anything plugged into it that is already charged.
		Strategy: Technological intervention	
Ice Cream or Ice Caps		Behavior: Promote environmental consciousness	These ice cream containers contain a visual narrative comparing consuming the Ice Caps with consuming goods to create awareness and foster discussion.
		Strategy: metaphor	

Heat Sensitive Wallpaper		Behavior: energy consumption	This wallpaper changes in visual appearance showing blossoms and leaves when the radiator is turned on and just leaves when the radiator is turned off.
		Strategy: Eco-Feedback	
Hughie Sink		Behavior: Recycling and water conservation	This is a water saving device that fits over the sink so that water used for washing hand or vegetables can get collected in this been and be reused later.
		Strategy: Scripting	
Faucet Buddy		Behavior: Water conservation	This device fits over the exiting tap and provides information on the temperature of the water and the amount of water being used.
		Strategy: Eco- feedback	
Show-me shower head		Behavior: Water conservation	show-me stands for shower water meter. It is a device that measures the amount of water that is being used during a shower. Each LED lights up for every 5 liters of water used.
		Strategy: Eco- feedback	

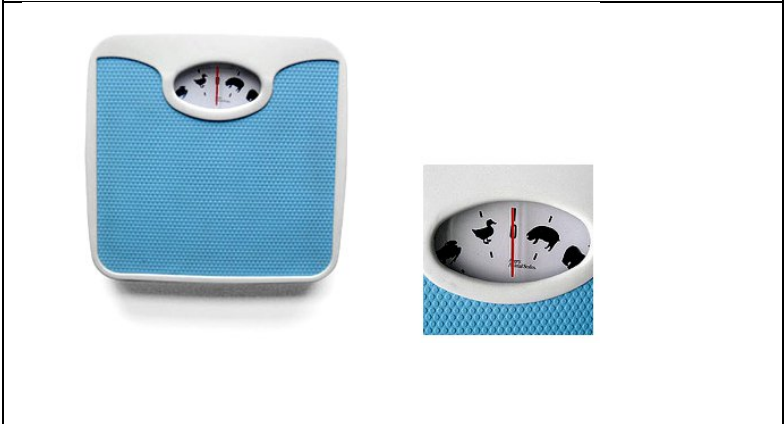
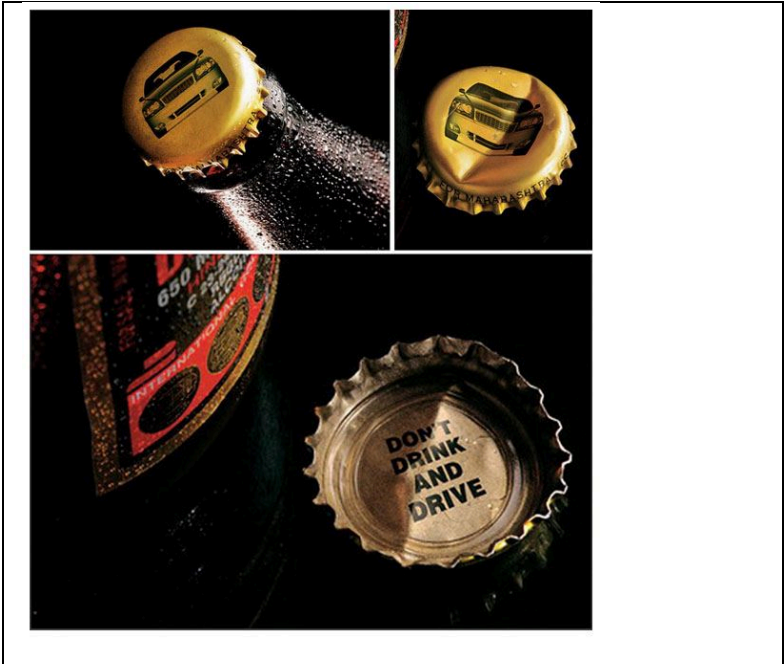
Smart Gauge		Behavior: Fuel conservation	show-me stands for shower water meter. It is a device that measures the amount of water that is being used during a shower. Each LED lights up for every 5 liters of water used.
		Strategy: eco-feedback(implicit), metaphor	
Pyramid cigarette receptacle		Behavior: Not to leave trash on the surface	The pyramid shaped cigarette bin keeps waste from being placed on the top.
		Strategy: Scripting (slanty design)	
Cone cups		Behavior: Leaving the cups on the surfaces	
		Strategy: Scripting (slanty design)	
Sloan flush		Behavior: water conservation	Dual-function toilet flush offers two flush modes: a low water flush for disposing of liquid waste only, and a higher volume flush for dealing with solid waste
		Strategy: Eco-feedback, scripting	
		Behavior: water conservation	
		Strategy: Eco-feedback, scripting	

APPENDIX II: DESIGNS ANALYZED IN STUDY 2









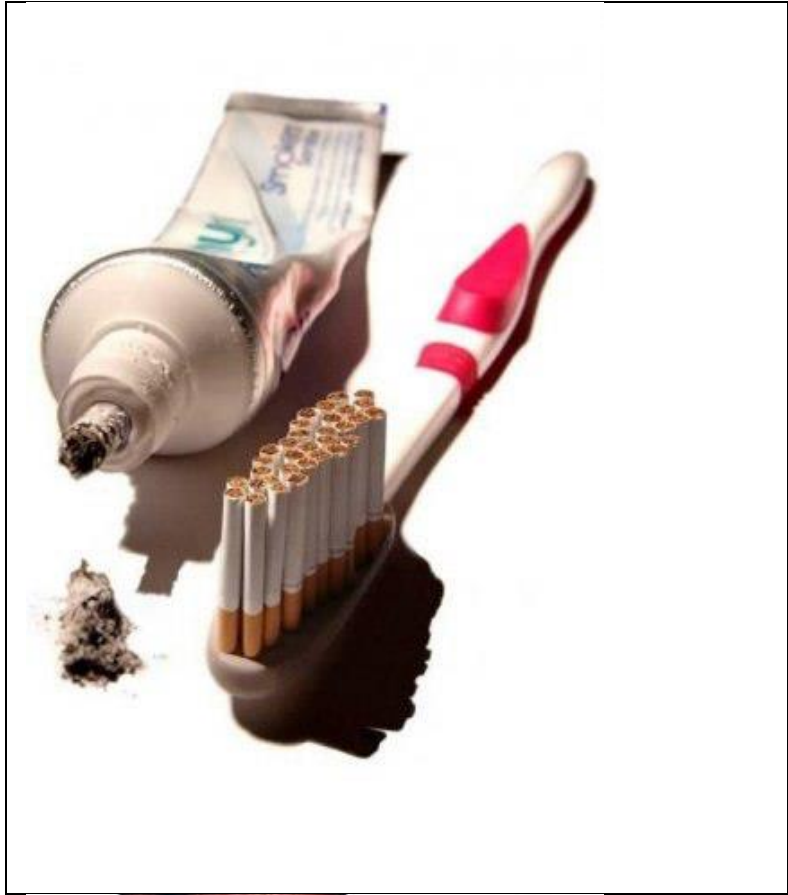




Clips & Visuals At Air Zoo
 National Museum on the lawn
 National Avenue
 City of Chicago, Illinois
 Agency: Team USA, New York

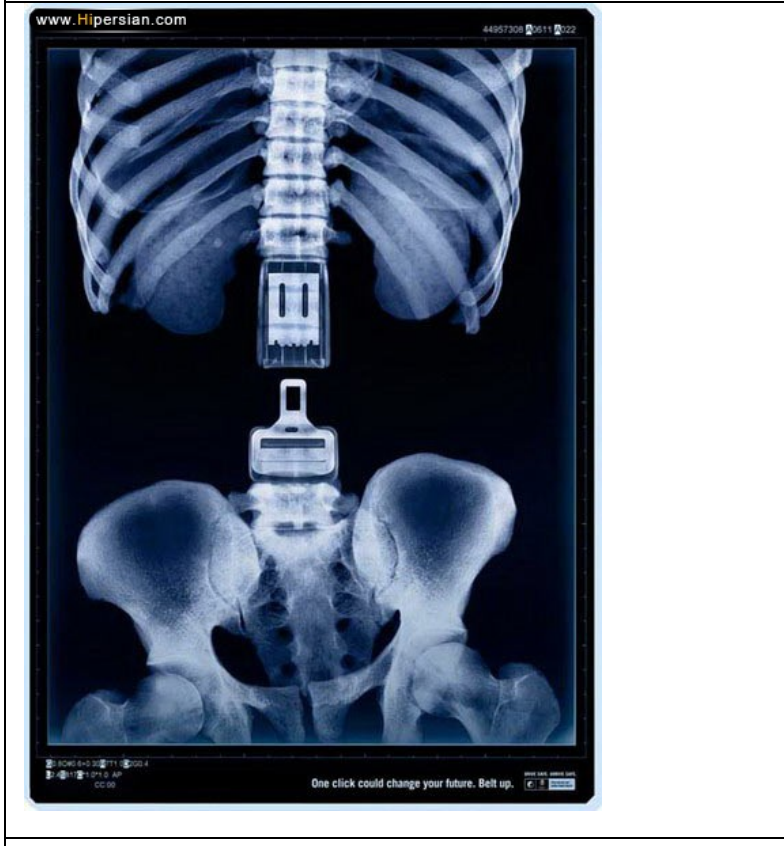
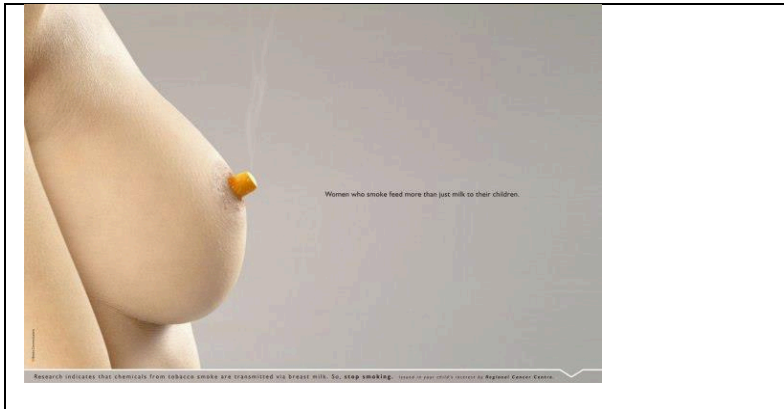
On the occasion of World Water Day
 (22 March), we came up with this idea to
 make the problem right at the source. We
 created a picture (shown in the picture) to
 persuade people not to waste the water.
 Whenever someone comes to use the tap,
 he/she can witness a whole new scene
 if the world's water resources dried up.



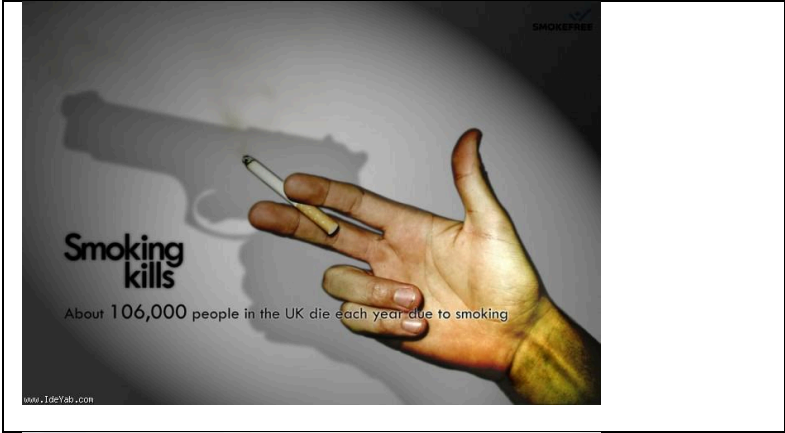


If you won't
give up smoking
maybe you'll
do it for

Did you know that there's
a valve in your penis that
traps the blood inside so
you can get an erection?
That every time you smoke,
this valve is damaged?
That if you don't quit now,
it might stop working
altogether? You do now.
Text HARD to 84198
for a free information pack.









APPENDIX III: INTERVIEW QUESTIONNAIRE, STUDY 3

Washington Plymouth

Time:

Day:

Subject #:

Intro script: Hi, I am a student at UofM working on a research about design and user experience with products. Would you be willing to let me ask you a few questions about your experience in the coffee shop? It shouldn't be more than 5 minutes.

(Please ask them if you can go to a reserved table for the interview. If they are not willing to, try to sit in a way that they are back to the napkin dispenser. If it is not still possible, please indicate here as NP):

Thanks for your time and interest to participate in this interview. Please note that there are no right or wrong answers to these questions. I'm just interested in your opinions and thoughts. For documentation purposes and in case I miss something in my notes, I'm using an audio recorder. Are you comfortable using the audio recorder?

I start with some general demographic questions and will read the answers for you

May I ask your age range? Are you under 20 20-30 30-40 40-50 over 50

What is your highest education level? High school/Some college Bachelor degree
 Graduate degree

Now, I'm going to ask some questions about your coffee shop experience:

- How often do you come to this coffee shop? (this location of SW) On a weekly basis? Everyday? How many times per week or per month?
- How do you usually come here? Alone? With friends? In a group?
- For what purpose do you usually come to this coffee shop? (*open ended, just check boxes as they are responding*)
 - Study Late night hang out
 - Meeting Grab a coffee to go
 - Gatherings Dine in coffee other....

Now I'm going to ask you some questions about the napkin dispenser in the coffee shop.

- [Without looking back at the napkin dispenser], can you describe to me what the napkin dispenser looked like?
- [*If applicable*] How did you feel about what you saw? What are your thoughts about it?
- [*If applicable*] I noticed you took some napkins. Was there anything different about this napkin dispenser and ones you normally see here or in other coffee shops? please explain.

Washington Plymouth

Time:

Day:

Subject #:

- *[If they remember the napkin dispenser],* What message would you think the napkin dispenser is trying to convey?
- Did you notice any change in the amount of napkins you used compared to the usual amount?
- *(if the person did not take any, say “ for example, do you think it encouraged you not to take any napkins?”)*

Product evaluation and feedback:

- This napkin dispenser tries to encourage you to take fewer napkins and think about how many you really need by associating it to a tree’s life. To what extent do you think the designer has been successful in conveying this message?
- In your mind as a user, what other things could be changed in this design to better convey this message to the user?

Now, I’m going to ask you some questions about your daily habits (read the answers aloud):

- How often do you recycle? Never when convenient most of the times always
- How much do you care about energy conservation:
 not at all a little bit to some extent I care I care a lot
- Are you concerned about the environmental issues?
 not at all a little bit to some extent I am concerned I concern a lot
- On average, how many napkins do you typically use at a coffee shop?

Follow up:

- We might have one follow up question about what we talked about today. Are you willing to give us your email address or phone number to contact you?


APPENDIX IV: CONCEPT SHEET, STUDY 4

Concept Generation Sheet Design Activity 1-B

Name: _____

Concept # _____

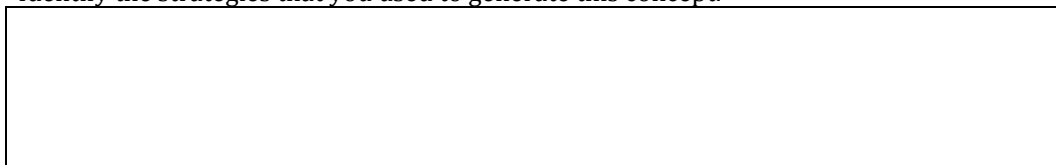
Concept Drawing: Sketch your concept in the box below.



Concept Description: Describe the concept. How does it work? What are the features, mechanisms, and details?



Identify the strategies that you used to generate this concept.



APPENDIX V: CODING SCHEME, STUDY 4

Task # 1: Design a light switch for a household that encourages people to turn off the light when leaving the room

Please code all the concepts in one sheet.

In the coding sheet, please first enter the concept code (at the bottom of each page) as x-A-0xx.

Look at the concept (top box) and try to make sense of the design. Then look at the box in the middle of the page and read the description of the concept.

Now look at the excel sheet and rate the concept based on your overall understanding on the following dimensions. Please note that you should be able to use the whole range of rating (1-7 or 1-5) across all the concepts. This type of scaling is called **Likert Scale**.

- 1- **Creativity**: on a scale of 1 (not creative at all) to 7 (very creative), how creative each idea is. You do not need to spend a lot of time thinking about your judgment. Try to go with your first impression.
Creative (oxford dictionary): relating to or involving the use of the imagination or original ideas to create something
Creativity (dictionary.com): the ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc.; originality
- 2- **Novelty**: On a scale of 1 (not novel at all) to 7(very novel), how novel this concept is?
Novel: something new or unusual (you have not heard of before), original or striking especially in conception or style
- 3- **Persuasiveness**: On a scale of 1(not persuasive) 5 (very persuasive), how persuasive (convincing) do you think this product is (for turning the light off)?
- 4- **Effectiveness**: On a scale of 1 (not effective) to 5(very effective) how effective this light switch is for turning the light off? (how likely you are to turn the light off if using this light switch)?
- 5- **User involvement**: does the user turn the light off? Does the actual behavior happen? (No=0, Yes=1)
- 6- **Metaphors**: has the designer used any (relevant) metaphors? Relevant means a metaphor which makes sense and points to the desired behavior (energy consumption, conservation, eco-friendliness). (No=0, Yes=1)
- 7- (By just looking at the concept), which of the following heuristics are identifiable? (mark all that apply) 1=yes
1: conveying a message, 2:Using a slogan, 3: creating a reward/punishment feeling, 4: exaggeration, 5: showing the final impact (of behavior), 6: the product responds to the behavior (interactive), 7: The behavior changes the design in some way.
- 8- (By reading the descriptions in the bottom box), which of the above heuristics are reported? Yes=1
- 9- Which of the following features/strategies apply to the concept? (choose all that apply)

Humor/Fun: making the behavior funnier to do

Technological Enforcement: use of technology/sensors to substitute the behavior (turning the light off)

Financial Incentives: encouraging people through financial incentives (paying rewards)

Salience: making the behavior/light switch more salient (visible/ noticeable) by making it bigger, shinier, flashy, colorful, sending alerts, etc.

Use of text: if the light switch encourages the user to turn the light off by a text message

Physical enforcement: forcing people to turn the light off by causing problems (punishment) in the flow of their life (slamming, kicking, siren, etc.)

Ease of use: making the behavior (turning the light off) much easier to do

Eco-feedback: giving the users information about their behavior and/or its consequences

Inspired by nature: if the design inspired by any natural element (tree, earth, etc.)

Note:

The quality of the sketches is not important in assessing creativity of a concept.

Technical goodness, concept elaboration, and feasibility do not count in creativity assessment.

APPENDIX VI: POST ACTIVITY QUESTIONNAIRE, STUDY 4

Questionnaire Design Activity 1-A

Dear Participant:

This questionnaire is designed to understand the deeper levels of your thoughts during idea generation phase. Please answer the following questions based on your recent design activity experience.

Name:

Age:

Gender:

Major:

- 1- What year are you in school?
- 2- Do you have a background / experience in product design?
- 3- Have you designed or thought about designing the product you just design, before today?
- 4- Did you use any specific technique or strategy for idea generation?
- 5- Did you use an existing product as a starting point for your design? Please explain.
- 6- Did you get any inspiration from the work(s) of another designer? Please explain.
- 7- On a scale of 1-7 how challenging did you find the task?
1 2 3 4 5 6 7
Not challenging at all neutral very challenging
- 8- What were the challenges you faced during the design process?
- 9- How helpful was brainstorming to you in generating ideas for your design problem? Please explain.
- 10- On a scale from 1 to 7, how creative do you feel that your ideas are? Circle one.
1 2 3 4 5 6 7
Not creative at all neutral very creative

Design Activity 2-A

Dear Participant:

This questionnaire is designed to understand the deeper levels of your thoughts during idea generation phase. Please answer the following questions based on your recent design activity experience.

Name (Initial):

Age:

Gender:

Major:

- 1- Did you use any specific technique or strategy for idea generation?
- 2- Did you use an existing product as a starting point for your design? Please explain.
- 3- Did you get any inspiration from the work(s) of another designer? Please explain.
- 4- Did you use metaphors in your design concepts? Please explain:
- 5- On a scale of 1-7 how challenging did you find using the metaphors in the context of your design task?

1	2	3	4	5	6	7
Not challenging at all			neutral			very challenging
- 6- What were the challenges you faced during the design process?
- 7- How helpful was using metaphors to you in generating ideas for your design problem? Please explain:
- 8- On a scale from 1 to 7, how creative do you feel that your ideas are? Circle one.

1	2	3	4	5	6	7
Not creative at all			neutral			very creative
- 9- How different do you find your ideas using metaphors comparing to the last time you used brainstorming?

Design Activity 3A

Dear Participant:

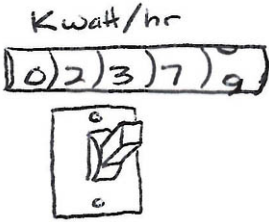
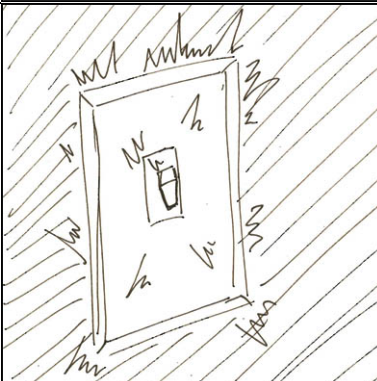
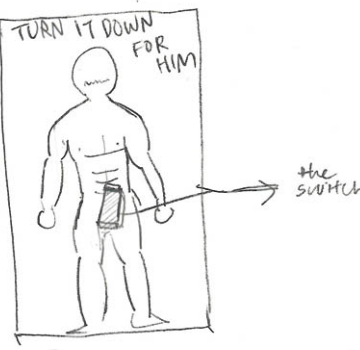

This questionnaire is designed to understand the deeper levels of your thoughts during idea generation phase. Please answer the following questions based on your recent design activity experience.

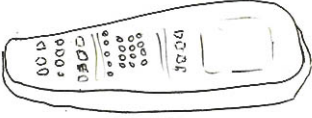
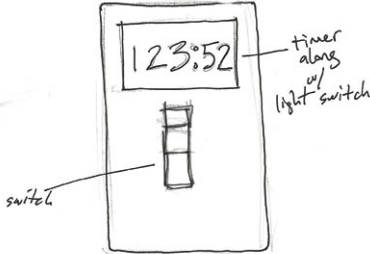
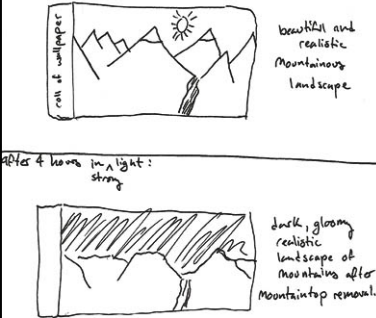
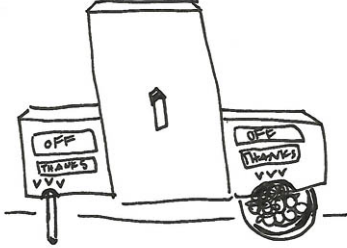
Name:.....

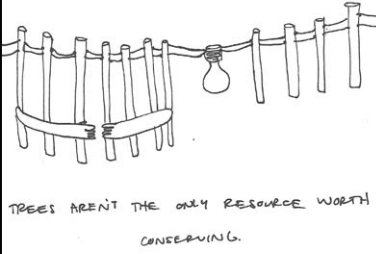
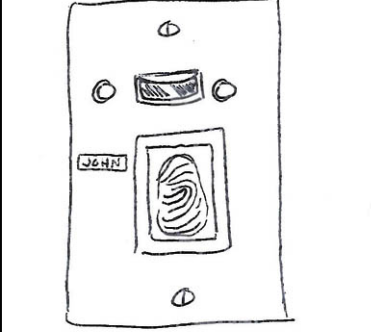
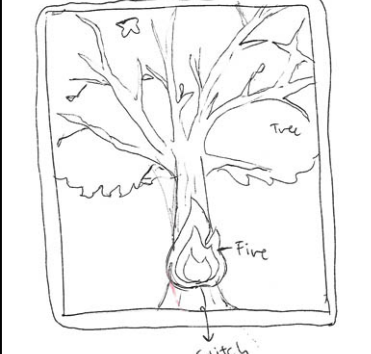
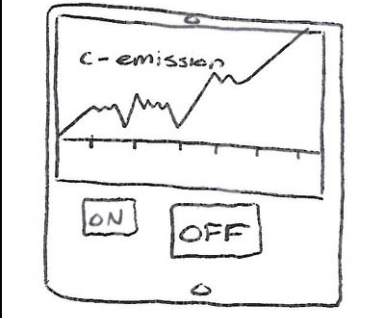
- 1- Did you use any specific technique or strategy for idea generation?
- 2- Did you use an existing product as a starting point for your design? Please explain.
- 3- Did you get any inspiration from the work(s) of another designer? Please explain.
- 4- Did you use metaphors in your design concepts? Please explain:
- 5- Did you use Persuasive Metaphor Heuristics to generate ideas? Please explain:
- 6- On a scale of 1-7 how challenging did you find using the Metaphor Heuristics in the context of your design task?
1 2 3 4 5 6 7
Not challenging at all neutral very challenging
- 7- What were the challenges you faced during the design process?
- 8- How helpful was using metaphors to you in generating ideas for your design problem? Please explain:
- 9- On a scale from 1 to 7, how creative do you feel that your ideas are? Circle one.
1 2 3 4 5 6 7
Not creative at all neutral very creative
- 10-How different do you find your ideas using Persuasive Metaphor Heuristics comparing to the last time you used metaphors without any specific strategy and guideline?

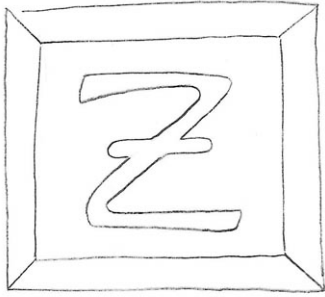
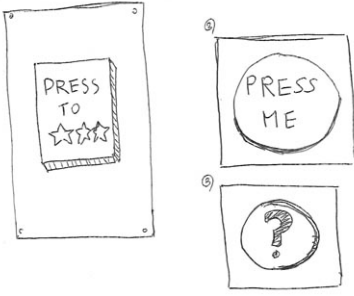
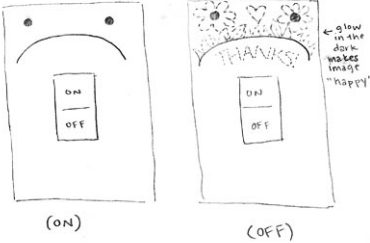
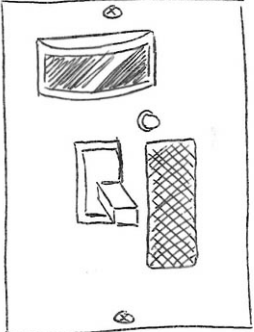
Please explain what your thoughts looked like, how you felt about your design activity and your own ideas.

APPENDIX VII: EXAMPLES OF CONCEPT EVALUATION, STUDY 4

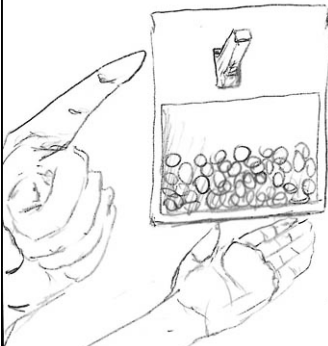
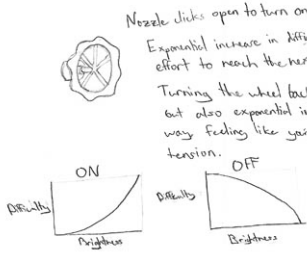
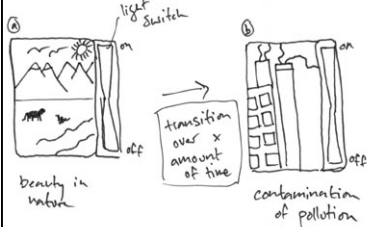
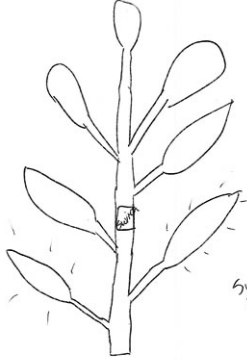
Light Switch Creativity			
3-A-042		Shows immediate energy usage to inform the user on energy consumption.	Creativity Low
1-A-006		A light switch that glows in the dark.	Creativity Low
3-A-46		I light switch that turns on/off representing a male body.	Creativity High
2-A-026		When the light switch is being turned on, fire is displayed, but when t is switched off, a tree is displayed.	Creativity High

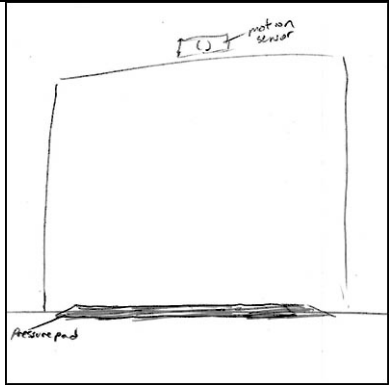

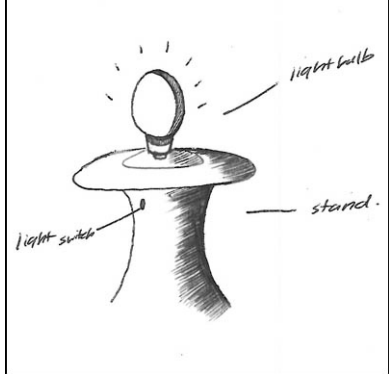

Light Switch Novelty			
1-A-033		A device that resembles a TV remote, cell phone, and game controller that can access the lighting in the room.	Novelty Low
1-A-019		A light switch that counts the time the lights has been on.	Novelty Low
3-A-062		Photosensitive material that changes the design from a beautiful landscape to a barren one with extended exposure to strong light.	Novelty High
1-A-012		A dispenser that dispenses candy, cigarettes, or candy cigarettes when the light it turned off.	Novelty High

Light Switch Persuasiveness			
3-A-043	 <p>TREES AREN'T THE ONLY RESOURCE WORTH CONSERVING.</p>	Visual metaphor of tree hugging to remind users of environment.	Persuasiveness Low
1-A-045		A pre-programmed finger print scanner that turns on/off a light depending on whether all the users have scanned in and left the room/	Persuasiveness Low
3-A-024		When the light is switched on, the tree turns red, but when the light is switched off, it turns green.	Persuasiveness High
3-A-041		Display the c-emissions over the last 100 years and predicts future c-emission depending on your usage.	Persuasiveness High

Light Switch Effectiveness			
2-A-022		A backlit "Z" button that is green when lights are on and pulses blue when lights are off.	Effectiveness Low
1-A-051		Light switches in the form of buttons that trigger curiosity in the user.	Effectiveness Low
3-A-024		Evokes feelings of guilt/satisfaction when the lights are turned off or on.	Effectiveness High
1-A-043		The motion sensor at the top detects movement in the room, when no motion is detected anymore the light flashes red and an alarm sounds.	Effectiveness High

Light Switch User Involvement			
1-A-003		A button that is built into the knob so when the user enters or leaves by turning the knob, the lights are turned on/off.	User Involvement Low
1-A-040		When the user enters/exits the room, the footsteps trigger the light to turn on or off depending on the direction of traveling.	User Involvement Low
3-A-002		A light switch that charges money on your card every time the user swipes it to turn on light.	User Involvement High
1-A-001		When the door is pushed with two hands, the lights are turned off.	User Involvement High

Light Switch Metaphor			
3-A-038		Candy dispenser that dispense candy when the lights are switched off.	No- Metaphor
3-A-23	<p>Nozzle clicks open to turn on light. Exponential increase in difficulty/effort to reach the next click. Turning the wheel back is easy but also exponential in another way feeling like gas releasing tension.</p> 	A nozzle that gets more difficult to spin to turn on light and less difficult to turn off the light.	No Metaphor
2-A-057		As the light is kept on, the design changes to draw a comparison between energy use and nature.	Metaphor
2-A-013	 <p>Switch slides up stem. Lights are on dimmer.</p>	When the switch is turned off, the leaves glow making a night light, but when the light is left on for a long time the leaves slowly fade like a plant dying.	Metaphor

Light Switch Uniqueness			
1-A-034		Light is triggered on when the pad is stepped on or the motion sensor senses movement.	Uniqueness Low
1-A-061		Pressure sensor mat by door that turns on and off light when stepped on.	Uniqueness Low
2-A-017		A light that metaphorically represents "light is knowledge".	Uniqueness High
1-A-029		A tail or rope that is tugged on to turn on/off the light.	Uniqueness High

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